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THE RELATIONSHIP BETWEEN DIGITALIZATION AND THE LABOR MARKET: A BIBLIOMETRIC ANALYSIS

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Abstract: *This paper aims to analyze recent scientific research on digitalization and the labor market. The development of robotic process automation, artificial intelligence and digital platforms has contributed to the increasing digitalization of the labor market. The COVID-19 pandemic has further developed the usefulness of digital technologies in the workplace. The objectivity of the bibliometric analysis allowed the identification of literature of interest for the connection between digitalization and the labor market. Given the context, this paper provides a bibliometric analysis of the literature on digitalization, employment, and the digital economy of the labor market for the period 2020-2025. The relevant literature was collected from the Web of Science Core Collection of Clarivate Analytics. 463 documents, such as articles, early access documents, and book chapters (predominantly in English), were registered and evaluated in the bibliometric analysis of the fields of Economics, Management, Business, Education, and related fields in the social sciences. Evaluative bibliometrics was used, coupled with scientific mapping techniques, such as keyword co-occurrence, bibliographic linkage, co-citation, and co-authorship. The thematic structures were refined using the VOSviewer software. The results obtained show that publications and citations are increasing (from 36 in 2020 to 114 in 2025; a total of 4321 citations). The thematic axes focus on thematic topics regarding digital skills and human capital, digital transformation at the firm level, productivity and distribution of earnings, employment in the ecosystem, inequality, and public policies in the digital transition. In conclusion, the results show that the implications of digitalization on the labor market are specific; they must be considered when developing public policies.*

Keywords: *digitalisation; labour market; bibliometric analysis; digital skills; employment.*

JEL Classification: *J21; J24; O33*

1. Introduction

Digital transformation has become a primary driver of structural change in modern economies, with technologies like artificial intelligence (AI) and digital platforms fundamentally reshaping work organization, competency demands, and labor market outcomes. This process was significantly accelerated by the COVID-19 pandemic, which forced firms to rapidly adapt to a shifting technological landscape.

Despite the intense academic focus on this intersection across fields like economics, management, and education, there is a need for a systematic synthesis of the rapidly evolving research produced in recent years.

This topic has generated a wide range of papers in a few fields that mainly include the fields of economics, management, information systems, and education. From an economic perspective, the focus has been on the aggregate and distributive consequences of technological advances on employment, wages, productivity, and the structure of occupations in the labor market. In this context, the published works have used analyses based on quasi-experimental approaches.

The specialized literature in the field of management and organization analyzes changes in digital capacity and work reconfiguration processes at the firm level. Publications in educational studies analyze digital skills and modified training systems.

This paper contributes to the literature by applying an objective scientific mapping methodology (VOSviewer), managing to clearly delineate four major thematic pillars of the digital transition. The added value of our research lies in identifying critical gaps in the current literature, such as the underrepresentation of platform work and the gig economy, thus providing an essential foundation for public policy development and for guiding future econometric research efforts.

In this context, bibliometric analysis has identified a series of research trends, emerging themes, and research gaps in different fields of knowledge. This paper used evaluative bibliometrics and scientific mapping to analyze the most recent research literature on digitalization and the labor market. This study addresses the following *research questions:*

Q1: *What is the overall structure, dynamics, and intellectual architecture of scientific literature concerning the intersection of digitalization and the labor market between 2020 and 2025?*

Q2: *Which thematic clusters and research gaps have emerged within this interdisciplinary body of work?*

To answer these questions, the paper pursues several *research objectives*: describing the bibliometric characteristics of the current research dataset; evaluating the dynamics of publications and citations to identify high-impact sources and authors; reconstructing the relational structure of the field through co-occurrence and co-citation analysis synthesizing the main thematic axes of the literature.

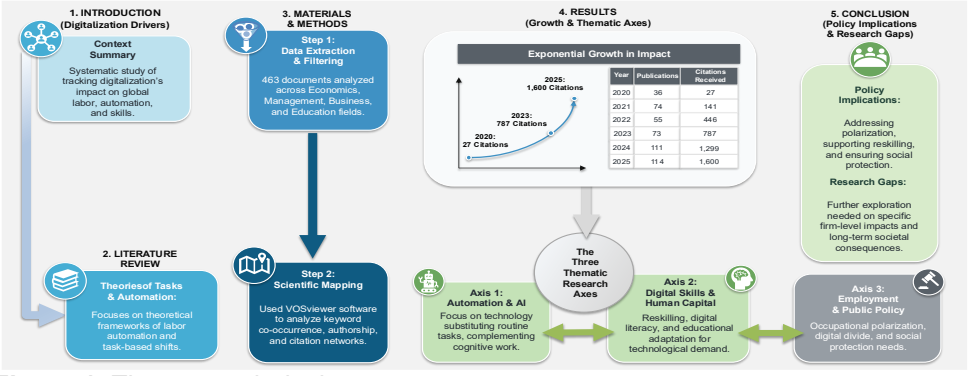


Figure 1: The research design
Source: Authors' own elaboration

Regarding the research stages, they are included in the form of a research design in Figure 1.
The paper's structure includes the Introduction as the first section. In Section 2, the literature review is presented. Section 3, the materials and methods, is presented. Section 4 presents the results and discussions. In Section 5, the conclusion is presented.

2. Literature Review

The theoretical background of this paper draws on several scientifically interconnected research areas. Thus, labor market theories, both classical and neoclassical, postulate that the level of wages and employment is the result of the interaction between demand and supply. In terms of employment, technological progress has both substitution and complementarity impacts by increasing the demand for cognitive tasks.
The task-based framework formalized by Autor et al. (2003) provides a widely used analytical lens, distinguishing between routine and non-routine tasks and showing how computerization affects each category differently.
Subsequent contributions extended this framework to address polarization – the simultaneous growth of high-skill and low-skill employment at the expense of middle-skill occupations (Autor and Dorn, 2013; Goss et al., 2014). The robotics literature introduced firm and sector-level evidence on the labour market consequences of automation (Acemoglu and Restrepo, 2018, 2019; 2020; Graetz and Michaels, 2018), while Frey and Osborne (2017) stimulated a broader debate by estimating the susceptibility of occupations to computerization. Brynjolfsson and McAfee (2014) contributed an influential narrative on the second machine age, highlighting both the productivity potential and the distributional risks of general-purpose technologies.
The concept of digital transformation at the firm level has been theorized in management and information systems literature (Vial, 2019; Verhoef et al., 2021), with increasing attention to the complementarity between digital technologies and skilled labour, and to the role of digital capabilities in enabling firms to convert technology investments into productivity gains (Shakina et al., 2021).
According to Akerman et al. (2015), Nunez-Canal et al. (2022), and He et al. (2022), digital skills and human capital are mediated both individually and collectively. Recent studies exemplify the digital economy's phenomena of rising inequality, particularly during the COVID-19 pandemic, where inequities were exacerbated (Matthess and Kunkel, 2020). Numerous studies have recently analyzed the digital economy's consequences, especially its ramifications for the labor share of the value added and the capital-labor value distribution (Autor et al. 2020, Li et al., 2023; Wu and Yang, 2022).
As digitalization permeates all sectors of activity, it generates a new form of economic activity - the digital economy - which can no longer be viewed as a distinct sector, but as an expanding ecosystem that reconfigures markets, value chains and interactions between economic actors (Bukht & Heeks, 2017; OECD, 2020). As digitalization expands, the phenomenon of sectoral convergence emerges, whereby traditional boundaries between industries blur. Services such as telemedicine, online education or fintech have a predominantly digital component and interconnect with several domains simultaneously, contributing to the reshaping of the economic landscape (Bharadwaj, Sawy, et al., 2013). Measuring the degree of digitalization

through dedicated tools, such as the European Commission's DESI scoreboard or the IMD World Digital Competitiveness Ranking, provides useful quantitative benchmarks on connectivity, digital skills and the integration of technologies in the business environment and the public sector (IMD, 2025).

3. Materials and Methods

The empirical basis of this study used a set of 463 documents, which were extracted from the *Web of Science Core Collection* (Clarivate Analytics). The method known as topic search (TS method) was used. The data retrieval strategy was based on the following three thematic pairs:

TS = (("digital transformation" AND "labor market") OR ("digitalization" AND "employment") OR ("digital economy" AND "skills"))

The document set was limited to the period 2020–2025 and to the specific categories within the Web of Science that refer to the research field of interest, namely: Economics, Business, Management, Business Finance, Education, Educational Research, Education Scientific Disciplines, and Social Sciences Interdisciplinary. Document types were limited to Article, Early Access, and Book Chapters, corresponding to the final exported dataset used for the bibliometric analysis. The export date is 22.11.2025. For consistency, a record with PY=2026 (Early Access 2025) is classified as 2025. To make the corpus-selection procedure more transparent, Table 1 reports the documented filtering flow from the initial topic-and-time-window search to the final exported corpus. The table also specifies the concrete selections applied at each stage of the Web of Science filtering process.

Table 1. Selection flow of the bibliometric corpus

Step	Filtering stage	Concrete selections applied	Records
1	Initial topic search and publication window	Topic search: ((“digital transformation” AND “labor market”) OR (“digitalization” AND “employment”) OR (“digital economy” AND “skills”)); Year Published: 2020–2025	1070
2	Web of Science Categories filter	Economics; Business; Management; Education Educational Research; Social Sciences Interdisciplinary; Business Finance; Education Scientific Disciplines	569
3	Final document-type filtering and export	Document Types: Article; Early Access; Book Chapters. Database: Web of Science Core Collection. Retrieval/export date: 22 November 2025	463

Source: Authors' own elaboration based on the Web of Science Search History and the exported citation report retrieved on 22 November 2025.

The final bibliometric corpus was exported from the Web of Science Core Collection on 22 November 2025 (N = 463). Intermediate search-history entries generated during repeated document-type refinements were not used as analytical datasets.

Therefore, the table reports only the relevant selection stages leading to the final exported corpus.

Because the Web of Science Core Collection is dynamically updated, later reruns of the same query may return a different number of records; consequently, all bibliometric indicators reported in this article refer strictly to the frozen dataset exported on 22 November 2025.

The analysis was based on the use of two methods. The first method was evaluative bibliometrics, which used standard indicators such as the number of publications, total citations, citation distribution, and rankings of sources, authors, organizations, and countries to describe the performance and structure of scientific production. The second method was scientific mapping, which was carried out using the VOSviewer software and four of the relational methods: (i) keyword co-occurrence (Author Keywords) to determine the thematic structure; (ii) co-authorship by country to map collaborative networks; (iii) bibliographic linkage by country to study research fronts; and (iv) co-citation of cited references to map intellectual structure.

To answer the research question, the bibliometric search in WOS was restricted to articles published in the period 2020-2025, obtaining 1,070 articles. We consider that this time interval provides relevant information, both quantitatively and qualitatively, by weighing the number of articles in relation to the total. After applying the selected Web of Science Categories — Economics, Business, Management, Education, Educational Research, Social Sciences Interdisciplinary, Business Finance, and Education Scientific Disciplines — the dataset was reduced to 569 records. Finally, after applying the document-type filter and retaining Article, Early Access, and Book Chapters, the final exported corpus consisted of 463 records.

The selection procedure confirms that the final dataset was not restricted to a single disciplinary category, because the relationship between digitalization and the labour market requires a multidisciplinary and integrated approach. Digital transformation intersects with economics, management, education, social sciences, business finance, and technological change, which justifies the inclusion of several Web of Science Categories. Figure 2 presents the paper selection process used to construct the final bibliometric corpus. Figure 2 presents the article selection process.

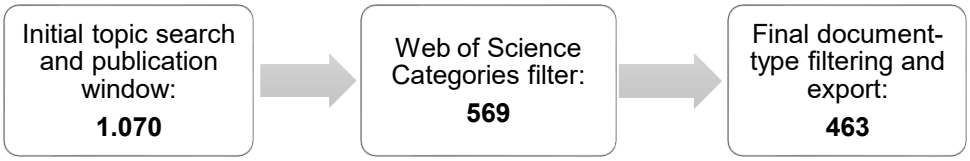


Figure 2: The process of selecting specialized literature
Source: Authors' own elaboration based on the Web of Science Search History and the exported citation report retrieved on 22 November 2025

Table 2 summarizes the VOSviewer analysis configurations. To ensure methodological transparency and reproducibility, the VOSviewer settings were explicitly reported. Table 1 presents the configurations used for each bibliometric network, including the type of analysis, unit of analysis, counting method, operational thresholds, and the number of items retained after threshold application.

Table 2: VOSviewer Analysis Configurations

Analysis Type	**Unit of Analysis**	**Counting Method**	**Number of operational thresholds** *Min= Minimum and Max= Maximum*	**Items included**
Keyword co-occurrence	Author Keywords	Full counting	Min=5 (occurrences of a keyword)	49 out of 1,695 keywords
Co-authorship	Countries	Full counting	Min=5(documents of a country); Min=0(citations of a country); Max=25(countries per document)	28 out of 84 countries
Bibliographic coupling	Countries	Full counting	Min=2(documents of a country); Min=0(citations of a country); Max=25 (countries per document)	59 out of 84 countries
Co-citation	Cited references	Full counting	Min=5 (citations of a cited reference)	145 out of 21,751 cited references

Source: Authors' own elaboration based on VOSviewer

Maps were created in VOSviewer and were based on full counting. In country-based analyses, documents co-authored by 25 countries or fewer were included. Table 2 shows the VOSviewer configurations and operational thresholds for the scientific mapping analyses. All maps were created with the full counting method. In the keyword co-occurrence analysis, the Author Keywords were the unit of analysis, and a minimum of five occurrences was required. Out of a total of 1,695 keywords, 49 keywords met the requirement. For the country co-authorship network, the inclusion thresholds were set at a minimum of 5 documents per country and 0 citations per country; 28 out of 84 countries met these thresholds. For the bibliographic coupling analysis by country, the minimum threshold was set at 2 documents per country and 0 citations per country; 59 out of 84 countries were included. For the co-citation analysis, Cited References were used as the unit of analysis, with a minimum threshold of 5 citations per cited reference; 145 out of 21,751 cited references met the threshold. In the country analyses, reports with many co-authored countries were neglected, with a limit of 25 countries per document. Table 3 provides a summary of the key features of the Web of Science database.

Table 3: General Dataset Characteristics (Web of Science)

Indicator	**Value**
Total documents (N)	463
Publication years (PY)	2020–2025 (plus 1 record PY=2026, Early Access 2025)
Export date (DA)	2025-11-22
Total citations (TC sum)	4321
Documents with 0 citations	135 / 463 (29.2%)
Primary language	English (422; 91.1%), Russian (22; 4.75%), Spanish (10; 2.16%)
Dominant WoS indices	ESCI (n=242), SSCI (n=195), BKCI-SSH (n=22), SCI-Expanded (n=18)

Source: Authors' own elaboration based on the Web of Science.

Table 3 shows that the 463 sample documents have a total of 4,321 citations at the time of export, with 29.2% of the sample receiving no citations because a dataset with a substantial number of more recent documents was considered. The largest index is the Emerging Sources Citation Index (ESCI, n= 242), followed by the Social Science Citation Index (SSCI, n= 195). The dominant language of publication is English (91.1%). Publications in languages other than English include 4.75% Russian, 2.16% Spanish, and 1.08% Ukrainian, which is consistent with the geographical distribution of the countries of origin of the authors.

4. Results and Discussions

The distribution of the disciplinary categories analyzed reflects the interdisciplinary nature of specialized literature. The field of Economics tops the list with 169, followed by the fields of Management with 102 and Business with 95. The fields of Education and Educational Research, with 79, and Interdisciplinary Social Sciences, with 63 demonstrate the increasing fusion of competence and policy perspectives. This distribution is illustrated in Figure 3 in a treemap format.

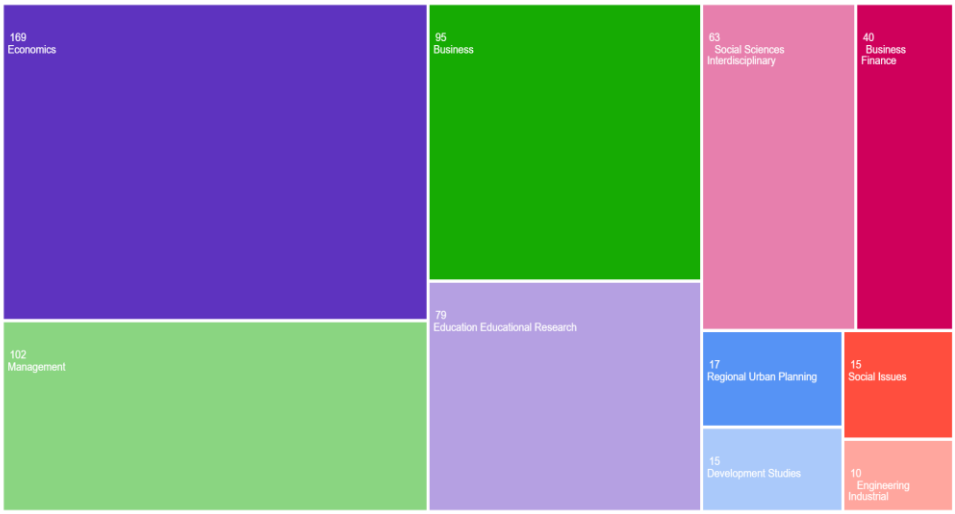


Figure 3: WoS Category Distribution (Treemap)
Source: Authors' own elaboration based on the Web of Science

From 2020 to 2026, the total amount of publications grew from 36 to 114; this means they are still headed for growth, however, the growth is uneven, the numbers for 2021 showed a spike (74 publications), 2022 had a dip (only 55 publications), then there are steady increases for the publication's numbers in 2023 (73), 2024 (111), and 2025 (114). The annual number of citations obtained has also increased for each year of this interval, from 27 in 2020 to 1600 for the year 2025.

Table 4 presents the number of publications and citations in the period 2020-2025.

Table 4: Publications and citations by year (2020–2025)

Year	Publications (number)	Citations received in the year (number)	Cumulative citations 2020–y
2020	36	27	27
2021	74	141	168
2022	55	446	614
2023	73	787	1,401
2024	111	1,299	2,700
2025	114	1,600	4,300

Source: Authors' own elaboration based on the Web of Science

Figure 4 presents the evolution of publications and citations in the period 2020–2025.

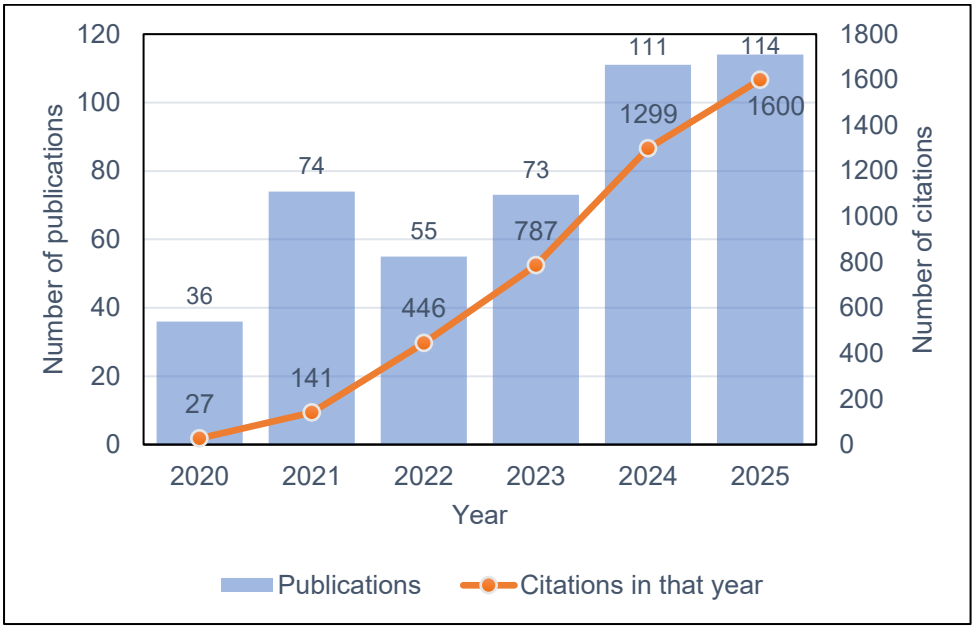


Figure 4: Annual Evolution of Publications and Citations Received (2020–2025)
Source: Authors' own elaboration based on the Web of Science

The data identified for 2022 showed a parallel increase in both the number of publications and citations. This is clear evidence of the transition from a conceptual to a consolidation phase, in which empirical studies that can be replicated continue to underpin subsequent studies.

The other publications that have a very high volume (based on the number of published documents) are “Financial and Credit Activity - Issues in Theory and Practice” (14 publications), “Technological Forecasting and Social Change” (13 publications) and “Technology in Society” (12 publications). However, if we consider the impact of citations, here the ranking tells us a completely different story. At the top of the citation impact figures are “Technological Forecasting and Social Change” (558 total citations; 42.9 average citations per document) and “Technology in Society” (513 citations; 42.8 average impact). Followed by the Journal of Business

Research (304 citations). This contrast between impact and volume shows us that visibility depends on the position of publications in citation networks and not just on the frequency of published documents.

Among the most cited individual papers by far are: Matthess and Kunkel (2020), Structural Change and Digitalization in Developing Nations (155 citations); Dutta et al. (2020) Digital Transformation Priorities of Indian Manufacturing SMEs (139 citations); and Wu and Yang (2022) The Impact of the Digital Economy on Employment Structure in China (138 citations). This analysis shows an increase in research interest in advanced and emerging economies.

Figure 5 displays the keyword co-occurrence network and author keywords. It is observed that the distribution of publications among authors is extremely uneven, with the highest number of publications by an author being three, and the rest being two or fewer publications. Fossen and Sorgner have two publications together and 183 citations. Sindhwani (Rahul) is also represented with two publications and 148 citations. We believe that this is because interdisciplinary fields are emerging.

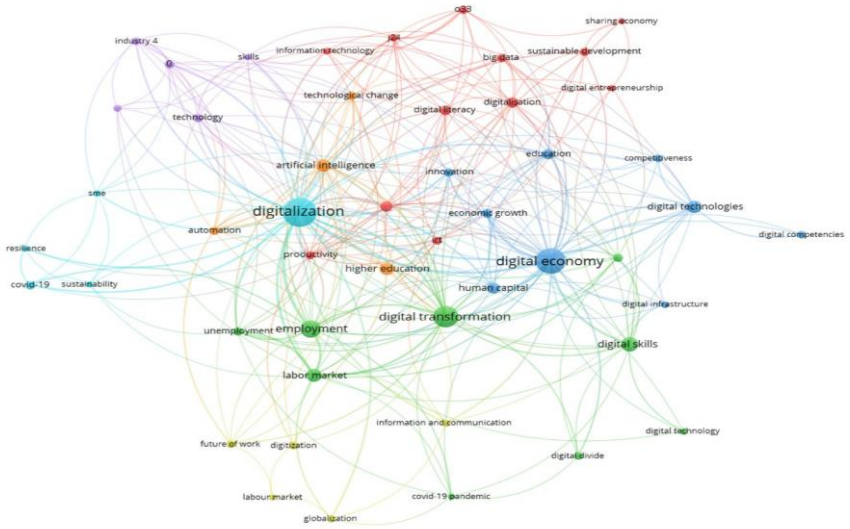


Figure 5: Keyword Co-Occurrence Network – Author Keywords (VOSviewer, network view)
Source: Authors' own elaboration in VOSviewer based on the Web of Science

By geographical affiliation, the most productive countries are, in order, China (66 documents), Russia (63), Ukraine (50), Spain (34), Germany (30), the United States (30), Italy (26), the United Kingdom (18), Romania (17), and India (15). At the institutional level, the Academy of Economic Studies has the most documents, with 10, followed by the University of Bucharest with 6. The analysis of the co-occurrence of keywords for the author identified seven thematic clusters, as shown in Figure 5.

Table 5 presents the thematic clusters in the author's key words co-occurrence and the thematic orientation.

Table 5: Thematic clusters in the author keywords co-occurrence network

Cluster	Key words (occurrences)	Thematic Orientation
1 – Red (12 terms)	digitalisation (13), entrepreneurship (13), digital literacy (12), productivity (9), big data (8)	Micro-level transformation and entrepreneurship
2 – Green (9 terms)	digital transformation (54), employment (36), digital skills (24), labor market (21), unemployment (8)	Labour market outcomes and digital transition
3 – Blue (9 terms)	digital economy (76), human capital (15), education (13), economic growth (10), innovation (8)	Macro-level growth, human capital and innovation
4 – Yellow (5 terms)	future of work (7), globalization (6), ICT (6), labour market (5)	Future of work and globalization
5 – Purple (4 terms)	industry 4 (7), fourth industrial revolution (6), skills (5)	Industry 4.0 and skill demand
6 – Teal (5 terms)	digitalization (100), covid-19 (9), resilience (5), SME (5), sustainability (5)	Pandemic context, resilience, and SMEs
7 – Orange (4 terms)	artificial intelligence (19), higher education (18), automation (9), technological change (8)	AI, automation, and educational adaptation

Source: Authors' own elaboration based on VOSviewer

In the country co-authorship network (Figure 6), the USA (total link strength = 28) and Germany (22) act as collaboration hubs even though they do not have the highest document counts. China (66 documents), Russia (63), and Ukraine (50) have higher output volumes but weaker link strength, suggesting a greater proportion of their research output is nationally concentrated.

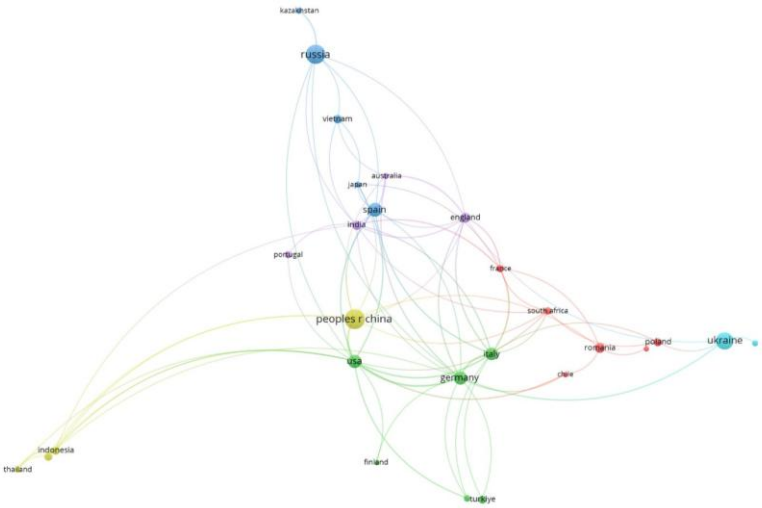


Figure 6: Country Co-Authorship Network (VOSviewer, network view)
Source: Authors' own elaboration in VOSviewer

Figure 7 displays the bibliographic coupling network by country. The bibliographic coupling network (Figure 7) counts the proximity of countries based on shared citations. China has the highest total link strength (7,177), followed by Italy (5,358), Germany (4,879), and the USA (4,057). This suggests they all converge around similar conceptual frameworks, in this case, the task-based approach and literature on digital transformation.

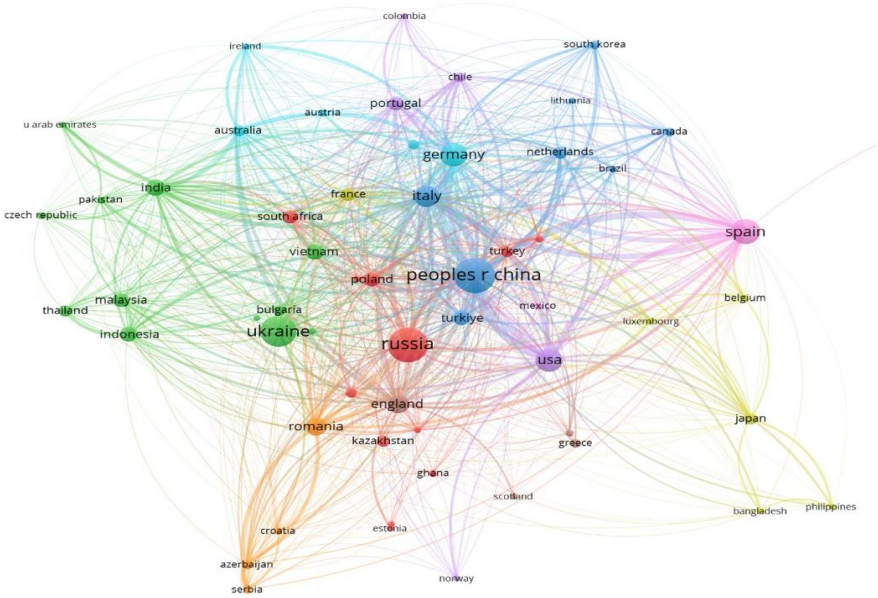


Figure 7: Bibliographic Coupling Network by Country (VOSviewer, network view)
Source: Authors' own elaboration in VOSviewer based on the Web of Science

Figure 7 presents Romania (total link strength = 2,104) in Cluster 7 (Orange), which suggests a relatively less influential research front, though still with strong activity, anchored in the European policy and economic spaces. Figure 8 presents the co-citation network and cited references.

From Figure 8, the co-citation network has six clusters. In cluster 3 (blue), the foundation of the discussion on automation and the labor market comes from the works of Frey and Osborne (2017) and Acemoglu and Restrepo (2018; 2019; 2020). Cluster 4 (yellow) is the task-based economic school, represented by Autor et al. (2003), Autor and Dorn (2013) and Goos et al. (2014). Digital transformation at the firm level is the focus of cluster 1 (red), with Vial (2019) and Verhoef et al. (2021). In cluster 2 (green), the digital economy area is represented by Goldfarb and Tucker (2019), and the area of econometric researchers is represented by Arellano and Bond (1991).

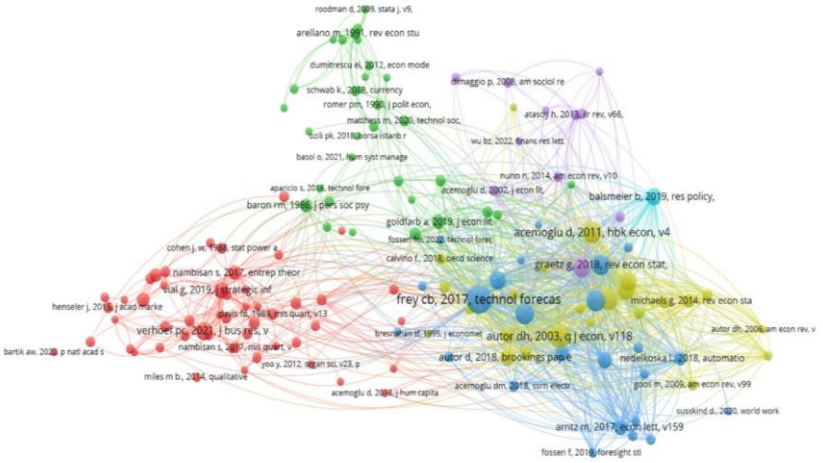


Figure 8: Co-Citation Network – Cited References (VOSviewer, network view)
Source: Authors' own elaboration in VOSviewer based on the Web of Science,

Triangulating the keyword clusters, co-citation structure, and highly cited works, four dominant thematic axes characterize the literature. *Axis 1 – Automation and Artificial Intelligence*. Grounded in the task-based framework (Autor et al. (2003)) and in the automation literature (Frey and Osborne, 2017; Acemoglu and Restrepo, 2019; 2020), this axis analyses how digital technologies substitute routine tasks and complement non-routine cognitive work, with distributional implications for wages and occupational structure. *Axis 2 – Digital Skills, Human Capital and Educational Adaptation.* Competency acquisition and development mediate the relationship between technology adoption and labour market performance. Research in this axis explores digital literacy, reskilling and upskilling, and the role of educational systems in matching skill supply to technological demand (Nunez-Canal et al., 2022; Shakina et al., 2021). *Axis 3 – Firm-Level Digital Transformation, Productivity and Earnings Distribution.* This axis focuses on the organisational dimensions of digitalisation, including investment in digital technologies, process reconfiguration, and the redistribution of value added between labour and capital (Li et al., 2023; Dutta et al., 2020; Vial, 2019, Fossen and Sorgner, 2021).*Axis 4 – Employment Structure, Inequality and Public Policy.* The fourth axis addresses the structural and distributional consequences of digital transition, including occupational polarisation, the digital divide, and the role of institutional frameworks and active labour market policies (Wu and Yang, 2022; He et al., 2022; Fossen and Sorgner, 2022).

5. Conclusions

This study focused on systematic bibliometric mapping in the period 2020-2025, related to the digitalization process and the labor market. In this regard, a total of 463 documents indexed by Web of Science were analyzed. The strong upward trend in both publications and citations demonstrates the consolidation of academic interest and, therefore, the interdisciplinary nature of the field. The disciplinary

distribution (Economics, Management, Business, Education), international connection, and co-citation networks illustrate the developing disciplinary character of the field.

The analyzed specialized literature was structured around four main thematic axes: employment structure with inequality and policies, automation and artificial intelligence, digital skills and human capital, as well as transformation and productivity at the firm level. Each of these axes covers specific, but interconnected, research directions and methods, and highlights the relevance of integrating economic and organizational approaches for future studies.

The results of this paper showed that the heterogeneity of digitalization measurements, endogeneity in the technology-work relationship, and distributional heterogeneity (by gender, age, space, and time) are some of the methodological challenges. There is also an underrepresentation of the analyzed keyword network for platform work, the gig economy and remote work, so these areas can be the subject of specific research efforts.

From a policy perspective, it was found that there is a considerable volume of literature studies that highlight the specific factors that the literature describes as relevant to the context. These factors are institutional framework, digital infrastructure, level of competence, firm size, and sectoral distribution. In response to the mentioned factors, future policies should focus on building a digital and social protection infrastructure.

The current research will be continued in the future through a more detailed and structured refinement of the specialized literature to identify empirical and econometric research that can explain the integration of AI in the labor market in the context of recently adopted legislation at the EU level.

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COLLABORATIVE NETWORKS OF FIRMS AND INNOVATIVE CLUSTERS IN THE DIGITAL ECONOMY: A BIBLIOMETRIC ANALYSIS

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Abstract: *This study examines the development of research on inter-firm collaborative networks and innovation clusters in the digital economy through a bibliometric analysis of scientific literature. Its main objective is to identify key research trends, analyze the evolution of publications over time, and explore collaboration patterns among authors, institutions, and countries. The study also investigates emerging topics related to digital innovation ecosystems. As digital transformation continues to reshape economies and societies, collaboration between firms, universities, and research organizations has become increasingly important for innovation, knowledge sharing, and regional development. Drawing on cluster theory, innovation networks, and open innovation perspectives, this study provides an overview of how these concepts have evolved within the context of the digital economy. The analysis follows the PRISMA 2020 framework and is based on peer-reviewed articles and review papers indexed in the Web of Science Core Collection between 2000 and early 2026. Bibliometric techniques and network visualizations were applied using Bibliometrix to examine co-authorship relationships, co-citation networks, keyword co-occurrence patterns, and thematic structures. The findings show a significant increase in scholarly interest in collaborative networks and innovation clusters, particularly in recent years, as digital technologies and Industry 4.0 applications have become more widespread. The analysis highlights the most influential countries, institutions, and research collaborations in the field, while identifying major themes such as knowledge spillovers, university–industry cooperation, digital ecosystems, and regional innovation policies. By bringing together a fragmented body of literature, this study offers a comprehensive overview of the field and identifies several directions for future research. In particular, the results point to the need for more multi-level analytical approaches, greater integration of artificial intelligence in network analysis, and more longitudinal studies comparing the evolution of digital innovation ecosystems across different regions. These findings may support both future academic research and evidence-based regional development policies.*

Keywords: *Bibliometric analysis; Web of Science; Digital innovation ecosystems; Open innovation; PRISMA protocol; Industry 4.0.*

JEL Classification: *L14; O31; O32; O36; R11*

1. Introduction

This paper provides a systematic bibliometric analysis of research on collaborative networks of firms and innovation clusters in the digital economy. As digital technologies continue to transform economic and innovation processes, understanding how collaboration networks evolve and contribute to innovation has become increasingly important. Accordingly, the study focuses on six key aspects of the literature: the evolution of research output over time, the main thematic areas, co-authorship and institutional collaboration patterns, collaboration dynamics within innovation ecosystems, emerging research trends, and gaps that warrant further investigation.

2. Theoretical Background

Collaborative networks and innovative clusters represent key components of the digital economy and contemporary innovation ecosystems, facilitating knowledge exchange, technology transfer, open innovation, and regional competitiveness. Theoretical developments in this field have evolved through several interconnected perspectives, reflecting broader technological, economic, and industrial transformations. The main theoretical frameworks that have shaped research on collaborative networks and innovative clusters are summarized in Table 1.

Table 1: *Theoretical perspectives on collaborative networks and innovative clusters*

Theoretical perspective	Main focus	Contribution/Relevance
Cluster Theory	Geographic concentration of firms and institutions	Evolution toward digitally connected and hybrid clusters
Innovation Network Theory	Relationships, knowledge flows, and social capital	Real-time collaboration and reduced geographical constraints
Open Innovation	Knowledge exchange across organizational boundaries	Platform ecosystems and co-creation of innovation
Smart Specialization (S3)	Place-based regional innovation policies	Alignment of regional strengths with digital and green transitions
Digital Economy Frameworks	Digital infrastructure, governance, and regulation	Institutional support for data-driven innovation ecosystems

Source: Authors' own elaboration

One of the most influential perspectives is *Cluster Theory*, introduced by Porter (1998), which initially focused on the competitive advantages generated by the geographical concentration of interconnected firms and supporting institutions. While traditional clusters relied primarily on physical proximity and localized interactions, recent developments have led to the emergence of hybrid clusters in which digital platforms complement geographical concentration, enabling local firms to participate in global innovation and value networks. This evolution reflects the transition from the industrial logic of earlier production systems toward the digitally interconnected environments associated with Industry 4.0 - 5.0.

A complementary perspective is provided by *Innovation Network Theory*, which examines the relational structures, social capital, and collaborative ties that facilitate collective learning and innovation. Earlier forms of collaboration were often based

on relatively stable and contractual relationships among organizations. However, the widespread adoption of digital technologies has transformed innovation networks from static, contract-based alliances into dynamic and data-driven ecosystems characterized by real-time communication, continuous knowledge exchange, and reduced geographical constraints.

The development of *Open Innovation frameworks* further expanded the understanding of collaborative innovation processes. In contrast to traditional closed innovation models, where research and development activities were conducted primarily within organizational boundaries, open innovation emphasizes the strategic value of knowledge flows across firms, universities, research institutes, and other stakeholders. The increasing technological complexity of digital transformation (Industry 4.0) has reinforced the importance of these collaborative arrangements, particularly through platform-based ecosystems that support co-creation and distributed innovation.

At the policy level, *Smart Specialization Strategies* (S3) have emerged as a prominent framework for regional innovation development, particularly within the European Union. Based on a place-based approach, S3 seeks to align regional strengths and capabilities with strategic innovation priorities, while supporting both digitalization and sustainability objectives. As a result, these strategies have become important instruments for advancing the twin (digital and green) transition across European regions.

More recently, *Digital Economy frameworks* have provided a broader institutional and regulatory perspective on innovation and collaboration. Developed by international organizations such as the European Union and OECD initiatives these frameworks establish strategic priorities, measurement indicators, and governance principles related to digital infrastructure, data governance, cross-border digital trade, digital skills, and the ethical deployment of artificial intelligence.

Although collaborative networks and innovative clusters have attracted increasing scholarly attention, a comprehensive understanding of the field's intellectual structure and development trajectory remains limited. Examining how research has evolved over time, which topics have received the greatest attention, and where important gaps persist is therefore of both theoretical and practical relevance. In response to these challenges, the present study applies a standardized bibliometric methodology to investigate the evolution of research on collaborative networks and innovative clusters in the context of the digital economy.

3. Methodology

3.1. Research Design – PRISMA 2020

To address the stated objectives and ensure a transparent and replicable analytical process, this study follows the PRISMA 2020 guidelines to conduct a systematic literature review. This internationally recognized framework provides clear guidelines for identifying, screening, and selecting relevant studies, thereby enhancing the methodological rigor and consistency of the review process.

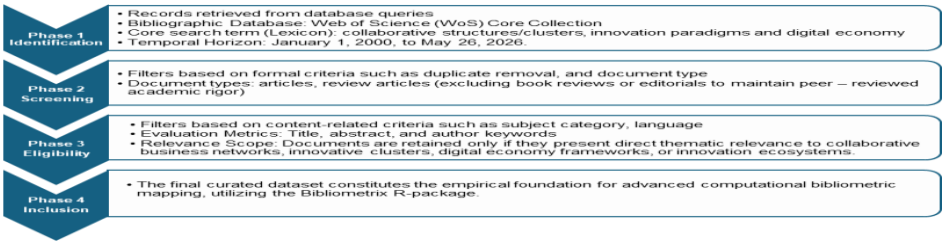


Figure 1: PRISMA 2020 literature selection process
Source: Authors' own elaboration

As illustrated in Figure 1, the literature selection process followed the four sequential phases recommended by the PRISMA 2020 framework: identification, screening, eligibility assessment, and inclusion. This structured approach ensured a transparent and systematic selection of publications relevant to the research objectives.

*Phase 1: Identification***.** To retrieve the relevant literature, a Boolean search query was developed and applied to the WoS Core Collection database. The search was conducted using the Topic Search (TS) field, which examines titles, abstracts, author keywords, and Keywords Plus. The analysis covered publications indexed between 2000 and 2026, providing a longitudinal perspective on the evolution of research in the field. To capture the complexity of the research domain, the search strategy combined three interrelated dimensions: collaborative networks and clusters, innovation-related concepts, and the digital economy context. The following search string was used: TS=(("*collaborative networks*" OR "*firm networks*") AND ("*innovation clusters*" OR "*industrial clusters*") AND ("*digital economy*" OR "*innovation ecosystems*" OR "*open innovation*" OR "*regional innovation systems*" OR "*digital transformation*")).

Phase 2: Screening. Following the initial data extraction, the retrieved records were subjected to a screening process aimed at ensuring the quality and consistency of the dataset. Duplicate records were identified and removed, while the inclusion criteria were restricted to peer-reviewed journal articles published in English. Editorials, book reviews, conference abstracts, and other non-peer-reviewed publications were excluded, together with records published in languages other than English.

Phase 3: Eligibility. The records remaining after the screening stage were evaluated against the predefined eligibility criteria through a review of titles, abstracts, and author keywords. Only studies providing direct theoretical or empirical insights into collaborative networks, innovation clusters, and digital economy-related processes were retained. Publications with limited relevance to the research scope were excluded from further analysis.

Phase 4: Inclusion. Following the screening and eligibility assessment, the remaining records were included in the final dataset. The selected publications were exported and standardized for bibliometric analysis using the Bibliometrix R-package. This dataset constituted the basis for the subsequent analyses, including co-authorship networks, co-citation analysis, and thematic mapping.

3.2. Research Matrix and Analytical Mapping

To ensure methodological consistency, the research objectives were aligned with specific bibliometric techniques implemented in the Bibliometrix and Biblioshiny (R-

package) environment. This alignment is summarized in the matrix below, which links each objective to the corresponding analytical approach and empirical indicators.

Table 2: Research Matrix: Objectives, Bibliometric Methods, Empirical Indicators

#	Research Objective	Bibliometric Method / Tool	Core Metrics & Empirical Indicators	Location in Paper
I	Temporal Evolution	Descriptive Bibliometrics & Longitudinal Mapping	Annual Scientific Production, Annual Growth Rate, Document Average Age, Trend Topics Trajectories	*Section 4.1 & 4.4*
II	Core Thematic Domains	Conceptual Structure Network Analysis	Keyword Co-occurrence Mapping, Callon's Centrality & Density Quadrants, Factorial MCA Space	*Section 4.4 & 4.5*
III	Co-authorship & Affiliations	Social Structure Mapping & Geographic Metrics	Most Productive Authors, Relevant Affiliations, Corresponding Author's Countries (SCP/MCP), Country Citations	*Section 4.2 & 4.3*
IV	Innovation Ecosystem Dynamics	Intellectual Structure & Citation Topology	Author and Document Co-citation Networks, Reference Metrics, Average Citations per Document, Density View	*Section 4.5 & Chapter 6*
V	Emerging Frontiers	Chronological Lexical Inferences	Trend Topics Mapping (2019–2026), Frontier Keyword Intensity Tracking (AI, Digital Infrastructures)	*Section 4.1, 4.4 & 7*
VI	Literature Gaps	Multi-Network Intersection Analysis	Structural Fragmentations (Social vs. Conceptual), Thematic Map Quadrant Intersections (Emerging vs. Niche)	*Section 4.6 & 7*

Source: Authors' own elaboration

3.3. Data Sources and Collection Strategy

The empirical data for this science mapping study were retrieved from the Web of Science (WoS) Core Collection, including the Science Citation Index Expanded (SCIE), Social Sciences Citation Index (SSCI), and Conference Proceedings Citation Index (CPCI). This database was selected due to its extensive coverage of peer-reviewed literature in economics, management, and related fields, as well as its robust citation indexing system.

The data extraction was conducted in May 2026 using a Boolean search strategy applied to the Topic field, which includes titles, abstracts, and author keywords. To ensure a comprehensive coverage of the research field, the analysis period was defined from 2000 to May 2026, capturing the full evolution of studies related to the digital economy and innovation ecosystems.

The retrieved records, including full bibliographic information and cited references, were exported from WoS in plain text (.txt, tab-delimited) and BibTeX (.bib) formats. These datasets were subsequently used as input for bibliometric analysis and visualization in the Bibliometrix environment.

To ensure a homogeneous and high-quality dataset, clear inclusion and exclusion criteria were applied during the screening stage of the PRISMA 2020 protocol.

• Document type: Only peer-reviewed journal articles were included in the analysis. book reviews, conference abstracts without full methodological details, and letters to the editor were excluded to ensure the reliability and comparability of the dataset.
• Language: The search was limited to publications written in English to ensure consistency in analysis and comparability of results across studies.
• Subject areas: The selection was restricted to journals indexed in relevant fields, including Business, Economics, Management, Industrial Engineering, Operations Research, and Social Sciences. Studies focused exclusively on technical or engineering aspects without explicit analysis of collaborative networks or innovation clusters were excluded.
Studies were identified using the WoS Core Collection database.

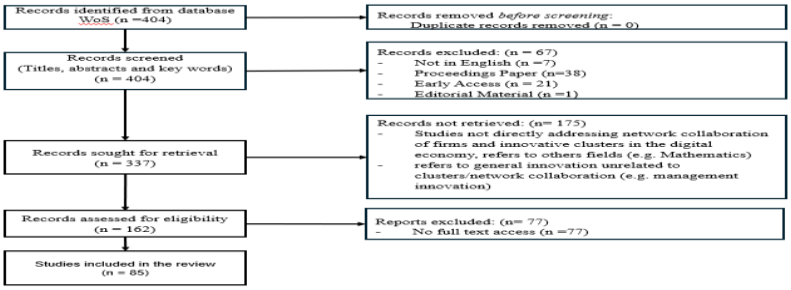


Figure 2: PRISMA 2020 flow diagram of the study selection process
Source: Authors' own elaboration

3.4. Bibliometric Analysis Tools and Analytical Framework

The bibliometric analysis of the 85 selected documents was conducted using Bibliometrix and Biblioshiny (R package, version 4.1). These tools were employed to support the full science mapping process, including data processing, descriptive analysis, and network visualization. The software was used to calculate key bibliometric indicators such as annual scientific production, growth rates, and Trend Topics analysis. It also enabled the construction of co-authorship networks, keyword co-occurrence networks, and co-citation networks at both author and document levels. In addition, Biblioshiny was applied to perform Multiple Correspondence Analysis (MCA), allowing the identification of latent thematic structures and the visualization of conceptual clusters within the dataset.
The final dataset was analyzed using a multi-level bibliometric approach covering temporal, social, intellectual, conceptual, and multivariate dimensions of the field. • Temporal analysis: Annual publication trends were examined to identify the evolution and growth of research on the digital economy over time. • Social structure analysis: Co-authorship networks were analyzed at author, institutional, and country levels. International collaboration was assessed using SCP and MCP indicators. • Intellectual structure analysis: Co-citation and bibliographic coupling analyses were conducted to identify the main intellectual foundations of the field based on 6,407 references. • Conceptual structure analysis: Keyword co-occurrence analysis and Callon's strategic diagram were used to classify themes into motor, basic, niche, and emerging clusters based on centrality and density. • Thematic and multivariate analysis: Multiple Correspondence Analysis (MCA) was applied to identify latent thematic structures and relationships between research clusters.

4. Results

The empirical outputs derived from the bibliometric mapping are structured systematically below, decoding the domain's intellectual, geographic, social, and latent conceptual topographies.

4.1. Evolution of Publications and Research Trajectory

The bibliometric analysis was performed on a dataset of 85 documents published between 2017 to 2026, distributed across 49 distinct sources. Although the search covered the period from 2000 to 2026, no documents meeting the selection criteria were identified before 2017. The field demonstrates an outstanding intellectual dynamic, characterized by an *Annual Growth Rate of 24.14%* and a contemporary *Document Average Age of 3.22 years*.

The evolution of annual scientific production indicates a clear transition from an emerging research topic to a rapidly growing field of study, which can be divided into three distinct phases.

• *Inception Phase (2017–2019).* Research output was limited during this period, increasing from a single publication in 2017 to four publications in 2019. This suggests that research on digital ecosystems and firm networks was still at an early stage of development.

• *Growth Phase (2020–2023).* Publication output increased significantly, reaching seven articles in 2020 and peaking at twelve articles in 2022. The slight decline observed in 2023 (10 articles) may indicate the consolidation of key research themes before a new period of expansion.

• *Expansion Phase (2024–2026).* The field reached its highest productivity in 2024, with 19 publications representing 22.3% of the total dataset. Although publication counts decreased to 13 articles in 2025 and 7 articles in 2026, this trend should be interpreted with caution, as the 2026 data reflect only the partial coverage of the ongoing year.

The evolution of publication output was accompanied by noticeable changes in the thematic focus of the literature, as reflected by the Trend Topics analysis. Between 2019 and 2022, research was primarily centered on traditional management and business concepts, with particular attention to "*competition*" (peaking in 2021), "*collaboration*", and "*management*" (peaking in 2022), reflecting interest in the adaptation of firms to collaborative networks. By 2023, the literature showed a stronger focus on "*open innovation*" and organizational "*performance*", suggesting a consolidation of research around innovation-related outcomes. From 2024 onwards, the thematic emphasis shifted toward knowledge-based approaches and digital technologies, with increasing attention to "*digital*" infrastructure and "*artificial intelligence*", which emerged as some of the most prominent topics in 2026.

4.2. Authors, Countries, and Institutions

4.2.1. Institutional Centers of Excellence

Research output is concentrated in a relatively small number of institutions, with a strong presence of universities from Northern and Western Europe, as well as Italy:

• *University of Vaasa (Finland):* The most productive institution in the dataset, with 9 publications.

• *Vrije Universiteit Amsterdam (Netherlands):* Ranked second, with 6 publications.
• *Institutions with 5 publications*: Coventry University and the University of Birmingham (United Kingdom), together with the University of Bologna and the University of Macerata (Italy).
• *Institutions with 4 publications*: Aarhus University (Denmark), Luleå University of Technology (Sweden), Nanjing University of Science and Technology (China), and the University of Messina (Italy).

4.2.2. Geographic Dominance and Collaboration Intensity

Country-level publication patterns were examined using the corresponding author's country and the distribution of Single Country Publications (SCP) and Multiple Country Publications (MCP). *Italy* recorded the highest number of publications (23 documents). Most studies were produced through domestic collaboration (15 SCPs and 8 MCPs), although international collaboration also played an important role. *The United Kingdom* ranked second with 11 publications and showed a high level of international collaboration, with 8 MCPs and 3 SCPs. Approximately 72.7% of UK publications involved international co-authorship. *China and Germany* exhibited more domestically oriented publication profiles. China recorded 7 publications (6 SCPs and 1 MCP), while Germany produced 6 publications (4 SCPs and 2 MCPs). Among the Nordic countries, *Sweden* displayed a balanced collaboration profile (3 SCPs and 3 MCPs), whereas all publications from *Finland* involved international collaboration (4 MCPs and 0 SCPs).

4.2.3. Citation Impact

Citation patterns do not fully mirror publication output. *Italy* recorded the highest citation count, with 1,273 citations, indicating a strong bibliometric impact within the field. *Sweden* ranked second with 804 citations, followed by the United Kingdom with 628 citations. *The United States* (329 citations), *France* (318 citations), and *China* (279 citations) also recorded substantial citation levels. Additional contributions were observed for *Germany* (185 citations), *Denmark* (100 citations), *Spain* (75 citations), and the *Netherlands* (64 citations).

4.3. Collaboration Networks

The collaboration patterns in this field were examined at both the country and author levels. The dataset includes 298 authors, while single-authored publications are relatively rare, with only seven authors publishing individually. The average number of co-authors per document is 3.59, and 45.88% of the publications involve international collaboration, highlighting the importance of cross-border research partnerships in this domain.
Despite this collaborative profile, the Author Collaboration Network reveals a fragmented structure composed of several relatively independent research groups rather than a single, highly interconnected community.
The largest collaboration clusters can be interpreted as follows:
• *Cluster 1:* Includes Tuertscher P. and Philipp P., together with Aalbers R. and Berends H., focusing on the structural dynamics of digital system.
• *Cluster 2:* Centers around Kraus S., Bouncken R.B. and Alghani K.A., with research interests related to digital entrepreneurship and platform-based strategies.

• *Cluster 3:* Includes Gomes E., Angwin D., Borde S.M., and Asgari O., whose collaboration is mainly associated with corporate strategy, organizational agility, mergers and acquisitions, and strategic alignment in digital environments.

In addition to these major communities, several *smaller collaboration groups* remain relatively isolated from the central network. Several smaller research groups are also visible, including collaborations between Adomako S. and Amankwah-Amoah J. (emerging markets), as well as Bogers M. and Burcharth A. (open innovation paradigms), which remain weakly connected to the larger collaboration network.

Overall, the collaboration network indicates that although international scientific cooperation is relatively high, the intellectual structure of the field remains decentralized. The limited connectivity between the principal research communities suggests opportunities for stronger interdisciplinary and international collaboration, which could facilitate greater knowledge integration and accelerate the consolidation of the research domain.

4.4. Keyword Analysis and Conceptual Structure

A total of 340 unique Author Keywords were identified in the dataset.

4.4.1. Co-occurrence and Thematic Clustering

The keyword co-occurrence network reveals two main thematic clusters.

• *The Strategic Innovation & Ecosystems Cluster:* This cluster is centered on keywords such as *"innovation"*, *"performance"*, *"capabilities"*, and *"business"*. It links tightly with terms like *"ecosystem"*, *"digital platforms"*, and *"strategy"*, addressing how traditional industrial networks evolve into digital platform environments.

• *The Digital Transformation & Knowledge Capabilities Cluster*: This cluster is characterized by keywords such as "open innovation", "knowledge", and "digital transformation". It integrates with "dynamic capabilities", "SMEs", and "management", exploring how internal organizational adjustments allow smaller firms to leverage external data. A smaller, auxiliary sub-cluster (represented by terms like ”absorptive-capacity” and “research-and-development”) remains tightly embedded within this second macro-cluster, further highlighting the internal mechanisms required for technological adaptation.

4.4.2. Strategic Classification (Thematic Map)

Projecting these terms onto Callon’s Centrality (X-axis relevance degree) and Density (Y-axis development degree) quadrants provides insights into the relative importance and maturity of the identified themes: • Motor Themes (high centrality, high density): These themes include the Entrepreneurial Innovation cluster (“open innovation”, “entrepreneurship”, “dynamic capabilities”) and the Business Ecosystems cluster (“business”, “digital transformation”, “ecosystems”). They represent well-developed and influential themes within the field.

• *Basic Themes (high centrality, low density)***:** This quadrant includes the Institutional Knowledge cluster (“knowledge”, “SMEs”, “collaboration”) and the Firm Performance cluster (“innovation”, “performance”, “capabilities”). These themes are central to the field but remain open to further conceptual development.

• *Niche Themes (low centrality, high density)***:** Represented by topics such as “models”, “supply chain”, “value”, “management”, and “high-tech”, these themes correspond to specialized research areas with relatively limited connections to the broader literature.

• *Emerging Themes (low centrality, low density)*: This quadrant includes keywords such as “absorptive capacity”, “Industry 4.0”, “firms”, “digitalization”, and “value creation”. These topics may represent emerging directions for future research and reflect the growing interest in the application of digital technologies within industrial contexts.

While the strategic thematic map classifies clusters based on their maturity and relevance, it considers each cluster as a single aggregated unit. To obtain a more detailed understanding of the field structure, Multiple Correspondence Analysis (MCA) was applied as a dimensionality reduction technique. This method projects individual keywords into a two-dimensional conceptual space, revealing the underlying dimensions of the data and the conceptual proximity between research themes.

4.4.3. Factorial Analysis (MCA)

The Multiple Correspondence Analysis (MCA) projects the author keywords into a two-dimensional geometric space, explaining 19.67% of the variance on Dimension 1 and 13.21% on Dimension 2. This dimensionality reduction technique groups the literature into three main thematic areas:

• *Institutional and Ecosystem Governance Domain:* This quadrant includes keywords such as “innovation ecosystems”, “governance”, and “sustainability”. It reflects research focused on governance mechanisms and the role of institutional factors in innovation systems.

• *Operational Digitalization and Knowledge Capabilities Domain*: This area includes keywords such as “digital transformation”, “artificial intelligence”, “big data” feed into collaborative R&D processes (“open innovation“,“collaboration“, “value co-creation“), ultimately resulting in enhanced "firm performance". It highlights the increasing focus on digital technologies and organizational capabilities in innovation processes.

• *Entrepreneurship and Strategy Domain:* This group includes keywords such as “entrepreneurship”, “strategy”, and “competition”. It represents the foundational business-oriented literature that underpins research on innovation and digital transformation.

4.5. Bibliometric Maps and Source Concentration

4.5.1. Integrated Analysis: Publication Trajectory and Source Concentration

The cognitive stratification of the literature into governance, operational digitalization, and strategic baselines established via the factorial analysis does not occur in an institutional vacuum. Instead, these latent sub-domains are systematically nurtured and disseminated by specific scholarly communities. To understand how these conceptual structures are structurally institutionalized over time, it is essential to map the outlets through which this scientific discourse is channeled. Consequently, the next logical stage of this investigation shifts from lexical spaces to publication venues, mapping the interaction between research trajectories and source concentrations.

The chronological pathway shifts in absolute alignment with both keyword migrations (*Trend Topics*) and the institutional focus of the *Most Relevant Sources* driving the dataset. The field is highly anchored in innovation and management journals. The absolute flagship presence belongs to *R&D Management with 12 papers*, followed by the *Journal of Business Research (5 papers)* and the *European Journal of*

Innovation Management (4 papers). A stable secondary tier includes Research Policy (3 papers) and *IEEE Transactions on Engineering Management (3 papers).*
When integrated chronologically, the academic dissemination channels closely mirror the evolutionary trajectory of the field, segmenting into three clear developmental phases.
• *Phase 1 (2017–2019): The Strategic Inception*: This initial period was primarily supported by traditional, strategy-driven journals such as the *California Management Review* and *Competitiveness Review*. The scientific discourse during this window focused heavily on how classic *"competition"* (which later reached its baseline volume peak in 2021) and macro-level *"management"* paradigms adapt to early-stage physical networks prior to heavy, data-driven systemic restructuring.
• *Phase 2 (2020–2023): The Operational Transition*: The literature experienced a sharp acceleration heavily fueled by *R&D Management* and the *Journal of Business Research*. These outlets functioned as the primary catalysts for shifting the academic narrative away from generic business administration toward highly structured *"open innovation"* models and empirical corporate *"performance"* metrics (which achieved their tracking peak in 2023).
• *Phase 3 (2024–Mid-2026): The Socio-Technical Acceleration:* The contemporary frontier of the domain is strongly driven by high-level policy and technology management platforms, most notably *Research Policy* and *IEEE Transactions on Engineering Management*. This phase focuses heavily on tracking the concrete implementation of "digital" infrastructure and advanced "artificial intelligence" inside cyber-physical networks and decentralized industrial platforms - a trend that exhibits maximum keyword intensity and theoretical saturation in the first half of 2026.

4.5.2. Density and Intellectual Gravity

The reference *Co-citation Network*—which relies on a vast foundation of *6,407 cited references* and boasts an exceptionally high *Average Citations per Document of 50.87* - uncovers a clear *bi-focal intellectual gravity structure* when viewed via density topography. *The Knowledge Absorption Focus (Primary Thermal Peak)* it is heavily dominated by *Cohen and Levinthal (1990)* (*absorptive capacity*) and *Dahlander and Gann (2010)* (*open innovation search strategies*). This is the densest zone of intellectual authority in the entire dataset. *The Structural Ecosystem Focus (Secondary Thermal Peak):* it forms a tight, high-density belt driven by *Jacobides, Cennamo and Gawer (2018)* (*ecosystem architecture*) and *Adner and Kapoor (2010)* (*co-innovation structures*). Seminal strategic works like *Teece, Pisano and Shuen (1997)* and *Teece (2007)* on dynamic capabilities, alongside digital theory anchors such as *Nambisan et al. (2017)*, form the widespread, lower-density *structural bridges* that hold these two core pillars together.

4.6. Identified Research Gaps

The multidimensional mapping of the literature exposes five critical research gaps that remain unresolved within the current academic discourse:
1.Lack of Multi-Level Analyses (Firm–Cluster–Region): Existing studies focus either on micro-level firm capabilities or macro-level regional ecosystems, leaving a severe shortage of integrated frameworks tracking how firm digitalization scales up to alter cluster performance.
2.Insufficient Integration of AI and Digital Platforms: While "digital transformation" is a mature motor theme, the concrete operational integration of modern *Artificial*

Intelligence (AI), blockchain, and algorithmic platform governance within traditional industrial networks remains superficial.
3.Limitation of Longitudinal Studies: The literature heavily relies on cross-sectional surveys or static bibliometric snapshots, lacking long-term longitudinal research tracking the actual survival rate and lifecycle of collaborative networks over a decade-long digital shift.
4.Lack of Comparative Analysis Between Mature and Emerging Digital Ecosystems: Current models are heavily biased toward advanced knowledge economies (e.g., Nordic Europe or Italy), failing to provide comparative data analyzing how digital ecosystem structures differ when deployed in developing economic contexts.
5.Insufficient Measurement of Collaborative Network Performance: The literature lacks standardized, empirical metrics and quantitative indicators to precisely measure the net performance, ROI, and efficiency of knowledge sharing within digitalized clusters.

5. Discussion

The synthesis of these multidimensional bibliometric findings uncovers several critical paradoxes and structural evolutions that reshape our understanding of clusters and collaborative networks within the digital economy.

5.1. The Evolution of Cluster and Collaborative Network Concepts

The results demonstrate a profound paradigm shift in how business networks are conceptualized: *the transition from relationship-driven geographic clusters to algorithm-driven digital ecosystems.* The longitudinal trend topics (Phase 1 vs. Phase 4) and factorial analysis reveal that between 2019 and 2022, firm collaboration was viewed almost exclusively through a traditional, human-managerial lens anchored in regional proximity (*"management", "collaboration", "competition"*). By 2026, this framework has been increasingly superseded by a more techno-deterministic approach, where "digital" platforms and *"artificial intelligence"* play an increasingly important role in shaping network structures. The historical concept of the industrial cluster, traditionally reliant on physical localization and face-to-face trust, has evolved into a more fluid, boundary-less digital innovation ecosystem where algorithmic compatibility and data interoperability increasingly influence a firm's position.

5.2. The Role of the Digital Economy in Restructuring Interfirm Collaboration

A major structural disconnect is exposed when cross-referencing the conceptual structures with the social networks of the domain. While the thematic map and keyword networks show a highly integrated vocabulary, where terms like *"open innovation"*, *"digital transformation"*, and *"ecosystem"* are universally shared, the Author Collaboration Network reveals noticeable social fragmentation. Scholars are writing extensively about highly open, collaborative, and decentralized ecosystems, yet they are doing so within isolated "academic silos" or closed cliques (e.g., *Tuertscher's clique vs. Kraus's clique*). This lack of direct social collaboration among primary research hubs severely limits the development of a unified empirical framework.
Furthermore, the Thematic Map Network reveals a stark operational imbalance: the intellectual pipelines connecting internal knowledge management to open innovation

are mature and thick, but the pathways leading from abstract ecosystem theories to concrete empirical implementations of Industry 4.0 remain thin and peripheral. This implies that while the digital economy has contributed to reshaping how firms are conceptualized in the literature, a robust, unified framework explaining how these digitalized networks integrate with physical cyber-physical manufacturing systems is still missing.

5.3. Regional Differences and Innovation Ecosystems

The comparison between national volumetric outputs (*SCP* vs. *MCP*) and total citation counts reveals a notable geographic differentiation in how digital transformation is studied

• The "Localized Deep-Dive" Model (Italy and China): Italy leads brute production (23 documents) and citation authority (1,273 citations), while China exhibits a vertical growth surge. However, both nations display heavily domestically-focused publication structures (high *SCP* ratios). This indicates that their research is deeply anchored in rich, local industrial contexts—such as Italy's traditional manufacturing districts undergoing digital modernization or China's state-driven localized platform structures.

• The "Global Integration" Model (United Kingdom and Finland): Conversely, the UK and Finland produce fewer raw documents but act as the primary international collaboration hubs (exhibiting exceptionally high *MCP* ratios, reaching 100% for Finland).

This regional dichotomy implies an intellectual division of labor within global innovation ecosystems: frameworks are often tested and deeply explored within thick, local industrial clusters (the Italian/Chinese model), but their conceptual generalization into universal, cross-border business ecosystem theories largely depends on the highly collaborative, international channels driven by Anglo-Saxon and Scandinavian research hubs.

6. Conclusions

This comprehensive bibliometric study has systematically mapped the intellectual, social, and conceptual trajectory of research at the intersection of the digital economy, firm networks, and innovation ecosystems. By analyzing the structural data from 2017 to 2026, several foundational conclusions can be drawn. The field has transitioned from an emerging niche into an actively expanding academic frontier, driven by an exceptional *Annual Growth Rate of 24.14%* and a contemporary body of literature (average age of 3.22 years). There is a clear evolutionary migration from human-managerial, relationship-driven regional clusters (2019–2022) to technology-driven, boundary-less ecosystems influenced by Artificial Intelligence and digital platform architectures (2025–2026). Europe remains the global epicenter of this debate, characterized by a clear structural dichotomy between the *Localized Deep-Dive* model (led by Italy's heavy citation authority of 1,273, focusing on domestic industrial districts) and the *Global Integration* model (led by the UK and Finland, driving international cross-border knowledge spillovers through high MCP ratios).

For corporate managers and entrepreneurs navigating the digital transformation shift, the results offer critical strategic guidelines.

• *Prioritize Absorptive Capacity over Network Size:* The high density surrounding the Cohen and Levinthal (1990) node suggests that simply joining a digital platform or cluster is insufficient. Managers should actively invest in internal training, digital infrastructure, and data literacy to build the internal "absorptive capacity" needed to convert external ecosystem knowledge into firm performance. • *Transition from Linear Value Chains to Platform Co-creation:* As traditional supply chains migrate toward niche themes on the Thematic Map, managers must restructure corporate strategy around open innovation and value co-creation. Survival in the digital economy requires firms to develop "dynamic capabilities" to act as agile complementors within broader digital platform ecosystems.

For regional policymakers and economic developers, the bibliometric maps provide actionable insights:

• *Foster Digital Interoperability over Physical Proximity:* Traditional cluster policies based strictly on geographic zoning are becoming obsolete. Policymakers must shift funding toward building secure digital infrastructure, regional cloud networks, and AI-driven data hubs that allow SMEs to collaborate across borders.

• *Bridge the Macro-Micro Innovation Gap:* The thin network pathways between macro "innovation ecosystems" and empirical "Industry 4.0" settings highlight a potential policy gap. Governments should launch targeted funding programs (e.g., specialized digital innovation hubs) that help traditional manufacturing SMEs transition into cyber-physical production networks.

7. Limitations and Future Research Directions

While this study provides rigorous, data-driven insights into the digital ecosystem literature, several structural limitations should be acknowledged:

• *Database Selection:* The dataset was strictly extracted from a single indexation framework (WoS), which might exclude relevant conference proceedings or emerging open-access engineering journals indexed in Scopus or Google Scholar.

• *Language Bias:* The search criteria favored English-language documents, potentially underrepresenting highly localized empirical studies published in native languages (e.g. SME clusters in Latin America, Asia, or Eastern Europe). • *Temporal Truncation:* Because the current tracking year is *2026*, the data for the final year represents only a partial snapshot, which limits the ability to calculate a complete annual citation ceiling for the most recent AI-driven literature. Based on the visual paradoxes and thin structural pathways discovered in the bibliometric mapping, three high-impact avenues are proposed for future academic inquiry:

1.Empirical Micro-Foundations of AI in Ecosystems: Future research is encouraged to move beyond abstract discussions of digitalization to investigate the exact mechanisms through which *Artificial Intelligence (AI),* machine learning algorithms, and smart contracts support trust, governance, and value distribution among firms. *2.SME Integration into Industry 4.0 Networks***:** Given that "Industry 4.0" and "SMEs" reside in the emerging quadrant of the Thematic Map, a significant opportunity exists to study *how* small-scale traditional manufacturers can overcome financial and technological barriers to securely connect their physical machinery to global cyber-physical platforms. *3.Cross-Silo Academic Collaboration***:** To address the social fragmentation identified in the Author Collaboration Network, future scholars should build interdisciplinary teams, combining computer science, organizational behavior,

and regional economics, to develop a unified, standardized theory of digital economy governance.

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ECONOMIC AND ENTREPRENEURSHIP EDUCATION: AN INTEGRATED ANALYSIS OF COMPETENCE AND SKILLS DEVELOPMENT IN THE CONTEXT OF THE KNOWLEDGE-BASED ECONOMY

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Abstract: *The rapid transformations of the contemporary economy, characterized by digitalization, globalization, and the transition toward a knowledge-based economy, require a fundamental rethinking of the role of education in human capital development. In this context, economic education and entrepreneurship education have become essential components of modern educational systems, contributing to the development of competencies necessary for adapting to labor market dynamics and societal changes. This paper aims to analyze the relationship between economic education and entrepreneurship education from an integrated perspective, highlighting their complementary role in the development of cognitive, practical, and attitudinal competencies. The research is based on a theoretical and bibliometric approach, combining a systematic review of the relevant literature with a bibliometric analysis of scientific publications using specialized tools. These findings indicate that economic education provides the conceptual and analytical foundation for understanding market mechanisms, while entrepreneurship education facilitates the transformation of this knowledge into action through innovation, initiative, and value creation. The integration of these two dimensions contributes to the development of a complex educational profile characterized by critical thinking, decision-making ability, adaptability, and entrepreneurial mindset. Furthermore, the bibliometric analysis reveals emerging trends in the field, including the increasing importance of interdisciplinary approaches, experiential learning, and the integration of digital and sustainability-related competencies. These trends reflect the alignment of educational systems with the requirements of the knowledge-based economy and European educational policies. The results also suggest that the integration of economic and entrepreneurship education has a significant impact on the development of transversal competencies, which are essential for professional integration, particularly in the case of liberal professions. In this context, education plays a key role not only in knowledge transmission but also in shaping individuals capable of acting as agents of economic and social change. The paper contributes to the existing literature by consolidating the conceptual framework regarding the relationship between economic and entrepreneurship education and by emphasizing their role in developing competencies relevant to contemporary economic and professional environments.*

Keywords: *economic education; entrepreneurship education; competencies development; knowledge-based economy; human capital; entrepreneurial skills; higher education; experiential learning.*

JEL Codes: *A20; I23; J24; M13*

1. Introduction

The structural transformations of the global economy, characterized by accelerated digitalization, increased capital mobility, and intensified international competition, place significant pressure on educational systems to adapt and redefine their objectives. The knowledge-based economy requires not only the accumulation of information, but also the development of complex and transferable competencies that enable individuals to adapt to rapid changes, innovate, and actively participate in economic and social processes.

In this context, economic education and entrepreneurship education have acquired strategic importance, being recognized as key pillars in the development of competitive human capital. Economic education contributes to the development of individuals' ability to understand economic mechanisms and is associated in the literature with increased productivity and long-term economic growth (Becker, 1993; Barro, 1991).

At the same time, entrepreneurship education fosters initiative, creativity, and the ability to transform ideas into value-generating actions, being considered a key driver of economic development and innovation (Raposo and Paço, 2011; Thrane et al., 2016).

Although often addressed separately in both academic literature and educational practice, these two forms of education exhibit a high degree of complementarity. Economic education provides the theoretical and analytical foundation necessary for understanding how economies function, while entrepreneurship education builds upon this knowledge by developing practical competencies and an opportunity-oriented mindset.

The issue of integrating economic and entrepreneurship education becomes particularly relevant in the context of liberal professions, where professional success depends not only on domain-specific technical competencies but also on the ability to manage resources, adapt to market conditions, and develop independent initiatives. Therefore, the formation of a comprehensive professional profile requires the integration of economic knowledge with entrepreneurial skills within a coherent and context-adapted educational framework.

The aim of this paper is to analyze the relationship between economic education and entrepreneurship education from a theoretical and methodological perspective, highlighting their role in developing competencies relevant to the knowledge-based economy. In this regard, the paper seeks to provide a critical synthesis of key conceptual approaches, identify relevant theoretical models, and examine current trends in the literature.

The research objectives are: (i) to clarify the conceptual foundations of economic and entrepreneurship education and their interrelationship; (ii) to analyze the relevant theoretical frameworks and explanatory models; (iii) to identify dominant research directions through bibliometric analysis; and (iv) to highlight implications for competence development and professional growth.

From a methodological perspective, the study is based on a theoretical and documentary approach, complemented by a bibliometric analysis of the literature. This combined approach enables both conceptual grounding and the identification of emerging trends in the field.

Through this approach, the paper aims to contribute to the consolidation of an integrated perspective on economic and entrepreneurship education, emphasizing

their role in shaping an educational profile aligned with the requirements of the contemporary economy and in supporting sustainable professional development.

This paper contributes to the existing literature in several ways. First, it provides an integrated perspective on economic education and entrepreneurship education, which are often treated as separate domains in previous studies. Second, it applies bibliometric analysis to systematically map the structure and evolution of research in this field, offering a comprehensive overview of key themes, influential authors, and collaboration networks. Third, the study identifies emerging research directions and highlights the need for interdisciplinary approaches in competence development, particularly in the context of the knowledge-based economy. By combining theoretical insights with bibliometric evidence, the paper advances the understanding of how these educational domains interact and contribute to professional and economic development.

2. Context

Economic education and entrepreneurship education have evolved in recent decades as complementary fields, driven by the transformations of the global economy and the transition toward a knowledge-based economy. This transition has led to a paradigm shift in education, emphasizing the development of transferable competencies and human capital (Becker, 1993; Hanushek and Woessmann, 2007).

In the academic literature, economic education is defined as a process aimed at developing individuals' capacity to understand and interpret economic phenomena, make rational decisions, and actively participate in economic and social life (Belfield, 2000; Geamănu, 2009). It contributes to the development of economic thinking and analytical skills and is grounded in human capital theory, which highlights the direct relationship between education, productivity, and economic growth (Becker, 1993; Barro, 1991).

On the other hand, entrepreneurship education focuses on developing initiative, innovation, and the ability to identify and exploit economic opportunities. According to the EntreComp framework, it involves the development of an integrated set of competencies, including creativity, risk-taking, strategic planning, and the ability to implement ideas in real-world contexts (European Commission, 2016).

A comparative analysis of these two concepts reveals a relationship of functional complementarity. Economic education provides the cognitive foundation necessary for understanding market mechanisms and economic relationships, while entrepreneurship education builds upon this knowledge through action, guiding individuals toward initiative and innovation. This relationship can be interpreted as a transition from "understanding" to "application," that is, from the theoretical to the practical dimension of economic training.

Empirical studies indicate that entrepreneurship education has a positive influence on entrepreneurial intentions and the development of transversal competencies (Sirelkhatim and Gangi, 2015; Ncanywa and Dyantyi, 2022).

From a theoretical perspective, the integration of economic and entrepreneurship education is supported by several relevant educational paradigms. The constructivist paradigm, rooted in the work of Piaget and Vygotsky, emphasizes the active role of the individual in knowledge construction and the importance of social interaction in the learning process. In this context, economic and entrepreneurship education are no longer perceived as processes of knowledge transmission, but rather as processes of competence development through experience and reflection.

The relationship between the two forms of education is thus characterized by functional complementarity. Economic education provides the cognitive basis, while entrepreneurship education translates this knowledge into practice, contributing to the development of an adaptable and innovation-oriented professional profile (Csaba et al., 2016; Gîmbuță, 2018).

The integration of these dimensions is further supported by modern educational paradigms. The experiential learning paradigm, for instance, highlights the importance of learning through experience and is particularly relevant for entrepreneurship education (Kolb, 1984; Pittaway and Edwards, 2012).

At the same time, the competency-based paradigm redefines educational objectives in terms of learning outcomes, emphasizing the development of competencies that can be applied in real-world contexts (European Commission, 2021). In this approach, competencies are understood as integrated combinations of knowledge, skills, and attitudes that enable individuals to perform effectively in diverse professional and social environments.

Recent literature also highlights emerging conceptual directions, such as the integration of digital and sustainability-related dimensions into economic and entrepreneurship education. European strategic documents emphasize the need to develop digital, entrepreneurial, and green competencies as a response to technological transformations and global economic challenges (European Commission, 2023).

In this context, education becomes an interdisciplinary process that integrates elements from economics, psychology, sociology, and technology, aiming to develop flexible and innovative economic thinking. This interdisciplinary approach is essential for understanding the complexity of the contemporary economic environment and for enhancing individuals' adaptability to change.

A central concern in the literature is the impact of economic and entrepreneurship education on competence development. Empirical studies show that economic education enhances critical thinking and analytical capabilities, while entrepreneurship education fosters creativity, initiative, and risk-taking. Together, these dimensions contribute to the formation of a complex educational profile characterized by autonomy, adaptability, and an innovation-oriented mindset.

In the case of liberal professions, this integration becomes particularly relevant, as professional success depends not only on technical expertise but also on the ability to manage economic activities and develop client relationships. Thus, economic and entrepreneurship education contribute to the formation of an integrated professional identity capable of responding to the demands of the contemporary economy (Domilescu, 2019; Igbokwe-Ibeto et al., 2018).

Therefore, the conceptual framework of this paper highlights the need for an integrated approach to economic and entrepreneurship education, one that overcomes disciplinary fragmentation and responds to the requirements of a dynamic, knowledge-based economy.

3. Methodology

The research methodology is situated within the paradigm of theoretical and documentary studies, which is specific to the early stages of scientific inquiry, where the emphasis is placed on conceptual development and theoretical grounding. The methodological approach combines a systematic review of the literature with bibliometric analysis, aiming to identify the main research directions and emerging

trends in the field of economic and entrepreneurship education (Sirelkhatim and Gangi, 2015).
The literature review focused on identifying key theoretical models relevant to the study, including human capital theory (Becker, 1993), experiential learning theories (Kolb, 1984), and competency-based frameworks promoted at the European level, such as EntreComp (European Commission, 2016).
The theoretical-documentary component involved a critical review of relevant scientific literature, drawing on sources indexed in international databases such as Web of Science. In addition, bibliometric tools such as VOSviewer were employed to analyze relationships of co-occurrence, co-authorship, and co-citation. These methods are widely used in the literature for mapping research fields and identifying emerging trends (Fayolle, 2013). The selection process of the literature was based on criteria such as relevance, recency, and scientific impact, including works addressing fundamental concepts, theoretical models, and empirical studies in the field.
More specifically, the bibliometric analysis was conducted using the Web of Science Core Collection database. The search strategy was based on the keywords “entrepreneurship education” and “economic education”, applied through a Topic Search (TS) query, which includes titles, abstracts, and author keywords.
The initial search identified over 2000 publications. Subsequently, the dataset was refined by applying several filtering criteria, including the time frame (2020–2025), document type (scientific articles), and relevance to the research topic, focusing on high-impact journals in the fields of education, economics, and entrepreneurship. Following this selection process, a final sample of 538 articles was retained for the bibliometric analysis.
The selected publications were exported and processed using VOSviewer software, enabling the construction of co-occurrence, co-authorship, and co-citation networks, which formed the basis for the subsequent analysis.
The bibliometric component of the research aimed to map the structure and dynamics of the field. In this regard, analyses of term co-occurrence, co-authorship, and co-citation were conducted using VOSviewer. This approach enabled the identification of key research themes, influential authors, and academic collaboration networks.
The co-occurrence analysis of terms allowed the identification of conceptual connections between economic education and entrepreneurship education, as well as their association with related concepts such as competencies, innovation, higher education, and sustainable development. At the same time, co-authorship analysis provided insights into the main academic centers and the geographical distribution of research activity in the field.
The co-citation analysis offered a deeper understanding of the intellectual structure of the field by identifying the most influential works and authors. This method contributes to clarifying the theoretical foundations of economic and entrepreneurship education and to identifying directions for future research.
The methodology employed presents both strengths and limitations. Among its main strengths are the systematic nature of the analysis and its capacity to integrate diverse theoretical perspectives into a coherent framework. Furthermore, bibliometric analysis provides an objective overview of the evolution of the field and its emerging trends.

However, certain limitations must be acknowledged. These stem primarily from the dependence on the selected databases and from the predominantly theoretical nature of the research, which does not allow for direct empirical validation of the proposed relationships. Nevertheless, the chosen methodology is appropriate for the objectives of the study and provides a solid foundation for future empirical research. By combining theoretical analysis with bibliometric methods, the study offers an integrated perspective on economic and entrepreneurship education, contributing to the conceptual clarification of the field and to the identification of relevant directions for future research.

4. Analysis of results

The analysis of results is based on a bibliometric investigation of the scientific literature on economic and entrepreneurship education, aiming to identify the conceptual structure of the field, the main research directions, and the networks of academic collaboration. In this regard, techniques such as co-occurrence, co-authorship, and co-citation analysis were employed, enabling a systemic understanding of the evolution and organization of scientific knowledge.

4.1. Co-occurrence Analysis of Terms

The co-occurrence analysis of terms highlights the conceptual structure of the field and the relationships between the main research themes. It allows for the identification of dominant thematic clusters and provides insight into how the concepts of economic education and entrepreneurship education are integrated within the scientific literature.

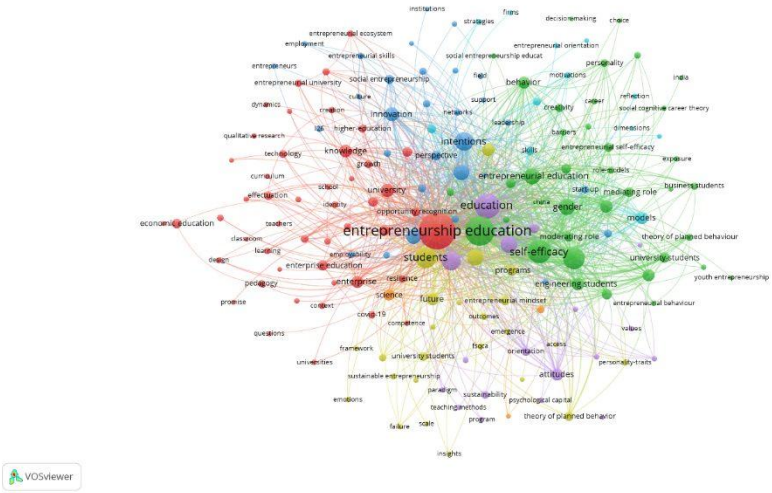


Figure 1. Co-occurrence network of terms in economic and entrepreneurship education
Source: own processing based on Web of Science data using VOSviewer

The interpretation of this network reveals the existence of several distinct but interconnected thematic clusters. A first cluster is centered around the concept of

"entrepreneurship education" and is associated with terms such as "innovation," "skills," "higher education," and "competence development." This cluster reflects the orientation of the literature toward the development of entrepreneurial competencies within higher education institutions and their role in fostering innovation.

A second cluster is structured around the concept of "economic education" and is linked to terms such as "financial literacy," "decision making," and "economic behavior." This cluster emphasizes the cognitive dimension of economic education and its role in shaping economic thinking and rational behavior.

A third cluster highlights the connections between education, sustainability, and development, including terms such as "sustainable development," "policy," and "lifelong learning." This structure indicates the emergence of an interdisciplinary perspective, in which economic and entrepreneurship education are integrated into broader educational policies and sustainable development frameworks.

The density of connections among these clusters suggests a high degree of conceptual interdependence, confirming that economic and entrepreneurship education are not isolated domains but rather components of a complex educational ecosystem. This interconnection supports the hypothesis of their integration in the development of competencies relevant to the knowledge-based economy.

4.2. Co-authorship Analysis

The analysis of co-authorship networks provides insight into the collaborative structure of research in the field of economic and entrepreneurship education, highlighting the authors, institutions, and geographical regions with the greatest influence.

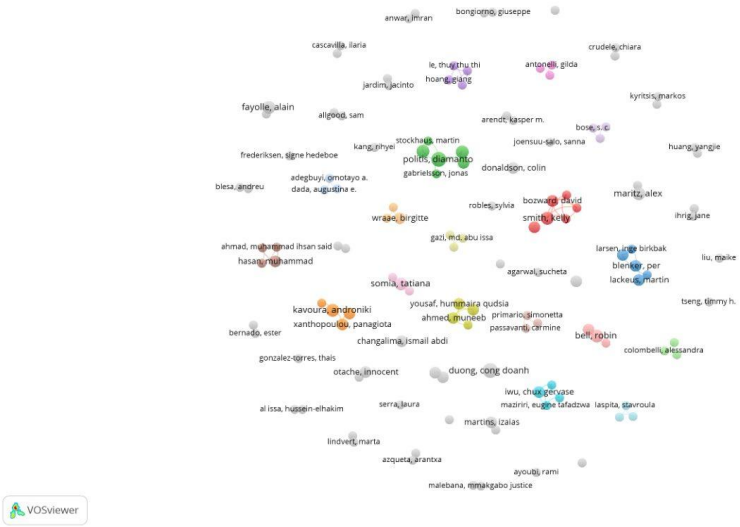


Figure 2. Co-authorship network among authors in economic and entrepreneurship education
Source: own processing based on Web of Science data using VOSviewer

The results indicate the existence of several research groups organized around highly visible authors who function as central nodes within the academic network. These authors contribute significantly to the development of the field through both scientific output and international collaboration.

Institutional analysis reveals that research is concentrated within universities and academic centers in Western Europe and North America, which dominate scientific production in the field. At the same time, there is evidence of a gradual expansion of collaboration networks toward other regions, including Central and Eastern Europe, reflecting the increasing internationalization of research.

From a geographical perspective, co-authorship networks indicate the presence of regional hubs of excellence, where collaborations are more frequent and more intensive. These networks facilitate knowledge dissemination and the development of shared research approaches.

An important observation is that the field exhibits a moderate degree of fragmentation, suggesting the existence of relatively autonomous research communities. This structure may represent both a limitation, due to incomplete integration, and an opportunity, through the diversity of theoretical and methodological perspectives.

4.3. Co-citation Analysis

Co-citation analysis enables the identification of the theoretical foundations of the field by highlighting the works and authors that have significantly influenced the development of economic and entrepreneurship education.

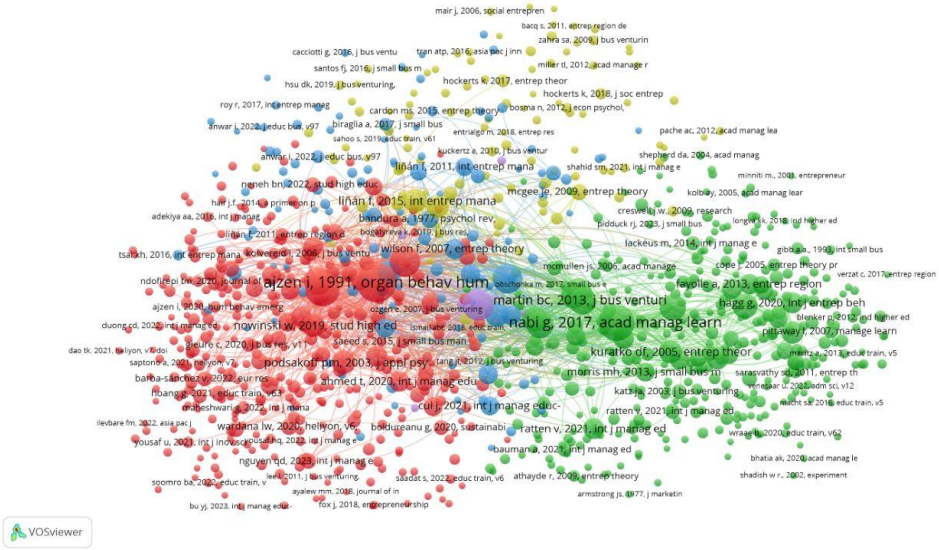


Figure 3. Co-citation network of scientific sources in economic and entrepreneurship education

Source: own processing based on Web of Science data using VOSviewer

The results show that the literature is organized around a set of foundational works addressing themes such as entrepreneurship, economic education, human capital theory, and learning theories. These works form the theoretical core of the field and are frequently cited together, indicating their continued relevance in contemporary research.

Several co-citation clusters can be identified, corresponding to different theoretical paradigms. One major cluster is associated with entrepreneurship literature, including studies that examine the role of education in fostering entrepreneurial behavior and initiative. Another cluster is centered on economic education and human capital theory, highlighting the relationship between education and economic performance.

Additionally, a distinct cluster emerges from the field of educational sciences, encompassing learning theories and pedagogical models applicable to economic and entrepreneurship education. This structure confirms the interdisciplinary nature of the field and the need to integrate economic and educational perspectives.

The co-citation analysis also highlights the evolution of the field through the emergence of recent works addressing topics such as digitalization, sustainability, and transversal competencies. These directions reflect the adaptation of research to contemporary economic and social changes.

5. Synthesis of Results

The results of the bibliometric analysis confirm the existence of a structural and functional relationship between economic education and entrepreneurship education. These two domains are interconnected both at the conceptual level and within the scientific research landscape, being integrated into an interdisciplinary framework focused on competence development.

The co-occurrence analysis highlights thematic convergence, the co-authorship analysis reveals the collaborative structure of research, and the co-citation analysis confirms the existence of a shared theoretical core. Together, these findings support the argument that economic and entrepreneurship education should be approached in an integrated manner in order to meet the requirements of the knowledge-based economy.

The results should be interpreted not only descriptively, but also critically in relation to the existing literature. The strong interconnection identified between economic education and entrepreneurship education confirms previous findings that emphasize their complementary role in competence development (Raposo and Paço, 2011; Thrane et al., 2016). However, the moderate fragmentation observed in the co-authorship networks suggests that the field is still evolving and lacks full theoretical consolidation, which is consistent with earlier literature reviews (Sirelkhatim and Gangi, 2015).

Moreover, the concentration of research within specific geographical regions highlights a potential imbalance in knowledge production, raising questions regarding the generalizability of findings across different educational and economic contexts. This suggests the need for more geographically diverse and interdisciplinary research approaches.

From a theoretical perspective, the results support the integration of economic and entrepreneurship education within a unified framework of competence development. At the same time, they indicate the necessity of further empirical validation, as the

current findings are primarily based on bibliometric patterns rather than direct measurement of educational outcomes.

6. Conclusions

This paper aimed to analyze the relationship between economic education and entrepreneurship education from an integrated perspective, within the context of the transformations specific to the knowledge-based economy. The theoretical-documentary approach, complemented by bibliometric analysis, enabled the identification of both the conceptual foundations of the field and the emerging trends in the scientific literature.

The findings indicate that economic education and entrepreneurship education should not be treated as separate domains, but rather as complementary dimensions of the educational process. Economic education contributes to the development of a solid cognitive foundation by enhancing individuals' understanding of economic mechanisms and rational behavior, while entrepreneurship education builds upon this knowledge by fostering initiative, innovation, and risk-taking.

The bibliometric analysis revealed a significant convergence of research themes across the two fields, as well as an increasing interest in interdisciplinary approaches, experiential learning, and the integration of digital and sustainability-related competencies. These trends reflect the adaptation of research to the evolving requirements of the contemporary economy and to the priorities of European educational policies.

Furthermore, the results suggest that the integration of economic and entrepreneurship education has a relevant impact on the development of transversal competencies, such as critical thinking, problem-solving, decision-making, and adaptability. These competencies are essential for professional integration and for building sustainable careers, particularly in the case of liberal professions, where autonomy and the ability to manage economic activities play a central role.

From a theoretical perspective, the paper contributes to strengthening the conceptual framework regarding the relationship between economic and entrepreneurship education, emphasizing the need for an integrated approach based on complementarity and interdependence. At the same time, the study highlights the role of modern educational paradigms—constructivist, experiential, and competency-based—in supporting this integrated model.

However, certain limitations must be acknowledged. These are mainly related to the predominantly theoretical nature of the research and the lack of direct empirical validation of the relationships examined. Additionally, the reliance on specific databases in the bibliometric analysis may influence the representativeness of the results.

In this context, future research directions should focus on the development of empirical studies aimed at investigating the impact of integrating economic and entrepreneurship education on professional performance, as well as on the design of applied educational models tailored to the specific characteristics of different fields of activity.

This study advances the literature by providing a comprehensive and integrative bibliometric analysis of the relationship between economic education and entrepreneurship education, offering a systematic mapping of research trends and contributing to a deeper understanding of their joint role in competence development within the knowledge-based economy.

In conclusion, the integration of economic and entrepreneurship education represents a relevant direction for the modernization of educational systems and for the development of human capital adapted to the requirements of the knowledge-based economy. Such an approach can contribute to the formation of complex competencies necessary for active and responsible participation in economic and social life.

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A CAUSAL RELATIONSHIP BETWEEN INFLATION AND ECONOMIC GROWTH IN EAST AFRICAN COUNTRIES: NEW EVIDENCE FROM SYMMETRIC AND ASYMMETRIC CAUSALITY TESTS

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Abstract*: In this paper, we examine the direction of heterogeneous causality between inflation and economic growth in East African countries (EAC) for the period 1970–2023. Most regional studies, while finding single-regime inflation thresholds, remain silent on the directional and shock-contingent Granger causality. Motivated by this gap, we apply the Dumitrescu–Hurlin heterogeneous panel Granger non-causality framework, as well as the Hatemi-J asymmetric shock decomposition framework, to distinguish between positive and negative innovations. Symmetric panel results indicate unidirectional Granger causality running from inflation to real GDP per capita growth, though this aggregated result conceals shock-dependent dynamics. Furthermore, the asymmetric decomposition suggests that the relationship is primarily shock-dependent and asymmetric: that is, positive inflation shocks Granger-cause positive growth shocks, while negative growth shocks Granger-cause negative inflation shocks. No evidence of cross-regime effects is found. These findings suggest that the inflation–growth nexus appears to be asymmetric, regime-dependent in the EAC, and that it may be undesirable to impose uniform convergence criteria if the inflation–growth predictability differs systematically across expansionary and contractionary regimes. Broadly, our results highlight the need to allow for cross-country heterogeneity in estimation and to explicitly test for dependence of shocks in causality analysis of emerging monetary unions.*

Keywords: *Inflation; Economic Growth; East African Community; Panel Granger Causality; Heterogeneous Panels; Asymmetric Shocks*

JEL classification: *E31; O55; C23; O47; C33; F45*

1. Introduction

The design of monetary stabilization in developing regional blocs depends largely on the direction, stability, and shock-dependence of the inflation–growth relationship; however, the empirical evidence for this point is uncertain for low-income settings (Barro, 1995; Fischer, 1993). Although high levels of sustained inflation are generally believed to have a negative impact on macroeconomic stability as such, the theoretical relationship between moderate levels of inflation and real activity has been shown to be ambiguous and may depend on different institutional and market structures (Levine & Renelt, 1992; Bruno & Easterly, 1998). This ambiguity is especially evident in low-income nations with large structural impediments to income

diversification, thin financial markets, and substantial external risk to economic activity; thus, changing the manner in which output and prices interact with one another (Pollin & Zhu, 2006).

Macroeconomic theories provide conflicting explanations of the causal ordering. The classical arguments for neutrality suggest that inflation, once anticipated, will not have a long-term impact on real output, even if it has an impact on relative prices and the allocation of resources (Friedman, 1977). In contrast, in the Keynesian framework, there is a potential for short-run non-neutrality where demand shocks can cause both output and inflation to rise together for a short period of time (Phillips, 1958). Endogenous growth models further suggest that inflation may also have long-term impacts on the economy because it reduces financial intermediation and decreases the effectiveness of capital accumulation (Azariadis and Smith, 1996). An important implication from this work is that the direction of causality between inflation and economic growth will vary based upon structural characteristics such as the level of financial depth, the degree of fiscal discipline, and how expectations are formed, and this relationship may also vary across countries belonging to the same integrating bloc (Gylfason and Herbertsson, 2001).

Empirical assessments of the inflation–growth causality vary widely based on estimation procedure or specification, the sample used, and the assumptions about cross-sectional properties of the data (e.g., common slopes) (Barro, 1995; Chimobi, 2010). Studies based on the assumption of common slopes among countries in panel analyses may be inaccurate due to differences in macroeconomic structure among those countries, and average results reported for the sample may fail to represent any one particular economy well. Similarly, linear symmetric specifications may obscure differences in responses to positive and negative shocks due to different channels of transmission for shocks (e.g., through demand, credit, and nominal rigidities) (Dumitrescu & Hurlin, 2012).

These issues are of particular importance to the East African Community (EAC) as it seeks to deepen integration towards the East African Monetary Union (EAMU). The EAMU convergence framework, including a proposed 8 percent inflation ceiling, essentially presupposes a symmetric and uniform inflation–growth relationship across member states (EAC, 2013). Recent EAC literature has overwhelmingly focused on threshold estimation (Yabu & Kessy, 2015; Ndoricimpa, 2017). Those estimates indicate levels of inflation beyond which the effects on growth rates become detrimental. They do not, however, determine whether inflation precedes cycles in growth rates, or vice versa, nor whether the relationships differ across expansionary and contractionary regimes. If the causal dynamics are shock-dependent, a uniform inflation ceiling can induce asymmetric and possibly procyclical real effects, complicating macroeconomic stabilization policy within a prospective union (De Grauwe, 2020; Oloo et al., 2021).

Against this background, in this study, we focus on the direction of the short-run Granger causality between inflation and real GDP per capita growth in the EAC over the period 1970-2023. Our empirical strategy proceeds in two steps. In the first step, we apply the Dumitrescu and Hurlin (2012) heterogeneous panel Granger non-causality test, as this allows the causal coefficients to differ across countries while ensuring valid panel inference. In the second step, to evaluate causality dynamics according to the direction of shocks, we appeal to the Hatemi-J (2012) decomposition into positive and negative cumulative innovations and re-estimate heterogeneous panel causality on these components. This design allows us to test

if inflationary accelerations and disinflationary episodes contain different Granger causal content for growth dynamics, and if Granger causality is predicted differently on growth contractions versus expansions for disinflation and inflation, respectively. More broadly, the paper contributes to the literature on inflation–growth dynamics in developing monetary unions by illustrating how panel-level inference in heterogeneous frameworks should be interpreted cautiously when Granger-causal patterns are regime-contingent. The results inform the empirical coherence of uniform convergence criteria in the EAMU context and speak to the broader question of whether nominal targets are sufficient when macroeconomic transmission is shock-dependent. The remainder of the paper is structured as follows: Section 2 reviews the literature; Section 3 outlines the methodology; Section 4 presents the findings; and Section 5 discusses policy implications.

2. Literature Review

Despite decades of theoretical exposition and empirical investigations, no agreement has yet emerged on the direction of the causality between inflation and growth, especially in heterogeneous developing economies. Although there is strong evidence linking high and volatile inflation to poor long-run economic performance (Barro, 1995, 2001; Fischer, 1993), the details of the causal connections are elusive. By misjudging the direction of causality, monetary authorities can end up enacting procyclical stabilization policies that further increase rather than decrease output volatility (Bruno & Easterly, 1998). In this section, we explore the theoretical channels of transmission and the empirical evidence, focusing in particular on the tension between the homogeneous panel assumptions and the structural heterogeneity of African and EAC economies.

2.1 Theoretical Framework

The theoretical literature suggests various forms of causal relationships between inflation and economic growth, which range from unidirectionality to neutrality. The first set of theories, based on the Monetarist/Neoclassical tradition, suggests a unidirectional relationship from inflation to economic growth. Friedman (1977) and Barro (1995) suggest that inflation leads to price volatility, which results in uncertainty. Uncertainty affects the signalling properties of relative prices. Thus, inflation affects the economy through the uncertainty and financial intermediation channels, as opposed to the aggregate demand stimulation. Uncertainty hinders long-term planning, leading to a reduction in the rate of capital accumulation because firms tend to substitute productive capital with hedging activities, thus retarding the rate of economic growth (Fischer, 1993). In the context of developing countries, the effects of inflation on economic growth are likely to be intensified by "financial repression" because inflation leads to an increase in the asymmetry of information in the credit market, thereby affecting the efficiency of financial intermediation (Azariadis & Smith, 1996).

In contrast, the Keynesian and Structuralist approaches reverse the causality chain by implying that inflation emerges naturally as a consequence of the real sectors' growth and the accompanying friction that arises along the way. Moreover, the applied insight of the Phillips curve concept implies that brisk economic growth, especially surpassing potential output levels in an economy, automatically breeds demand-pulling inflationary pressures (Phillips, 1958). Similarly, the Phillips curve

concept of economic growth triggering inflationary pressures is applicable in the context of African economies, with inflation arising due to the accompanying bottlenecks along the supply side of the economy resulting from an economy's inability to meet increasing demand levels in sectors such as food due to increasing incomes (Ghosh & Phillips, 1998).

The third view posits that there is bidirectional causation. This feedback loop tends to arise in countries where there are weak fiscal institutions; as a result of lower rates of economic growth, the tax base declines, which leads to a need for seigniorage (money printing) to cover the deficit. The increase in the money supply leads to a rise in inflation, which ultimately contributes to further erosion of the rates of economic growth (Bruno and Easterly 1998). The neutrality hypothesis, which is based on the Rational Expectations theory (Lucas 1973), posits that anticipated inflation shows no long-run causal relationship with real variables and thus has no effect on real variables in the long run (i.e., long-run superneutrality where all markets are fully flexible). However, this hypothesis is problematic in the case of developing economies because, in most cases, developing country markets are rarely frictionless.

Theoretical explanations for asymmetric inflation–growth dynamics are more convincingly grounded in models with nominal rigidities and state-dependent adjustments. In environments characterised by downward wage and price rigidity, negative demand shocks often generate disproportionately large real effects relative to positive shocks of similar magnitude. When nominal wages are resistant to downward adjustment, disinflationary episodes can be accompanied by output contractions that are larger than the expansions associated with moderate inflationary upswings (Ball & Mankiw, 1994). Similarly, menu cost and staggered price-setting models imply that firms adjust prices asymmetrically depending on the direction and persistence of shocks, thereby generating nonlinear output responses (Ball & Mankiw, 1994). In such frameworks, the inflation–growth relationship becomes inherently regime-contingent rather than symmetric across positive and negative disturbances.

2.2 Empirical Literature

Although significant amounts of research assess the magnitude or threshold effects of inflation on output, a fundamental question is temporal ordering. Does inflation systematically lead to changes in growth? Does growth create inflationary dynamics? Do the two variables work together in a feedback loop? Or are they relatively independent? In the empirical literature, all four views have been supported with no consistent relationship found across countries, income groups, or estimation methods.

2.2.1 Inflation → Growth

Many studies in the time-series literature have shown unidirectional Granger causality from inflation to growth. Several studies conducted in Pakistan (Mubarik, 2005; Hussain & Zafar, 2018), Turkey (Erbaykal & Okuyan, 2008), Nigeria (Omoke, 2010; Chimobi, 2010), Malaysia (Datta and Kumar, 2011), Bangladesh (Hossain et al., 2012), Qatar (Al-Khulaifi, 2018), and Liberia (Tenny, 2022) have found that inflation causes changes in the level of output with no sign of growth causing future inflation. In general, signs of the estimated effect have been shown to differ across

different countries; however, in many cases, the direction of the causal relationship runs from price level to level of output.

The majority of these, methodologically, rely on country-specific VARs, VECMs, or Granger causality tests. A smaller number use more sophisticated techniques, like Toda-Yamamoto causality tests. Again, a point worth emphasizing is that these types of analysis are essentially time series-based, individual country as opposed to cross-sections, which are much more representative at a regional level. The evidence collectively supports models with uncertainty, intermediation, or distortionary channels for the effects of inflation, reflecting that price volatility impounds forward-looking information for real activity.

2.2.2 Growth → Inflation

A second set of studies reverses the direction of causality; for example, evidence presented from Fiji (Gokal & Hanif, 2004), Nigeria (Bakare et al., 2015), Turkey (Özpence, 2016; Kanca, 2017), and Uganda (Abima, 2022), has found that the expansion in output precedes the inflationary dynamics, and reverse causality has not been established.

In general terms, these findings have been interpreted from a demand-pull perspective with rapid output growth putting pressure on resources, causing prices to rise. Some of these studies place a great deal of importance on structural issues such as import dependence and supply rigidity as mediating factors influencing demand-pull pressures on the economy; however, the majority of the evidence supporting these claims is based on country-level time series models that limit the generalizability of the findings to contexts of regional monetary integration.

2.2.3 Bidirectional Feedback

The third strand provides evidence of bidirectional causality. Cross-country panel evidence (Huang et al., 2009; Özylmaz, 2022) and country studies of China (Changshuai, 2012), Ethiopia (Rao, 2015), Japan (Singh, 2015), and BRICS (Behera, 2016) provide evidence of feedback mechanisms between the two variables where inflation and growth mutually reinforce each other.

Of particular note, several of the empirical analyses utilize panel causality techniques like the Dumitrescu–Hurlin framework. Nonetheless, the majority of the studies conducted in a panel environment have limitations related to their use of symmetric linear specifications and their failure to formally test for causal ordering that is contingent on the sign of macroeconomic shock.

2.2.4 No Causality: Superneutrality Evidence

A fourth empirical position states that there exists no significant causal linkage. For example, Brazil (Faria & Carneiro, 2001), Kenya (Kigume, 2011), Nigeria (Osuala, 2013; Shuaib et al., 2015), Turkey (Özçelik & Uslu, 2017), and ECOWAS member nations (Dada et al., 2017) have all concluded that there is no predictive causality present between the two variables.

In general, the results obtained in these studies provide evidence to support long-run superneutrality and weak transmission mechanisms of monetary policy. However, many of the existing studies are based on small-sample VAR specifications, which typically do not have enough power to identify heterogeneous and/or nonlinear relationships.

2.2.5 Asymmetric Causality in the Inflation–Growth Literature

A growing strand of literature challenges the assumptions of linear symmetric causality frameworks to fully explain macroeconomic phenomena. Utilising the approach of Hatemi-J on asymmetric decompositions, several papers find that positive and negative shocks transmit differently across economic variables. For instance, Syzdykova et al. (2022) employ the Hatemi-J asymmetric causality test on oil prices and macroeconomic stability and show that positive and negative oil price shocks differently affect domestic price levels. Similar results are found by Çelikel and Öndes (2025) using non-linear approaches on Turkey, for which inflation and GDP show an asymmetric cointegration pattern where rising inflation depresses output in the short term but a decline in inflation tends to promote economic growth. Olaniyi and Ologundudu (2022) assess the African context and use a bootstrap simulation with asymmetric causality tests to show that remittance shocks affect poverty differently depending on their sign. Olaniyi and Odhiambo (2024) also show how cross-country interdependence and asymmetry change causal inference in panel settings. Overall, this tract of literature suggests that macroeconomic causal mechanisms are regime contingent rather than symmetric.

Even with this understanding of asymmetry, much of the literature remains country-specific and, even so, it either explores nonlinear cointegration or sectoral transmission channels rather than inflation–growth causality within regional blocs. And even when asymmetric methods are adopted, they rarely combine the methodology with heterogeneous panel causality through which slope coefficients are estimated to depend on respective cross-sectional units (an important feature for small and structurally diverse monetary unions). To the best of our knowledge, no study has jointly combined heterogeneous panel Granger causality with asymmetric shock decomposition for the EAC. We seek to address this in the present study by combining heterogeneous panel Granger causality with asymmetric shock decomposition in a unified regional setting.

Combined, the empirical literature on causality is suggestive of three broad trends. Empirical findings are strongly estimator-dependent. Directional results change with lag selection, integration order, sample window, and model specification. The very existence of all four possible outcomes suggests that causal inference is sensitive to structural context and econometric design.

Second, most studies fall into the methodology of individual-country time series analysis: Because the studies reflect the dynamics of national bodies, the findings have poor external validity for a regional policy. A nascent monetary union, like the EAC, must design its policy on the basis of the panel level rather than attempting to infer findings from a group of national outlier cases.

Third, panel studies tend to impose slope homogeneity or linear symmetry. As Pesaran and Smith (1995) demonstrated, taking the cross-sectional averages of heterogeneous coefficients does not necessarily imply that the result corresponds to any single member state. Furthermore, linear symmetric models implicitly assume that inflation accelerations and disinflations have the same predictive effects, an assumption that may not be the case in countries exposed to commodity shocks, exchange rate effects, and demand surges.

Despite the increasing literature on the inflation–growth nexus, these findings are still somewhat limited for the EAC:

1. There is scarce evidence of panel-level causality specific to the EAC.
2. existing panel studies do not permit for slope heterogeneity within a small and heterogeneous monetary union;
3. No other study integrates heterogeneous panel causality with asymmetric shock decomposition in the EAC.

The present study aims to fill these gaps in the literature by combining the Dumitrescu–Hurlin heterogeneous panel framework with the Hatemi-J asymmetric shock decomposition. This allows the causal coefficients to differ across member states, while we also analyse whether the predicted dynamics differ across positive and negative macroeconomic regimes. In so doing, our analysis goes beyond the homogeneous panel averages and beyond the purely national time series evidence, directly testing whether the inflation–growth nexus in the EAC is both heterogeneous and shock-contingent.

3. Methodology

This section outlines the empirical strategy employed to examine both symmetric and shock-dependent asymmetric Granger-causal linkages between inflation and real GDP per capita growth in the EAC panel. The asymmetric specification combines the Dumitrescu–Hurlin panel test and the Hatemi-J (2012) positive and negative shock decomposition to analyse shock-dependent causality. The section also provides information about data and variables being used and how the panel causality testing framework will be conducted to address the research questions, given the possibility of heterogeneity and cross-sectional dependence.

3.1 Data and Variables

A balanced panel comprising annual data from 1970 through 2023 has been employed for the empirical analysis in this research study. The panel represents the five EAC member countries (Burundi, Kenya, Rwanda, Tanzania, and Uganda). Two macroeconomic variables are investigated using a dynamic relationship between them as the primary focus of this research study.

1. **Economic Growth** ($y_{i,t}$)**:** Measured as the growth rate of real Gross Domestic Product (GDP) per capita, calculated as the first difference of the natural logarithm of real GDP per capita (constant 2015 USD). This indicator is selected to capture improvements in the average standard of living rather than aggregate output expansion alone. Data are sourced from the World Bank's World Development Indicators (WDI).

2. **Inflation** ($\pi_{i,t}$)**:** is based on the annual CPI inflation rate (in percent) from WDI. Following Khan and Senhadji (2001), we apply the semi-log transformation to the CPI inflation rate to account for its distributional characteristics and reduce potential skewness. However, only values that could be logged were included in the analysis. To conduct the asymmetric causality test, the stationary innovation components of inflation and of growth are decomposed into positive and negative partial sums based on the Hatemi-J (2012) procedure, and the test of causality is performed on all cumulative components.

3.2 Analytical Strategy: Heterogeneous Panel Causality

To derive reliable inference on the inflation-growth nexus, this paper employs a sequential econometric approach that recognizes the structural heterogeneity of EAC. Pooled estimators premised on slope homogeneity, such as the conventional Granger test, position the dynamic causal nexus as identical for all member states, which is most likely an invalid assumption in a heterogeneous region.

Accordingly, we use the Dumitrescu and Hurlin (2012) heterogeneous panel Granger non-causality framework, which has the advantage for the present study through the utilization of heterogeneous coefficients, allowing the causal slope coefficients to differ among cross-sectional units, so one does not have to assume common slopes. To do so, we follow a two-step approach. First, we apply Symmetric Heterogeneous Causality (Section 3.3.1) to isolate the directional relationships. Subsequently, we generalize our model to an Asymmetric Shock-Dependent Specification (Section 3.3.2), where the innovation stationary processes are decomposed into the sum of their respective positive and negative parts, as proposed in Hatemi-J (2012). This allows us to test if the causal relationship depends on the sign of the shock, i.e., if economic growth responds asymmetrically to inflationary vs. disinflationary shocks.

3.3.1 Symmetric Heterogeneous Causality Test

To examine the standard short-run Granger causal linkage between inflation and economic growth, while controlling for cross-country heterogeneity, this investigation resorts to the heterogeneous panel Granger non-causality test developed by Dumitrescu and Hurlin (2012). Unlike traditional pooled panel causality tests, where homogeneous slopes are considered, with this test, cross-sectional unit-specific causal coefficients are allowed to vary, yet valid panel-level inference can be made. Let $y_{i,t}$ denote real GDP per capita growth and $\pi_{i,t}$denote the transformed inflation rate for country $i$at time t. These specifications are implemented using stationary series, consistent with the panel unit root results reported in Section 4.1.2. The symmetric heterogeneous causality test is implemented using the following bivariate panel VAR specification:

$$y_{i,t} = \alpha_i + \sum_{k=1}^{p} \gamma_i^{(k)} y_{i,t-k} + \sum_{k=1}^{p} \delta_i^{(k)} \pi_{i,t-k} + \varepsilon_{i,t}$$

$$\pi_{i,t} = \alpha_i + \sum_{k=1}^{p} \phi_i^{(k)} \pi_{i,t-k} + \sum_{k=1}^{p} \theta_i^{(k)} y_{i,t-k} + \nu_{i,t}$$

where α_i is country-specific fixed effect, p denotes the optimal lag length selected via the Akaike Information Criterion (AIC) for each country-specific regression, and the slope coefficients $(\gamma, \delta, \phi, \theta)$ are allowed to vary across countries, thereby taking into account structural heterogeneity within the EAC.

The null hypothesis of homogeneous non-causality is formally defined as: $H_0: \delta_i^{(k)} = 0$ for all cross-sectional units i and all lags k, which implies that inflation does not Granger-cause growth in any EAC member state. The alternative hypothesis allows for heterogeneous causality: $H_1: \delta_i^{(k)} \neq 0$ for at least one i.

Individual Wald statistics W_i are computed for each cross-sectional unit and averaged across the panel: $\bar{W} = \frac{1}{N}\sum_{i=1}^{N} W_i$. The standardized $\tilde{Z}$-statistic is then derived following Dumitrescu and Hurlin (2012). Given the panel structure of this study ($N = 5, T = 54$), where the time dimension substantially exceeds the cross-sectional dimension, the asymptotic properties of the D-H framework are appropriate.

Rejection of the null implies that Granger causality exists at least for a cross-sectional unit. This aligns with heterogeneous alternatives under Dumitrescu and Hurlin (2012). Although symmetric D-H test results reveal average short-run Granger causality patterns, there is no distinction between the impacts of positive and negative shocks. This brings the discussion closer to an asymmetric framework.

3.3.2 Asymmetric Heterogeneous Causality Test

To assess whether the relationship between inflation and economic growth is shock-dependent, we can extend the symmetric Dumitrescu–Hurlin model in an asymmetric way by introducing the asymmetric shock decomposition as proposed in Hatemi-J's (2012) work. This also enables the detection of causal relationships that could be missed by a purely symmetric, linear approach, like the effect of positive versus negative changes in inflation on economic growth.

Following Hatemi-J (2012), innovations in inflation and economic growth are decomposed into cumulative positive and negative partial sums. Let $\varepsilon_{i,t}$ denote the innovation component of the stationary variable, obtained from the estimated country-specific VAR residuals. The cumulative positive and negative shocks are constructed as:

$$x_{i,t}^{+} = \sum_{j=1}^{t} \max(\varepsilon_{i,j}, 0), x_{i,t}^{-} = \sum_{j=1}^{t} \min(\varepsilon_{i,j}, 0)$$

Applying this decomposition to both inflation and growth yields four cumulative series: $\pi_{i,t}^{+}$: cumulative positive inflationary shocks, $\pi_{i,t}^{-}$: cumulative negative (disinflationary) shocks, $y_{i,t}^{+}$: cumulative positive growth shocks (expansionary episodes), $y_{i,t}^{-}$: cumulative negative growth shocks (contractionary episodes). Since the decomposition is applied to stationary innovations, the resulting cumulative components are suitable for the asymmetric causality framework in Hatemi-J (2012). The heterogeneous D-H causality framework is then applied to all eight possible directional combinations between positive and negative shock components:

Inflation shocks → Growth shocks.

1. $\pi^{+} \rightarrow y^{+}$
2. $\pi^{+} \rightarrow y^{-}$
3. $\pi^{-} \rightarrow y^{+}$
4. $\pi^{-} \rightarrow y^{-}$

Growth shocks → Inflation shocks.

5. $y^{+} \rightarrow \pi^{+}$
6. $y^{+} \rightarrow \pi^{-}$
7. $y^{-} \rightarrow \pi^{+}$
8. $y^{-} \rightarrow \pi^{-}$

For each pairing, the null hypothesis of homogeneous non-causality is tested using the D-H Wald and standardized statistics.

Asymmetric causality is inferred when the null hypothesis of non-causality is rejected for a given directional shock pairing but not for its corresponding opposite shock configuration, indicating differential Granger causality content across positive and negative innovations. For example, rejection of $\pi^+ \rightarrow y^-$combined with non-rejection of $\pi^- \rightarrow y^-$constitutes evidence that inflationary and disinflationary shocks have asymmetric Granger causal effects on growth contractions. This asymmetric framework, therefore, allows the identification of shock-contingent causal mechanisms that may be particularly relevant for monetary policy design in structurally heterogeneous monetary unions such as the EAC.

4. Empirical Findings and Discussions

This section sets out the empirical results from our heterogeneous panel causality analysis and discusses what they imply for the interaction between inflation and growth in the East African Community. We do so in steps. First, we present the diagnostic tests confirming the validity of our econometric approach. Then, we present the symmetric heterogeneous causality results and thereafter the asymmetric shock-dependent outcomes.

4.1 Preliminary Data Diagnostics

Before proceeding to the heterogeneous panel causality framework, we first need to check the properties of the series in time and get an idea of whether cross-sectional dependence and stationarity exist.

4.1.1 Cross-Sectional Dependence

With economies in the East African Community increasingly integrated and member states sharing more exposure to similar terms of trade, climate-related impacts, and policy shocks, the assumption of independence across cross-sectional units is probably not very realistic. To formally assess this, we consider four complementary tests: the Breusch and Pagan (1980) Lagrange Multiplier test, the Pesaran (2004) scaled LM test, the bias-corrected scaled LM test of Baltagi et al. (2012), and the Pesaran (2004) CD test. This mix of statistics is appropriate for panels with a moderate time span and relatively small cross-sectional sets, such as in our study.

Table 1: Cross-Sectional Dependence Test Results

Variable	Breusch-Pagan LM	Pesaran-scaled LM	Bias-corrected scaled LM	Pesaran CD	Inference
y	37.63*** (0.000)	6.18*** (0.000)	6.13*** (0.000)	5.82*** (0.000)	CSD
π	82.03*** (0.000)	16.11*** (0.000)	16.06*** (0.000)	6.24*** (0.000)	CSD

Source: Authors' computations.

Note: y denotes real GDP per capita growth (Δln real GDP per capita), π inflation. The Breusch–Pagan LM, Pesaran scaled LM, bias-corrected scaled LM, and

Pesaran CD statistics are reported with corresponding p-values in parentheses. *** indicate significance at 1 per cent.

The findings, summarized in Table 1, strongly support rejection of the null hypothesis of no cross-sectional dependence at 1 percent, both for real GDP per capita growth rate and inflation. The corresponding Pesaran CD tests are 5.82 for real GDP per capita and 6.24 for inflation, considerably greater than critical values under the standard normal distribution. Collectively, these numbers indicate a high degree of contemporaneous interconnectedness among EAC countries. The cross-sectional dependence is consistent with the existence of common shocks affecting EAC member states simultaneously. For example, global supply-chain disruptions and commodity price volatility can transmit inflationary pressures and output fluctuations across the region through trade and financial linkages (Pesaran, 2006; Chudik and Pesaran, 2015).

Cross-sectional dependence has serious economic implications. According to Pesaran (2007), if there are unobserved common factors, using the first-generation panel unit root tests with the assumption of cross-sectional independence may produce misleading inferences about size. This may lead to spurious inferences regarding stationarity/non-stationarity of the data. Thus, the rejection of cross-sectional independence supports the use of second-generation unit root tests, such as CIPS and CADF.

4.1.2 Panel Unit Root Tests

Therefore, given that there is cross-sectional dependence, we make use of the Cross-sectionally Augmented IPS (CIPS) and Cross-sectionally Augmented Dickey–Fuller (CADF) tests to determine the order of integration. Unlike first-generation tests, such as ADF, which fail to deal with cross-sectional dependence and may have problems when there is an influence of unobserved common factors (O'Connell, 1998), in the second-generation tests, we deal with cross-sectional dependence explicitly by adding cross-sectional averages to the standard regression, as suggested by Pesaran (2007).

Table 2 summarizes the results. The null hypothesis assumes that the series contains a unit root.

Table 2: Panel Unit Root Test Results (CIPS)

Variables	Level		1st Difference		
	Without Trend	With Trend	Without Trend	With Trend	Inference
y	-6.026***	-6.095***	-6.139***	-6.311***	I(0)
π	-3.538***	-3.698***	-5.902***	-6.006***	I(0)

Source: Author's computations

Note: y denotes real GDP per capita growth (Δln real GDP per capita), π inflation. *** indicate significance at 1 per cent.

Table 3: Panel Unit Root Test Results (CADF)

Variable	Without Trend – At Level			Without Trend – 1st Diff.			With Trend – At Level			With Trend – 1st Diff.			Inference
	T-bar	Z-t-tilde-bar	P-value	T-bar	Z-t-tilde-bar	P-value	T-bar	Z-t-tilde-bar	P-value	T-bar	Z-t-tilde-bar	P-value	
y	-3.07	-3.135	0.001***	-4.638	-6.946	0.000***	-3.106	-1.965	0.025**	-4.574	-5.783	0.000***	I(0)
π	-3.178	-3.398	0.000***	-6.095	-10.489	0.000***	-3.202	-2.216	0.013**	-6.286	-10.233	0.000***	I(0)

Source: Author's computations
Note: y denotes real GDP per capita growth (Δln real GDP per capita), π inflation. ** and *** indicate significance at 5 per cent and 1 per cent, respectively.

These second-generation unit root findings are robust across the specifications. For real GDP per capita growth series, $(y_{i,t})$, CIPS statistics range from −6.026 to −6.095, and for the inflation series $(\pi_{i,t})$ values range from −3.538 to −3.698. In all instances, the unit-root null is rejected at 1 percent. The CADF statistics reported in Table 3 also reinforce these findings when considering both trend and without trend settings. In general, all the evidence suggests that both series are stationary in levels under CIPS and CADF specifications.
The fact that the inflation and growth series exhibit stationarity also holds important implications for the overall approach taken to our empirical estimation. The lack of stochastic non-stationarity in our inflation and growth series implies that there is no need to invoke the technique of panel cointegration or the vector error correction model in our empirical strategy. Moreover, we can employ the heterogeneous Granger causality approach of Dumitrescu and Hurlin at the levels of the series without risking spurious regression effects driven by common stochastic trends. This means, of course, that our proposed tests can be seen as tests of short-run Granger causality.

4.2 Symmetric Panel-Level Causality Results

To test for short-run Granger causality between inflation and per-capita real GDP growth for a panel of countries, we apply the Dumitrescu-Hurlin (2012) heterogeneous panel Granger non-causality test. The null hypothesis corresponds to homogeneous non-causality, denoted by HNC, where lagged values of the prior independent variable do not Granger-cause the dependent variable in any cross-sectional unit of the sample. The alternative hypothesis permits heterogeneous causality, implying that causality may exist for at least one country in the panel.

Table 4 reports the average Wald statistic ($\bar{W}$) and the associated standardized $\bar{Z}$-statistic for the period 1970–2023.

Table 4: Results of the Symmetric D-H Panel Granger Causality Test

Causality direction	$\bar{W}$-stat	$\bar{Z}$-stat	P-value	Decision
$\pi \rightarrow y$	5.829**	2.583	0.045	$\pi \rightarrow y$
$y \rightarrow \pi$	5.128	1.943	0.220	

Source: Author's Computations

Notes: *y denotes real per capita GDP growth, π inflation. ** denote rejection of the null hypothesis at the 5 percent significance level. $\bar{W}$-stat is the average Wald statistic, and $\bar{Z}$ -stat are the standardized Dumitrescu–Hurlin statistics. The arrow ($\Rightarrow$) indicates the direction of homogeneous Granger causality.*

The symmetric panel results indicate a unidirectional Granger causality running from inflation to real GDP per capita growth. The null hypothesis of homogeneous non-causality from inflation to growth is rejected at the 5 percent significance level ($\bar{Z} = 2.583,\ p = 0.045$). By contrast, the null that growth does not Granger-cause inflation cannot be rejected ($\bar{Z} = 1.943,\ p = 0.220$), providing no evidence of reverse Granger causal dynamics at conventional significance levels.

The rejection of homogeneous non-causality therefore suggests that the past values of inflation contain statistically significant Granger-causal content for growth in at least one member state of the EAC. This may be consistent with theoretical models, such as those where inflation affects real activity through mechanisms like uncertainty, financial intermediation, or the allocation channel (Friedman, 1977; Fischer, 1993).

Given that there is no reverse panel-level causality during this time, it implies that output expansions do not systematically predict inflation across the region. However, this should not be taken as evidence that there is no demand-driven inflation. Rather, it indicates that such demand-driven effects have yet to become sufficiently widespread in the panel to reject the null hypothesis of homogeneous non-causality used in the Dumitrescu-Hurlin approach.

4.3 Asymmetric Panel-Level Causality Results

To determine if the symmetric panel-level causality identified in Section 4.2 is hiding a shock-dependent mechanism, we perform the Hatemi-J (2012) decomposition and re-estimate heterogeneous panel causality from positive cumulative shocks as well as negative cumulative shocks. The Dumitrescu-Hurlin framework is then applied for each of the eight directional combinations.

For clarity, the results in Table 5 are grouped into three categories: (i) within-regime positive shocks, (ii) within-regime negative shocks, and (iii) cross-regime transmissions ($- \rightarrow +$ and $+ \rightarrow -$).

Table 5: Asymmetric Dumitrescu–Hurlin Panel Causality Results (Shock-Dependent Specification)

Shock Pairing	Causality Direction	W̄-stat	Z̄-stat	P-value	Decision
Positive Shocks	$\pi^+ \rightarrow y^+$	8.330**	4.866	0.04	$\pi^+ \rightarrow y^+$
	$y^+ \rightarrow \pi^+$	3.781	0.713	0.67	No causality
Negative Shocks	$\pi^- \rightarrow y^-$	2.403	−0.545	0.77	No causality
	$y^- \rightarrow \pi^-$	14.680**	10.662	0.01	$y^- \rightarrow \pi^-$
Cross-Regime (− → +)	$\pi^- \rightarrow y^+$	5.993	2.732	0.24	No causality
	$y^+ \rightarrow \pi^-$	4.863	1.701	0.47	No causality
Cross-Regime (+ → −)	$\pi^+ \rightarrow y^-$	4.982	1.81	0.48	No causality
	$y^- \rightarrow \pi^+$	3.597	0.545	0.64	No causality

Source: Author's computations.
Notes: y denotes real per capita GDP growth, π inflation. ** denote rejection of the null hypothesis at the 5 percent significance level. W̄-stat is the average Wald statistic, and Z̄ -stat are the standardized Dumitrescu–Hurlin statistics. The arrow (⇒) indicates the direction of homogeneous Granger causality.

The asymmetric results in Table 5 indicate that the inflation–growth relationship in the EAC is regime-contingent rather than symmetric. Specifically, we find evidence of unidirectional causality from positive inflation shocks to positive growth shocks ($\pi^+ \rightarrow y^+$), implying that inflationary accelerations contain predictive information for expansionary output episodes. This suggests that during periods of rising prices, nominal demand pressures may coincide with short-run output gains, consistent with models featuring temporary non-neutrality of money and short-run Phillips-type trade-offs (Phillips, 1958; Friedman, 1977).
Importantly, this transmission mechanism does not extend to negative regimes. In the contractionary domain, the direction of causality reverses. Negative growth shocks significantly predict negative inflation shocks ($y^- \rightarrow \pi^-$), whereas disinflationary shocks do not Granger-cause output contractions. This pattern indicates that recessions in the EAC precede and predict disinflationary dynamics, consistent with aggregate demand compression mechanisms in which declining output reduces price pressures (Fischer, 1993).
Equally important is the absence of cross-regime causality. Neither negative inflation shocks predict expansionary growth episodes nor positive inflation shocks predict

output contractions. The lack of significance in these cross-shock pairings implies that transmission mechanisms operate within regimes rather than across them.

All the evidence points to the conclusion that the inflation–growth nexus in the EAC depends on the nature of the macroeconomic shock. The results of the symmetric panel suggest that the inflation–growth relationship is largely due to behaviour in the presence of positive shocks to inflation. However, once the shock decomposition is accounted for, the dynamic relationship between inflation and growth can be seen to occur via both a forward and backward channel, with inflationary upswings leading to economic expansion and output declines resulting in disinflation. The linear symmetric models conceal the existence of this regime-specific structural relationship.

It is very important to understand that evidence of Granger causality asymmetry, rather than structural causation, should be read from these results. The Dumitrescu - Hurlin Framework identifies temporal precedence among different groups of countries, but does not provide evidence of structural transmission channels. The conclusions about asymmetrical behaviour can provide very important insights into the design of monetary stability in a future monetary union exposed to both common and idiosyncratic shocks.

4.4 Discussion: Regime-Contingent Inflation–Growth Causality Dynamics in the EAC

The findings of both the symmetric and asymmetric tests suggest that the inflation-growth nexus in the EAC is shock contingent. The findings of the symmetric test of Dumitrescu and Hurlin support the existence of a unidirectional predictive relationship from inflation to growth; however, the findings of the Hatemi-J decomposition reveal that the panel test results are regime-specific. In particular, positive inflation shocks lead positive growth shocks, and negative growth shocks lead disinflation; there is no support for any cross-regime effects.

This may well be one contributory reason why the recent evidence from the EAC and Africa seems rather mixed when analyzed using techniques like linear or level-based approaches. A major strand within the very recent literature emerging from the EAC refers to thresholds for inflation, often via consideration of inflation as a force acting to slow growth once it exceeds some particular range (Yabu and Kessy, 2015; Ndoricimpa, 2017; Ezako, 2023; Mbowe and Mpango, 2024). This body of literature offers some insight into “how much inflation is too much,” but does not address which leads in the short term—inflation or growth?—or for which regimes. Our paper extends this literature by indicating that the lead-lag relationship depends on the sign, in agreement with the idea that the inflation-growth linkage changes over contractionary vs. expansionary periods.

The results also align with broader recent panel evidence for Africa that stresses heterogeneity and instability in the inflation–growth nexus, where average effects can conceal conditional dynamics (Ndong et al., 2024). In particular, the finding that output contractions predict disinflation is consistent with demand-compression mechanisms highlighted in macro-growth interpretations of inflation dynamics, and it is compatible with regional work that documents the importance of common shocks and cyclical co-movements in EAC macro outcomes (Espinoza et al., 2010; Ezako, 2023). At the same time, the positive-regime result, where inflationary accelerations precede expansions, is consistent with short-run non-neutrality interpretations in which demand pressures temporarily raise both output and prices (Phillips, 1958;

Friedman, 1977). Taken together, the comparison suggests that parts of the existing evidence are not contradictory, but instead are capturing different regimes, samples, or identifying assumptions.

Two implications follow for the EAMU. First, convergence rules such as a uniform inflation ceiling implicitly treat inflation as uniformly informative about macroeconomic overheating and uniformly costly for growth. Our results suggest a more conditional interpretation: inflationary upswings coincide with expansionary episodes, while disinflation often reflects contractionary conditions rather than successful stabilization. Second, surveillance and coordination should therefore be explicitly shock-aware. The same inflation outcome can reflect different underlying conditions depending on whether the region is in an expansionary or contractionary regime, which matters for the calibration and timing of common policy responses (De Grauwe, 2020; Oloo et al., 2021).

Again, the overall body of evidence points to the regime-contingent approach because the presence of transmission is detectable within regimes, not detectable between regimes, and the symmetric approach hides these relevant distinctions. This approach reiterates the interpretation of the symmetric panel result while bringing it into line with the emerging body of recent EAC and African literature on the asymmetry between inflation and growth.

5. Conclusion

This paper examines the short-run Granger causality between inflation and real GDP per capita growth for the East African Community (EAC) over the period 1970-2023, using heterogeneous panel Granger causality methods. The motivation for this study stems from the EAC commitment towards the East African Monetary Union (EAMU), and the implicit assumption in the convergence criteria that the inflation-growth relationship for the EAC is stable and symmetric. We adopt the Dumitrescu and Hurlin heterogeneous panel causality methods, combined with the Hatemi-J decomposition, to determine whether causal relationships depend on the sign of the macroeconomic shocks (Dumitrescu & Hurlin, 2012; Hatemi-J, 2012; EAC, 2013).

Three key results can be noted. First, as revealed by the diagnostic evidence, the hypothesis of no cross-sectional dependence is rejected for both inflation and economic growth. Second, as revealed by second-generation unit root tests, both series appear to be stationary at levels, which means we can proceed directly to a causality analysis without needing to resort to any kind of cointegration-based correction mechanisms. Third, as revealed by the Dumitrescu–Hurlin test, which was carried out in its symmetric version, we can observe a one-way Granger causality running from inflation to economic growth at the panel level without any reverse causality from economic growth to inflation.

The main contribution of the paper is that this symmetric panel inference masks a pronounced asymmetry revealed by shock decomposition. In the expansionary regime, positive inflation shocks Granger-cause positive growth shocks ($\pi^+ \rightarrow y^+$), whereas the reverse direction is not supported. In contrast, in the contractionary regime, negative growth shocks Granger-cause negative inflation shocks ($y^- \rightarrow \pi^-$), while negative inflation shocks do not predict growth contractions. Cross-regime channels are statistically insignificant. Taken together, the results imply that inflation–growth interactions in the EAC operate within regimes rather than across them, and

that linear symmetric approaches may obscure sign-dependent Granger causal structure (Hatemi-J, 2012; Dumitrescu & Hurlin, 2012).

These findings suggest that uniform monetary convergence criteria may have heterogeneous macroeconomic implications across regimes. In particular, policy frameworks that respond mechanically to observed inflation outcomes may produce different real effects depending on whether inflationary or disinflationary dynamics are driven by positive or negative underlying shocks. While the present analysis does not estimate an explicit monetary policy reaction function, the asymmetric predictive relationships documented here indicate that regime-contingent considerations may be relevant for policy coordination within the EAC (De Grauwe, 2020; Oloo et al., 2021).

The findings should be interpreted with appropriate caution. Granger causality in this case measures predictability rather than structural causation, and the asymmetry by itself does not shed light on the true mechanisms at play to induce the observed regime dependence. Another drawback is that the EAC panel is small in the cross-sectional dimension, and the model with just two variables excludes some possibly important mediating channels, such as the role of fiscal dominance, exchange rate effects, and the role of external price shocks. All this hints at avenues along which this study could be extended in the future.

In short, the results suggest that, for the EAC, there is no simple, symmetric cause-and-effect relationship between inflation and growth. The Granger causality in this case depends on the particular type of shock: in this case, positive inflation shocks are predictive of positive growth shocks, whereas downturns are followed by a decrease in inflation. It is, therefore, important to consider this asymmetry to credibly conduct policy, specifically in terms of possible convergence criteria for monetary unions.

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GREEN PLATES, GREEN PLANET: THE FUTURE OF ORGANIC AGRICULTURE IN EUROPE

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Abstract: *Organic farming plays an essential role in protecting the environment and maintaining ecological balance, as it promotes agricultural practices that respect the natural rhythms of ecosystems. At European level, organic farming is recognized as an important factor for increasing biodiversity and protecting natural resources, contributing to reducing water pollution and improving environmental quality. In recent years, consumer interest in organic products has increased significantly, amid growing concern for health, food safety and sustainable development. People are increasingly attentive to the provenance of food and prefer products obtained by natural methods, without artificial additives or genetically modified organisms. This article examines the growing importance of organic food and sustainable agriculture in Europe, emphasizing their role in promoting human health, environmental protection, and long-term food security. Healthy food is increasingly recognized as essential for well-being, while organic products are gaining relevance due to consumer concerns about pesticide residues, genetically modified organisms, and environmental degradation. The article also discusses the principles of organic agriculture established by IFOAM and their relevance to sustainable diets defined by FAO. Special attention is given to the integration of emerging technologies (artificial intelligence, IoT, robotics, and digital platforms) which improve productivity while reducing environmental impact. Another focus is the reform of the Common Agricultural Policy and the introduction of eco-schemes, which encourage farmers to adopt environmentally friendly practices tailored to national needs. The article further explores the contribution of organic farming to soil health, biodiversity, and climate resilience, underlining its significance in achieving sustainable development goals. Finally, it reviews major European organic trade fairs in 2026 as strategic platforms for innovation, networking, and market expansion, demonstrating the sector's continued growth and transformative potential in shaping the future of agriculture and food systems in Europe.*

Keywords: *organic farming; organic food; Common Agricultural Policy; eco-schemes; European organic trade fairs*

JEL Classification: *O13; Q01; Q18*

1. Introduction

Healthy food is essential for maintaining overall well-being and leading an active, balanced life. It provides the body with the necessary nutrients, such as vitamins, minerals, proteins, carbohydrates, and healthy fats, that support growth, energy,

and proper functioning of organs. By choosing organic foods (fresh fruits, vegetables, whole grains) over processed and junk foods, we can develop better eating habits and promote long-term health. Buying organic food is often difficult due to a combination of higher costs, limited availability, and the intensive, time-consuming nature of the production and certification process (Robbins, 2023). Organic farmers depend on natural farming processes and methods, which can lead to lower crop yields compared to conventional agriculture. These reduced yields increase production costs per unit, thereby contributing to the higher market prices of organic food products. The EU's organic market is very dynamic. Its continuous positive development is due to a combination of factors, innovative character of organic food and farming, growing policy support and European citizens' increasing demand for high-quality, sustainable food production. What was previously regarded as a niche segment has emerged as a significant driver within the food industry, influencing supply chain structures, retail strategies, and hospitality offerings. This expansion presents substantial opportunities for food service providers, including restaurants, hotels, and institutional cafeterias, to tap into a rapidly growing and profitable market (Bartolozzi, 2025).

2. Literature review

Organic food sales have shown steady growth since the late 20th century. Increasing environmental awareness, along with concerns about the health effects of pesticide residues and the consumption of genetically modified (GMO) crops, has contributed to the expansion of the organic sector (Adamchak, 2026). The demand for organic food began to grow in the 1960s, largely influenced by the publication of Silent Spring by Rachel Carson, which highlighted the environmental damage caused by insecticides. Many studies consistently show that consumers of organic food exhibit systematically different dietary patterns compared with non-consumers. In particular, regular organic food consumers report significantly higher intakes of fruit, vegetables, whole grains, dietary fibre, and legumes, alongside a lower consumption of red and processed meat. Aguirre (2007) in his research has identified several reasons (e.g. organic products are healthy, chemical-free, protect the environment, relate to personal health, and help farmers) that consumers take into consideration when buying organic products (Wijaya and Purwoko, 2018). It is generally believed that compounds in organic fruits and vegetables promote human health and longevity (Wang et al, 2014). Thus, consumers who consistently consume organic foods tend to choose more fruits and vegetables and less meat (Rahman et al., 2024). Organic foods are also perceived as less processed and free of harmful chemicals, which can have a positive impact on consumers' health (Jakubowska et al., 2025). Consistent with these findings, frequent buyers of organic food demonstrate a significantly higher adherence to healthy dietary patterns (Kesse-Guyot et al., 2013). Many consumers perceive organic products as healthier compared to conventional options, which influences their purchasing decisions (Bazhan, 2024). This perception is often fuelled by marketing and the media, which emphasize the absence of pesticides and synthetic additives in organic products. Concerns about pesticides, herbicides, and other chemical additives used in conventional agriculture also motivate consumers to choose organic products. Many consumers associate the absence of pesticides in food production with better taste and higher quality compared to conventional products

(Jakubowska et al., 2025). Evidence in the current literature suggests that the consumption of organic foods confers promising health advantages for various consumers. Multiple statistical analyses have uncovered that organic foods contain significantly higher levels of certain nutrients, including vitamin C, iron and magnesium (Rahman et al., 2024).

Organic consumption patterns are closely aligned with the Food and Agriculture Organization's (FAO) definition of "sustainable diets", as follows: *Sustainable Diets are those diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources* (Burlingame and Dernini, 2012).

Data available on EU production and consumption of organic food show a growing trend in the 2010-2020 decade. An action plan for the development of organic production in the EU was adopted in 2021 (EC, 2021) to support both production and consumption, and to further enhance sustainability, in line with the European Green Deal, the Farm to Fork Strategy (EC, 2020) and the Biodiversity Strategy for 2030 (EC, 2023a).

3. Research methodology

The research methodology of this article is based on a qualitative documentary analysis approach, focused on collecting, examining, and interpreting data from both official institutional sources and scientific literature related to organic agriculture and sustainable food systems in Europe. The study relies on information obtained from European Union institutions, including European Commission reports, CAP Strategic Plans, and policy frameworks such as the European Green Deal and the Farm to Fork Strategy. Also, are used reports from organizations such as FAO and IFOAM to provide comparative perspectives and guidance on policy trends in organic farming. The scientific foundation of the article is supported by academic articles, and books, addressing consumer behaviour, health benefits of organic food, and technological innovation in agriculture.

4. Organic in Europe

Sustainable agriculture represents a fundamental approach that transforms the way we produce food, focusing on the balance between productivity, environmental protection, and social well-being. This approach integrates practices that protect soil, conserve water, promote biodiversity, and ensure economic viability for farmers (Dubey, 2026).

Organic agriculture is an important pillar of sustainable agriculture because it limits the use of synthetic chemical substances and emphasizes natural methods of fertilization and crop protection (Table 1). By using compost, organic fertilizers, and biological pest control solutions, farmers can work in harmony with nature and maintain ecosystem balance (Adamchak, 2026).

Table 1. IFOAM Principles about Organic Agriculture

IFOAM Principles	Description
Principle of Health	Organic agriculture should sustain and enhance the health of soil, plants, animals, humans, and the planet as one and indivisible.
Principle of Ecology	Organic farming should be based on living ecological systems and cycles, working with them, emulating them, and helping sustain them.
Principle of Fairness	Organic agriculture should build relationships that ensure fairness with regard to the common environment and life opportunities.
Principle of Care	Organic agriculture should be managed in a precautionary and responsible manner to protect the health and well-being of current and future generations.

Source: made by the author based on the information presented by IFOAM *(*The International Federation of Organic Agriculture Movements)

More than just a production technique, organic agriculture brings benefits to both the environment and consumers. It encourages the production of cleaner and more natural food, while also offering farmers the opportunity to develop long-term sustainable practices. Thus, this agricultural model contributes to a responsible lifestyle and to building healthier and more resilient communities (Table 2).

Tabel 2. Objective of Organic Production

Category	Objective of Organic Production
Environment & Climate	Contributing to the protection of the environment and the climate
Soil Health	Maintaining the long-term fertility of soils
Biodiversity	Contributing to a high level of biodiversity
Non-toxic Environment	Contributing substantially to a non-toxic environment
Animal Welfare	Ensuring high animal welfare standards and meeting species-specific behavioural needs of animals
Local & Short Supply Chains	Encouraging short distribution channels and local production across the EU
Genetic Resources Conservation	Encouraging the preservation of rare and native breeds at risk of extinction
Plant Genetic Adaptation	Developing plant genetic material adapted to the specific needs of organic agriculture
Genetic Diversity in Crops	Promoting biodiversity through diverse plant genetic material, including organic heterogeneous material and suitable organic varieties
Innovation & Breeding Development	Fostering organic plant breeding activities to support the economic development of the organic sector

Source: made by the author based on the information available in the document REGULATION (EU) 2018/848

4.1. Organic Farming and Emerging Technologies

Organic farming has proven sustainability benefits, including improved soil quality, enhanced biodiversity, and reduced pollution (Eyhorn et al, 2019 cited by Çakmakçı 2023). Agricultural sustainability is defined as the ability of a crop production system to continuously produce food without environmental degradation. Soil health is closely associated with sustainable agriculture, because soil microorganism diversity and activity are the main components of soil health (Tahat et al., 2020). The organic farming may largely exclude the usage of chemical fertilizers, pesticides, growth hormones and feed additives of livestock activities.

A combination of organic farming and new technologies is of utmost importance to reduce the limitations and challenges of organic farming (Gamage et al., 2023). The digital revolution helps farmers optimize resources, reduce environmental impact and increase productivity in a sustainable way (Tabel 3).

Table 3. Technological Innovation in Organic Agriculture

New Technology	Challenges in traditional organic agriculture	Benefits
IoT, AI, and data analytics integration	Integrating the Internet of Things, artificial intelligence and data analytics to automate agricultural processes helps in automatic irrigation control, early detection of plant diseases and prediction of crop yield.	Improved efficiency, early problem detection, optimized resource use, higher productivity
Drones	Real-time crop monitoring and early pest detection	Faster interventions, reduced losses
Sensor networks	Collection of environmental data (soil, humidity, temperature, etc.)	Informed decision-making and optimized growing conditions
Smart irrigation	Efficient water management	Reduced water consumption, preservation of soil health
Digital platforms and mobile applications	Provide farmers with real-time weather data, personalized crop management recommendations, and direct connectivity with markets and suppliers	Faster and more informed decision-making, improved market access, better farm management

Source: made by the author based on the information presented by Baldin, 2025

The integration of these modern technologies in agriculture is not only a step toward efficiency but also a way to ensure the long-term sustainability of agricultural production. From smart crop monitoring to connecting farmers with markets and suppliers through digital platforms, all these solutions support a more competitive, more resilient, and more environmentally friendly agriculture. By integrating ecological principles, innovative technologies, and scientifically validated traditional practices, this approach provides concrete solutions to the major challenges of the 21st century.

4.2. Eco-scheme, the new instruments of the CAP

The new Common Agricultural Policy (CAP), adopted in December 2021, was designed to help the EU farming sector respond to both local and global challenges by supporting the transition toward a smarter, more sustainable, competitive, resilient, and diversified agricultural system that ensures long-term food security (Table 4). Eco-schemes are a new instrument within the CAP designed to support this transition. EU Member States define eco-schemes in their CAP Strategic Plans. The European Commission evaluates and approves them as essential tools for helping the CAP achieve the objectives of the European Green Deal (EC, 2023b).

Table 4. The benefits of organic products from the perspective of sustainable development

Benefits of organic products	Contribution to sustainable development (European Green Deal)
Reduction in chemical pesticide use	Organic farming supports the EU target of reducing pesticide use and related risks by 50% by 2030, protecting the environment and human health.
Expansion of organic farmland	Contributes to achieving the goal of allocating 25% of EU agricultural land to organic farming by 2030, promoting more sustainable farming systems.
Reduction in antimicrobial use	Supports a 50% reduction in antimicrobial use in livestock and aquaculture, lowering the risk of antimicrobial resistance and protecting public health.
Efficient use of nutrients and fertilizers	Helps reduce nutrient losses by 50% and fertilizer use by at least 20%, maintaining soil fertility while reducing water and soil pollution.

Source: made by the author based on the information available in the document entitled 'Sustainable agricultural practices and methods' (European Commission)

A key innovation of the new CAP is the introduction of eco-schemes, which encourage farmers to adopt practices that reduce the negative environmental and climate impact of agriculture and promote more sustainable farming models. At EU level, eco-schemes targeted to soil conservation (increasing natural fertility, carbon farming) account for 30% of the overall; those addressing biodiversity and landscape features represent nearly 20% and those on grazing and grassland management account for 15%. Support to organic farming and pesticide management account for 6% each. Few Plans include specific schemes targeted to peatland and wetlands (2%) and animal-related actions (5%) (EC, 2023b).
Member States have the flexibility to adapt these eco-schemes to their national environmental and climate priorities (Table 5). Overall, CAP Strategic Plans include 158 eco-schemes across the European Union, with most Member States implementing several schemes, each targeting specific environmental or climate objectives (EC, 2023b).

Table 5. Eco-Schemes

Aspect	Description
Multi-dimensional eco-scheme countries	Six Member States — Czech Republic (CZ), France (FR), Hungary (HU), Ireland (IE), Netherlands (NL), Slovakia (SK) — introduced one multi-dimensional eco-scheme. Such schemes include a package of options, made up of a mix of practices of various degree of ambition, from which farmers can make a selection.
Whole-farm approach	In such cases, farmers are often requested to select or perform practices covering their whole agricultural area (this approach is referred to as a 'whole-farm approach'). In addition to the main 'whole-farm eco-scheme', Czech Republic (CZ) and Slovakia (SK) set out more specific ones;
Points-based eco-schemes	Netherlands (NL) and Hungary (HU) put forward points-based eco-schemes, which allocate a scoring/weighting to the different practices according to their likely positive impact and encourage farmers to select those practices most relevant to the environmental and climate-related needs on their farms and/or in their regions;
Other Plans	Some countries, such as Lithuania (LT), Ireland (IE), and Poland (PL), request farmers to take up more than one eco-scheme or a minimum number of practices, relating for instance to arable land, to ensure synergies and provide a higher environmental value

Source: made by the author based on the information provided by European Commission, (EC, 2023b)

At EU level, eco-schemes targeted to soil conservation (increasing natural fertility, carbon farming) account for 30% of the overall; those addressing biodiversity and landscape features represent nearly 20% and those on grazing and grassland management account for 15%. Support to organic farming and pesticide management account for 6% each. Few Plans include specific schemes targeted to peatland and wetlands (2%) and animal-related actions (5%) (EC, 2023b).

5. Key Events for Success in the European Organic Sector

In 2026, the organic products sector continues to strengthen its position internationally through a series of leading trade fairs and exhibitions dedicated to innovation, sustainability, and the development of responsible food supply chains. These events represent essential meeting platforms for producers, distributors, retailers, and industry specialists, offering opportunities for networking, the exchange of best practices, and the promotion of the latest trends in the field (Table 6). From certified organic foods and "free from" products to sustainable solutions for fruits, vegetables, and natural ingredients, each exhibition contributes to shaping the future of the global organic market. At the same time, the 2026 editions place special emphasis on new generations of entrepreneurs, innovative technologies, and the industry's adaptation to the demands of modern consumers.

Table 6. Key Events for Success in the European Organic Sector

Event	Description	Date and Venue
BIOFACH 2026: "Young Voices, Bold Visions"	The world's leading trade fair for organic food, BIOFACH brings together the international organic industry and highlights the innovations and visions of the new generation in sustainable agriculture and food systems.	10–13 February 2026, Nuremberg Exhibition Centre, Nuremberg, Germany
SANA Food – Organic Revolution 2026	A leading B2B event for the conscious and sustainable food sector, offering exclusive insights into organic market trends, consumption, supply chains, and sustainable development. It connects Horeca sectors, specialty retailers, and restaurant outlets with innovative agri-food producers of organic, vegan and high-quality sustainable products.	23 February 2026, Bologna, Italy
Alimentaria: 50 Years Feeding the Future	A landmark event for food industry professionals, celebrating its 50th anniversary with a special focus on organic producers and the European organic certification label.	23–26 March 2026, Fira de Barcelona – Gran Vía, Barcelona, Spain
MedFEL: the meeting point of the fruit and vegetable world	France's leading trade fair exclusively dedicated to the fruit and vegetable sector, focused on 100% sustainable practices and economic exchange within the industry.	28–29 April 2026, Exhibition Centre of Perpignan, Perpignan, France
Free From Specialty Food 2026	An exhibition dedicated to "free from" food and beverage products, promoting natural, organic, GMO-free, and pesticide-free ingredients in a rapidly expanding market sector.	16–17 June 2026, Vienna, Austria
Natural & Organic Food Show (NOPEX)	An event dedicated to natural and organic products, bringing together professionals from retail, hospitality, manufacturing, and international trade to explore future market trends.	16–17 September 2026, Excel London, London, United Kingdom
NATEXPO Lyon 2026	A strategic trade fair for organic industry stakeholders, designed to encourage exchange of ideas and shape the future of the organic market.	28–29 September 2026, Lyon, France
Nordic Organic Expo 2026	The leading Nordic event for certified organic and natural products, gathering top companies in food, beverages, health, and beauty sectors.	18–19 November 2026, Malmö Massan, Malmö, Sweden

Source: made by the author based on the information available in the document entitled 'Yearbook 2025 - Trends 2026 Bioeco Actual' INDEPENDENT ORGANIC TRADE MEDIA

In Europe's major exhibition centres, these events are becoming true strategic landmarks for the development of organic agriculture and responsible trade. Participation in such events provides industry stakeholders with direct access to international markets and valuable insights into the evolution of the organic sector. In this context, the main international trade fairs of 2026 highlight the dynamism and growth potential of the global bio industry.
Despite challenges such as economic fluctuations, supply chain constraints, and certification complexities, the European organic food market continues to thrive. The continued support of government policies, sustainable farming incentives, and the evolving tastes of consumers will ensure that organic food remains at the forefront of Europe's food industry (Bartolozzi, 2025).

6. Conclusions

Organic agriculture has become a central pillar of sustainable development in Europe, responding effectively to the interconnected challenges of food security, environmental protection, and public health. The steady expansion of the organic sector reflects not only growing consumer demand for healthier and safer food, but also a broader societal shift toward environmentally responsible production and consumption models. Organic farming contributes significantly to soil conservation, biodiversity preservation, reduced chemical dependency, and climate resilience, making it a key component of the transition to sustainable food systems. This article demonstrates that the integration of innovative technologies such as precision agriculture, artificial intelligence, IoT systems, and digital platforms is transforming organic farming into a smarter and more efficient sector. These technologies help overcome traditional limitations of organic production by improving resource management, increasing productivity, and supporting data-driven decision-making. At the same time, European policy instruments, particularly the reformed Common Agricultural Policy and its eco-schemes, provide essential financial and regulatory support for farmers adopting sustainable agricultural practices. Furthermore, the development of the organic market is reinforced by strong institutional commitment at EU level, including the European Green Deal, Farm to Fork Strategy, and the Organic Action Plan, all of which promote long-term sustainability goals. International trade fairs and specialized events across Europe also play a strategic role in accelerating innovation, strengthening partnerships, and expanding access to global markets. The future of European agriculture depends on the successful integration of ecological principles, technological advancement, and supportive public policies. Organic agriculture, supported by innovation and collaborative governance, offers a viable pathway toward a more resilient and sustainable agricultural system capable of meeting the demands of present and future generations.

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THE ROLE OF ACCOMMODATION, FOOD SERVICE AND HOSPITALITY IN THE HUNGARIAN ECONOMY IN 2008-2023

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Abstract: *The economic crisis that began in 2008 is now regarded as a historical fact – it was the first major crisis of the 21st century and caused a significant downturn in various sectors of the economy, particularly in lending. After nearly a decade of slow recovery, by 2019, economic indicators in most countries had reached record highs. Then, without much warning, the COVID-19 crisis emerged, creating an unprecedented global health, social, and economic "emergency" that also caused serious disruptions in Hungary. The travel and tourism sector was among the most heavily impacted, with demand dropping significantly at global, regional, and even local levels, and in some cases, coming to a complete halt due to strict travel restrictions such as border closures and the shutdown of restaurants, hotels, and entertainment venues. Although the acute phase of the crisis brought on by the coronavirus had passed by the summer of 2023, many sectors of the economy continue to experience its substantial short-and long-term aftereffects.*
This study focuses on the most affected sector – tourism – and examines the impact of the crisis on it. It explores the development of employment and gross average wages between 2008 and 2023, with special attention given to indicators characteristic of the accommodation and food service industry, such as the number of guest nights, the number of commercial accommodation establishments, and the revenue from domestic and international accommodation services.

Keywords: *crisis; tourism and hospitality; employment; sustainability*

JEL Classification: *G12; G15; G32*

1. Introduction

Tourism is an important driver of economic growth and job creation, but in addition to accommodation and food services, it also serves as a key engine for several other sectors such as road and air passenger transport, spa services, sports and leisure activities, cultural services, and various other industries. Within the Hungarian economy, the tourism sector plays a strategic role in contributing to GDP, maintaining balance in the current account and employment, and boosting overall consumption (Buljat et al., 2024; Darabos, 2015; Tömöri, 2021; Darabos et al., 2024). The accommodation and food service sector has a dual role in labor market: on the one hand, it increases employment, thereby helping to reduce unemployment, which generates revenue and savings for the state, since wages and related taxes and contributions are borne by companies, while unemployment

benefits are paid from state funds. Tourism and hospitality are characterized by seasonality, which, along with low wages, significantly contributes to high employee turnover.

This study presents the trends in employment and gross average wages between 2008 and 2023, with a particular focus on indicators specific to the accommodation and food service sector, such as the number of guest nights, the number of commercial accommodation establishments, and domestic and international accommodation revenues. The data confirm that during periods of crisis, a downturn is typical across many sectors, and there are also significant regional variations (Gyurko et al., 2024); however, during the recovery phase, the goal is to achieve the highest possible growth across all sectors of the economy. The tourism and hospitality sector had already reached pre-crisis levels in several areas by 2022–23, and in some cases significantly exceeded them. European Union development funds played a significant role in the development of tourism in Hungary. The subsidies were primarily aimed at helping less developed regions and rural tourism catch up. According to Iron and colleagues, rural tourism can contribute significantly to the performance of the rural economy, but during development efforts, the focus should be on quality factors (productivity, authentic experiences, workforce skills, etc.) rather than quantitative indicators (Iron et al., 2024).

One of the key issues of the 21st century is the need to enhance social and economic sustainability while reducing social and environmental degradation (Árva et al., 2020; Csobán et al., 2022). The "industry" of tourism significantly contributes to environmental pollution through the use of natural resources, open-air recreational spaces, sports facilities, and similar infrastructures.

Beyond the relevant academic sources, the research relies primarily on statistical data published by the Hungarian Central Statistical Office (KSH) and publicly available databases of the Hungarian National Bank (MNB).

2. Key Indicators of the Accommodation and Food Service Sector between 2008-2023

At the national economy level, the number of employed persons declined after 2008, and the employment rate fell below 60%. From 2014 onwards, a more significant increase was observed, with only minor declines in 2020 and 2021, but by 2023 employment levels had returned to those of 2019. Between 2008 and 2023, the number of employed persons increased from 3.83 million to 4.6 million, representing nearly 800,000 new jobs (Table 1). During 2009-2013, the unemployment rate fluctuated around 10-11%, but from 2013 onwards, it steadily decreased, resulting in a reduction in the number of unemployed from 416.6 thousand to 156.9 thousand between 2009 and 2019. However, during the COVID-19 crisis, an increase in unemployment was again observed.

In the accommodation and food service sector, employment grew slowly between 2009 and 2016, but from 2017 onwards, the number of employees in the sector continuously declined, primarily due to low wages, prompting many to seek employment abroad. Throughout the 2010s, the sector was increasingly characterized by a shortage of skilled labor. The lowest point in employment during the coronavirus pandemic was recorded in the first quarter of 2021, when only 142,000 people were employed in accommodation and food services – approximately 50,000 fewer than in the corresponding quarter of 2019 (Zerényi, 2023).

Table 1: Economic Activity of the Working-Age Population

Year	Employed persons (thousands)	Unemployed persons (thousands)	Unemployment rate (%)	Employment rate (%)	Accommodation and food service sector (thousands)	Change compared to previous year (%)
2009	3 831,4	416,6	9,8	59,8	157,2	1,00
2010	3 811,4	468,4	10,9	59,6	154,2	0,98
2011	3 833,0	464,5	10,8	60,3	165,2	1,07
2012	3 886,8	470,3	10,8	61,6	168,0	1,02
2013	3 963,8	438,2	10,0	63,3	164,7	0,98
2014	4 155,1	341,1	7,6	67,2	173,2	1,05
2015	4 275,8	306,4	6,7	68,3	189,0	1,09
2016	4 403,7	232,7	5,0	70,9	200,8	1,06
2017	4 489,3	190,6	4,1	71,5	195,5	0,97
2018	4 515,3	168,6	3,6	73,0	185,9	0,95
2019	4 548,6	156,9	3,3	72,4	193,4	1,04
2020	4 484,9	194,6	4,2	72,1	176,9	0,91
2021	4 511,2	190,4	4,0	73,3	169,4	0,96
2022	4 583,5	171,6	3,6	73,5	181,8	1,07
2023	4 600,1	198,3	4,1	73,9	179,5	0,99

Source: KSH (2024)

Following the lifting of pandemic restrictions, employment gradually increased in 2022, reaching nearly 182,000 people, which was 12,400 more than the previous year, though still below the pre-pandemic figure of 193,400. Although the number and proportion of vacant positions slightly decreased, the shortage of skilled labor continued to pose a significant problem for the sector. During these years, an increasing number of workers left the sector, seeking better-paid employment either abroad or in other industries (Béresné et al., 2021). In 2023, employment levels in the sector still had not recovered to pre-crisis levels: in the first quarter of 2023, approximately 12,000 fewer people were employed compared to the same period in 2019. Additionally, due to unfavorable demographic trends, the shrinking labor force is expected to remain one of the sector's greatest challenges (Zerényi, 2023). Even rising wages have not been sufficient to boost employment figures in this sector.
In 2023, the proportion of vacant positions in the accommodation and food service sector was 0.2 percentage points lower than the previous year, remaining below the national average (KSH, 2024).

According to Fekete-Fábián and co-authors (2022), following the prolonged 2008 economic crisis, the long-term decline in the number of registered job seekers was significantly supported not only by market processes but also by state interventions (such as the expansion of public employment programs and large-scale public investments), and this positive trend continued practically until the outbreak of the

pandemic. The decrease in employment due to lockdown measures would have been even more severe if workers in certain occupations and sectors had not been able to shift to remote work, typically working from home. According to research by Köllő and his co-authors (2021), most job losses occurred in the service sectors, including accommodation, catering, and tourism, despite the fact that these sectors had a much higher-than-average proportion of employees who were not working but had not been dismissed, as well as a particularly high proportion of employees working remotely. Without the opportunity for remote work, the employment rate would have deteriorated even more significantly.
The crisis also substantially increased the already high levels of income inequality (Köllő et al., 2021; Barizsné et al., 2021). While lower-income groups depleted almost all of their savings, higher-income groups generally did not experience financial hardship. Furthermore, the job loss rate was considerably higher among groups with lower education levels and those more vulnerable to deep poverty, compared to university graduates, further exacerbating income inequality.

Table 2: Trends in Gross Average Earnings in the National Economy and in the Accommodation and Food Service Sector, and Their Proportion

Years	National economy average (HUF)	Of which: accommodation and food service sector (HUF)	National economy average change compared to previous year = 100%	Accommodation and food service sector change compared to previous year = 100%	Ratio compared to national economy average = 100%
2009	199 837	122 561	100,6	101,6	61,3%
2010	202 525	122 699	101,3	100,1	60,6%
2011	213 094	125 757	105,2	102,5	59,0%
2012	223 060	139 731	104,7	111,1	62,6%
2013	230 714	146 742	103,4	105,0	63,6%
2014	237 695	152 874	103,0	104,2	64,3%
2015	247 924	157 560	104,3	103,1	63,6%
2016	263 171	165 969	106,1	105,3	63,1%
2017	297 017	189 489	112,9	114,2	63,8%
2018	329 943	211 984	111,3	112,6	64,2%
2019	356 286	234 509	111,3	111,5	65,8%
2020	391 194	245 265	109,8	104,6	62,7%
2021	425 915	261 633	108,9	106,7	61,4%
2022	499 980	314 513	117,4	120,2	62,9%
2023	571 182	367 194	114,2	116,8	64,3%

Source: KSH (2024)

In the national economy, gross average earnings nearly tripled between 2009 and 2023, rising from 200,000 HUF to 571,000 HUF, while in the accommodation and food service sector, they almost tripled as well, from 123,000 HUF to 367,000 HUF (Table 2). From 2017 onwards, the annual growth of the national gross average wage (297,017 HUF in 2017) slightly exceeded 10%, while in the accommodation

and food service sector, there was a 14% increase in 2017. However, wage growth in the sector stagnated somewhat in the following years, only surpassing 20% in 2022, with nearly 17% growth recorded in 2023, resulting in a gross monthly wage of 367,000 HUF for employees in the sector. Despite this substantial increase, the gross monthly average earnings of employees in accommodation and food services remain among the lowest, amounting to only 64.3% of the national average, still falling short of the pre-crisis 2019 level (65.8%).

Table 3: Key Indicators of the Accommodation and Food Service Sector

Years	Tourism balance (billion HUF)	Change in the number of beds in commercial accommodation facilities compared to the previous year = 100.0%	Change in the number of guest nights in commercial accommodation facilities compared to the previous year = 100.0%
2007	430	99,8	102,4
2008	506	96,2	99,2
2009	612	99,7	93,7
2010	652	103,2	104,5
2011	666	109,3	105,4
2012	692	98,8	105,8
2013	750	108,7	105,3
2014	880	101,3	106,4
2015	975	100,8	106,0
2016	982	102,0	106,7
2017	1 016	92,3	107,7
2018	1 179	100,4	104,2
2019	1 340	99,1	101,7
2020	650	77,9	43,4
2021	834	102,8	118,3
2022	1 228	103,8	153,6
2023	1 552	100,9	101,5

Source: KSH (2024)

The data in Table 4 and Figure 1 show the trends in the number of guest nights spent by domestic and foreign visitors. Both groups experienced a decline by 2009, with a larger drop observed among foreign guest nights (7.9%). In 2020, there was a significant decrease in both domestic (37.2%) and foreign (76%) guest nights, primarily due to travel and hospitality restrictions, most notably the closure of borders (Palkovics, 2022). In 2021, a recovery began, with the number of domestic guest nights increasing by 12.2% and foreign guest nights rising by 34.4%. In 2022, both segments showed significant growth, with domestic guest nights nearly reaching the 2019 level.

In 2023, while the number of domestic guest nights decreased by 5.4%, the number of foreign guest nights increased by 10.2%, although the latter still did not reach the 2019 figures. The decline in domestic guest nights can primarily be attributed to a decrease in household consumption, explained by high inflation and rising food prices and accommodation costs.

Table 4: Number of Domestic and Foreign Guest Nights in Commercial Accommodation Facilities

Years	Number of domestic guest nights	Number of foreign guest nights	Domestic change compared to previous year	Foreign change compared to previous year	Total	Total change compared to previous year
2007	9 957	10 171			20 128	
2008	9 964	10 010	0,1%	-1,6%	19 974	-0,8%
2009	9 490	9 220	-4,8%	-7,9%	18 710	-6,3%
2010	9 940	9 614	4,7%	4,3%	19 554	4,5%
2011	10 205	10 411	2,7%	8,3%	20 616	5,4%
2012	10 413	11 392	2,0%	9,4%	21 805	5,8%
2013	10 985	11 983	5,5%	5,2%	22 968	5,3%
2014	12 082	12 351	10,0%	3,1%	24 434	6,4%
2015	12 925	12 962	7,0%	4,9%	25 888	6,0%
2016	13 827	13 802	7,0%	6,5%	27 629	6,7%
2017	14 827	14 942	7,2%	8,3%	29 769	7,7%
2018	15 671	15 340	5,7%	2,7%	31 011	4,2%
2019	15 785	15 753	0,7%	2,7%	31 538	1,7%
2020	9 916	3 774	-37,2%	-76,0%	13 690	-56,6%
2021	11 122	5 071	12,2%	34,4%	16 193	18,3%
2022	15 590	12364	40,2%	143,8%	27 954	72,6%
2023	14 744	13629	-5,4%	10,2%	28 373	1,5%

Source: KSH (2024)

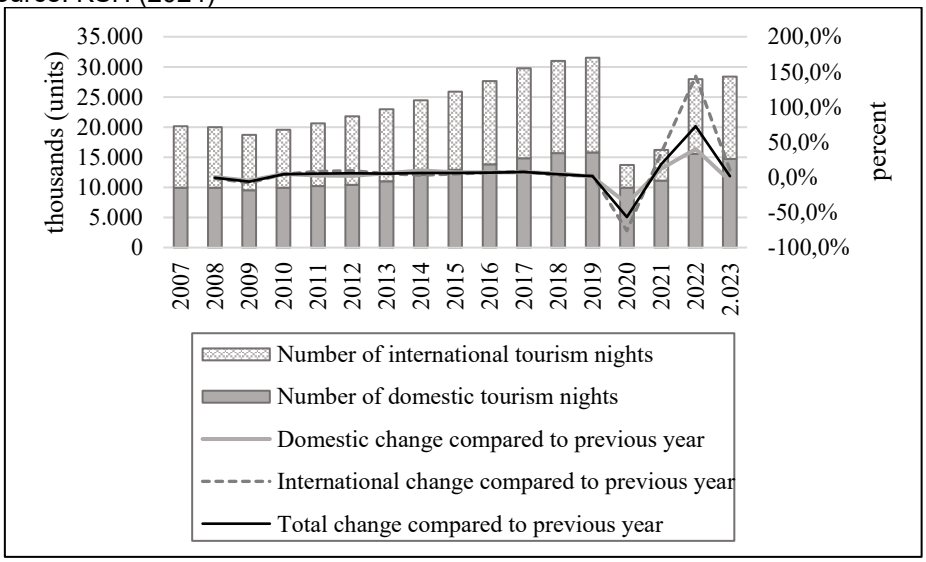


Figure 1: Number and Change of Domestic and Foreign Guest Nights in Commercial Accommodation
Source: KSH (2024)

According to data from the Hungarian Central Statistical Office (KSH), in 2009 the number of domestic guest nights fell to 95% and that of foreign guest nights to 92% compared to the previous year. In the following years, growth resumed, fluctuating

between 2% and 11%. In 2020, however, a dramatic decline occurred: the number of domestic guest nights dropped to 59.5%, and foreign guest nights plummeted to 22.2% of the previous year's figures (KSH, 2024), exceeding the rate of overall decline in total guest nights. Resilience to crises is enhanced by a proper balance between international and domestic tourism, as well as a diversified tourism offering, such as health tourism, natural attractions, and historic cities (Gyurko et al., 2024).
Accommodation revenues fell by 2-3% in 2009-2010, with little difference between domestic and foreign guests (see Figure 2). By 2019, revenues from both segments showed continuous growth. The amount paid by domestic guests nearly doubled (2.4 times higher), while revenue from foreign guests increased by almost 2.7 times during the period between the two crises. In 2020, domestic accommodation revenues dropped to 65.8%, while foreign revenues were severely hit by border closures, falling drastically to 21.6% compared to the previous year. In both 2022 and 2023, commercial accommodations realized significantly higher revenues in both segments, well above the 2009 levels.
The average gross accommodation fee per guest night paid by domestic guests increased from HUF 5,445 in 2009 to HUF 7,855 in 2019, while the corresponding figure for foreign guests rose from HUF 8,400 to HUF 13,250. This indicates that foreign tourists tend to choose more expensive accommodations offering higher-quality services. In 2020, the average accommodation fee per night for domestic guests did not decrease – in fact, it increased by 9.1%, while the fee paid by foreign guests fell by nearly 10%. In 2022 and 2023, however, both segments recorded a significant increase in average accommodation prices.

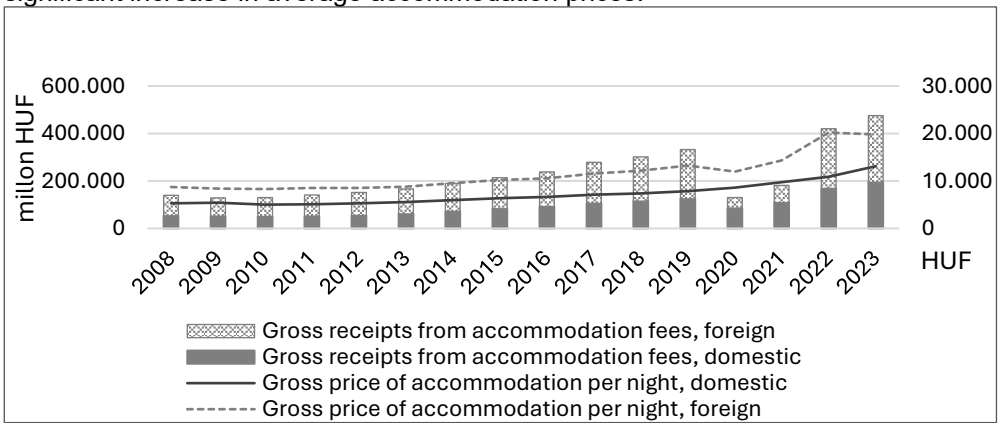


Figure 2: Accommodation Revenue and Gross Average Price per Guest Night in Commercial Accommodations – Domestic and Foreign
Source: KSH (2024)

The continuous increase in accommodation revenues was influenced not only by the rise in guest nights and the number of visitors but also by the ongoing weakening of the Hungarian forint. Accommodation prices significantly increased as early as 2022; when viewed in euros, the price hike was around 15%, indicating that accommodations became more expensive even alongside the forint's depreciation. However, payments made in forints provide a competitive advantage for accommodation providers, especially in Budapest, as Western guests are inclined to spend in non-eurozone countries primarily due to lower consumer prices.

During the period of the energy crisis and ongoing war, Western tourists have become more cautious, carefully considering where to spend their holidays. Prices continued to rise in 2023, with KSH data indicating an increase between 17% and 20%. Not only energy but also food prices have significantly increased, leading to substantial cost escalations for accommodations. The sector continues to face serious challenges due to labor shortages, further wage increases, and rising raw material costs, all contributing to additional price hikes. These costs are largely passed on to consumers, as companies can no longer absorb them.

3. The Issue of Sustainability in the Tourism Sector

The above analysis reveals that following the COVID crisis, employment increased, unemployment decreased, and the number of guest nights and both domestic and foreign visitors rose sharply. According to the latest statistical data, records were broken in Hungary in 2023 and 2024. But how long can this be sustained? Achieving sustainable tourism has become a priority for all stakeholders in Europe and Hungary. This requires ensuring an appropriate economic environment, social sustainability, and environmental sustainability.

After the pandemic – and even before – European tourism faced a new challenge: so-called "overtourism," its consequences, and the need for management and restrictions. While tourism boosts GDP, local residents – especially in large cities – are less enthusiastic about the influx of tourists, not to mention that increased demand drives up consumer and real estate prices. Árva and colleagues (2020) concluded that while tourism is one of the most dynamically developing sectors of the national economy, it has also become one of the largest polluters and least sustainable, making further tourism development nearly impossible in several destinations. In this situation, instead of previous solutions, new approaches must increasingly be integrated into marketing tools. Hungary has opportunities in this area, such as health, medical, and business tourism (Kinczel et al., 2023; Csobán et al., 2022; Novoselova et al, 2023). In his study, Gyurko highlights the importance of sustainable tourism development, the quality of infrastructure, and the role of integrating ESG factors (environmental, social, and governance considerations) in ensuring long-term competitiveness (Gyurko, 2025).

Sustainability will continue to be a defining trend in tourism. Tourists are increasingly seeking destinations and accommodations that employ environmentally friendly solutions. In Hungary, demand for nature-based tourism –such as national parks, ecotourism sites, and sustainable accommodations – is expected to grow.

According to Gabor et al., however, travellers consider factors such as air transport infrastructure, cultural resources, and price competitiveness to be just as important as environmental sustainability when making their decisions (Gabor et al., 2021).

4. Summary

Globally and within Hungary, tourism has been one of the most dynamically growing sectors in the last decades of the 20th century and the first two decades of the 21st century, becoming a social phenomenon affecting an increasingly broad segment of the population. However, crises have not spared this sector either.

Both crises led to downturns in the sector, but the consequences of measures aimed at curbing the pandemic – which also restricted free movement – were much more significant than those of the global economic crisis. Additionally, the two crisis periods affected domestic and foreign tourist travel differently.

The 2020 crisis impacted foreign tourist traffic almost immediately and to a much greater extent. From a regional perspective, while the global economic crisis did not

have a significant loser in tourism, Budapest suffered the most during the COVID-induced crisis, experiencing a drastic decline in foreign tourists. Nationwide, guest traffic, the number of guest nights, and accommodation revenues also significantly decreased. However, by 2023, the sector had already achieved significant results, reaching or surpassing 2019 levels in several areas, despite the substantially changed economic environment – primarily due to average inflation rates of 15-20% and rising energy prices, with food prices increasing by 30-50%.

During the 2008 crisis, the state did not intervene in the sector, but during the COVID crisis, entrepreneurs received benefits such as wage subsidies and reduced local tax obligations. Nevertheless, the sector suffered significant losses after 2020, with substantial labor migration to other sectors, and many small businesses ceased operations due to skyrocketing energy prices, most of which have not resumed activities since. While many smaller accommodations closed, several new, higher-standard, trend-setting accommodations opened across the country, which in itself is a price-increasing factor. Additionally, the reduced supply – or decreased competition – contributed to price increases. The restart occurred as early as 2021 in the accommodation and hospitality sector, and in 2022-2023, several areas significantly exceeded pre-2019 levels.

However, statistical data reveal a kind of duality behind the positive trend: while the number of foreign guests and guest nights is increasing, domestic demand is stagnating or shifting. According to statistics, Hungarians are traveling more, but an increasing number are choosing to travel abroad.

At the same time, the question arises: to what extent does the rapid growth following major crises serve sustainable, less polluting, environmentally and socially friendly tourism? Stakeholder interest conflict, and in the long term, resolving this must become a priority for decision-makers.

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ENTREPRENEURIAL MINDSET DEVELOPMENT IN POST-COMMUNIST ROMANIA: FAMILY ROLE AND EARLY MARKET PARTICIPATION

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Abstract: *Many researchers have shown that the family is the most important factor in the development of the entrepreneurial mindset. Children who grow up with entrepreneurial parents are much more likely to become entrepreneurs themselves. However, most of this research was done in Western countries where private business was never interrupted. This paper looks at what happens when entrepreneurial family tradition was destroyed, as it was in Romania during about forty years of communist rule. During that period, private business was forbidden, parents could not pass on entrepreneurial values to their children. This study is based on thirteen semi-structured interviews with Romanian entrepreneurs who were born between 1988 and 2001, meaning they grew up after communism ended but their parents lived most of their lives under it. The data were analysed using reflexive thematic analysis. The study found two main ways in which entrepreneurial mindset developed without the support of an entrepreneurial family. The first way, which was the most common, is that participants did not want to live the same kind of life as their parents. Their parents were capable people who were prevented by the communist system from becoming entrepreneurs, and many of them ended up with regrets. Seeing this, the participants decided they would not repeat the same trajectory. The second way involves early experience with real money and real markets, such as selling products at agricultural markets, renting objects to neighbours, or earning money independently as teenagers. These experiences gave participants the practical understanding of business that family entrepreneurial tradition would normally provide. The findings show that the post-communist rupture of intergenerational transmission produced a generation that developed entrepreneurial dispositions through alternative pathways.*

Keywords: *entrepreneurial mindset; intergenerational transmission; post-communist entrepreneurship; negative identification; early market participation*.

JEL Classification: *L26; M13; P20*

1. Introduction

Research has shown that family plays a very important role in the development of the entrepreneurial mindset. When parents are entrepreneurs, their children are more likely to become entrepreneurs too. Parents pass on values, knowledge, and ways of thinking that help children see business as something possible and desirable (Lindquist et al., 2015; Laspita et al., 2012). However, almost all this research was

done in Western countries where families were always free to be involved in private business. What happens when this normal family channel was broken for a long period of time?

Romania is a very relevant example of this situation. For about forty years under communist rule, private business was not allowed and people could not freely develop economic initiatives (Smallbone and Welter, 2001). The ways in which entrepreneurial knowledge and values are normally passed from parents to children through family businesses, role models, and everyday economic experience were all stopped. After communism ended in 1989 and Romania joined the European Union in 2007, entrepreneurship became possible again. But the entrepreneurial mindset, understood as a set of values and ways of thinking about business, was mostly missing from families where the parents had grown up under communism (Peng, 2003; Welter, 2011). So, the first generation that grew up completely after communism, those born in the late 1980s and 1990s, had to develop an entrepreneurial mindset without the family support that research normally describes.

Existing research has not really looked at this problem. Studies about how family influences entrepreneurship almost always assume that the influence works in a *positive* direction: entrepreneurial parents create entrepreneurial children (Lindquist et al., 2015; Laspita et al., 2012). This leaves two important mechanisms unexplained. First, what happens when parents were not entrepreneurs, not because they chose not to be, but because the political system did not allow it? In this case, children may develop entrepreneurial motivation in a different way: not by following their parents, but by deciding they do not want to repeat their parents frustrated, limited lives. Second, what other ways might people develop the practical economic knowledge that usually comes from family entrepreneurial experience? One important answer, found in this study, is early participation in real economic activities such as selling goods, managing money, or working independently at a young age.

This paper addresses this gap through a qualitative study of thirteen Romanian entrepreneurs from the first post-communist generation, born between 1988 and 2001. Semi-structured interviews were conducted and analysed using reflexive thematic analysis (Braun and Clarke, 2006). The study identifies two main patterns. In most cases, motivation to become an entrepreneur came not from having entrepreneurial parents, but from seeing the limited, employee-bound lives of parents who were prevented by communism from becoming entrepreneurs and deciding not to repeat that path. In a smaller number of cases, participants developed practical business knowledge through early real-money market activities selling goods, working independently, managing money as children or teenagers which gave them the economic understanding that family entrepreneurial tradition would normally provide.

The present research makes two contributions. First, it shows that the factors that lead to entrepreneurial mindset development are not the same everywhere; they depend on the historical and institutional context of the place where people grow up. Second, it provides a qualitative study of how entrepreneurial mindsets developed among the post-communist generation in Romania, a context that has received little attention in international entrepreneurship research.

2. Theoretical Background

2.1. The Entrepreneurial Mindset

The entrepreneurial mindset is generally understood as a set of ways of thinking and acting that help people identify and pursue business opportunities, manage uncertainty, and keep trying even when things are difficult (Daspit et al., 2021). Davis et al. (2016) define it as *"the constellation of motives, skills, and thought processes that distinguish entrepreneurs from non-entrepreneurs"*. An important contribution to understanding the mindset comes from Carol Dweck's work. Dweck and Yeager (2019) distinguish between a fixed mindset (the belief that abilities cannot be changed) and a growth mindset (the belief that abilities can be developed through effort and experience). They argue that which mindset a person develops depends mostly on their environment and experiences while growing up. This idea is central to the present study: if the mindset is shaped by the environment, then differences in environmental context, including historical and institutional differences, should produce different patterns of mindset development.

Three main groups of factors have been identified as antecedents of the entrepreneurial mindset: genetic and biological factors, family socialisation, and acquired skills through education and experience. For the purposes of this paper, the most relevant finding from the genetics literature is that of Lindquist et al. (2015), who studied both biological and adopted children in Sweden. They found that the environment after birth is twice as important as genetic factors in explaining who becomes an entrepreneur. This means that if the environment is disrupted, as it was in communist Romania, the effects on mindset development should be significant.

2.2. Family Socialisation and the Problem of Positive Transmission

The family is generally considered to be the most important socialisation environment for entrepreneurial values and behaviours (Cardella, Hernández-Sánchez et al., 2020). Research shows that having entrepreneurial parents increases the probability of becoming an entrepreneur by 60 per cent (Lindquist et al., 2015). Laspita et al. (2012) found that parental entrepreneurship is positively associated with children's entrepreneurial intentions and suggested that this intergenerational transmission may occur through family socialization, exposure to self-employment, and the transmission of values and business knowledge. Maziriri et al. (2022), in a qualitative study with South African entrepreneurial couples, found that entrepreneurial parents actively encourage their children's entrepreneurial development through specific activities and everyday exposure to business thinking. However, all this research assumes that the family influence works through *positive* transmission: entrepreneurial parents teaching and inspiring their children. The literature does not really examine what happens when parents are not entrepreneurs for reasons that are not their own choice but are imposed by the political system. Shepherd and Haynie (2009) showed that identity conflicts within families can accelerate entrepreneurial processes. Bandura (2012) explains in his social cognitive theory that people learn not only from positive models (people they want to imitate) but also from negative models (situations or people they want to avoid). In Romania, where the communist system prevented the parent generation from developing entrepreneurial lives, many children grew up watching their parents live constrained, unfulfilling working lives. The present study argues that this created a strong motivation to become something different – what the authors call *negative*

parental identification, which is defined as the process by which individuals develop entrepreneurial motivation through the conscious rejection of a non-entrepreneurial parental trajectory (Lindquist et al., 2015), using the parent's constrained or unfulfilled working life as a negative reference point rather than a positive model (Bandura, 2012; Shepherd and Haynie, 2009)

2.3. Early Economic Experience

A second pathway that has received less attention is early participation in real economic activities. Financial socialisation research shows that direct economic participation in childhood has lasting effects on adult behaviour (Webley and Nyhus, 2006). Rae (2006) applied this to entrepreneurship: competence develops mainly through real practice, not theory. Cope (2005) found that the most important entrepreneurial learning comes from events with real practical consequences. Gibb (2002) made this point most clearly: entrepreneurial learning requires real immersion in economic life, not simulation. A child who sells vegetables at a market and handles real money is having a completely different experience from one who plays Monopoly or uses a toy cash register. Thus, early real-money market participation is understood as direct involvement in real economic transactions — earning, selling, managing money, or negotiating in actual market contexts — occurring before the age of 18 (Webley and Nyhus, 2006; Cope, 2005), independently of formal education (Gibb, 2002) and without requiring an entrepreneurial family background.

2.4. Context: Post-Communist Romania

Welter (2011) argues that context is not just a background condition for entrepreneurship research, it is part of what makes entrepreneurship what it is. The historical, institutional, and social environment shapes not only what opportunities entrepreneurs see, but also how they understand themselves as entrepreneurs. Smallbone and Welter (2001) suggest that communist institutional and social legacies weakened the social conditions under which entrepreneurial values and practices could be reproduced, while making informal networks especially important in transition economies. Peng (2003) argued that major institutional changes, like the transition from communism to a market economy, change the way people think about what is possible in economic life.

Romania is a particularly useful case for studying these questions because the communist period ended at a specific known point (1989), which makes it possible to clearly distinguish between the generation that grew up under communism (the parents in this study) and the generation that grew up after it (the participants in this study). According to national experts, entrepreneurship education at primary and secondary school level in Romania is below average compared to other EU countries, and the main problems are that young people have little exposure to entrepreneurship and very few role models (Ille, 2021). This means that the first post-communist generation in Romania faced two problems at the same time: their families could not pass on entrepreneurial values because of communism, and the school system did not provide strong entrepreneurship education either.

3. Methodology

The study focused on entrepreneurs currently active in Iași, Romania. Three criteria were used to select participants: they had to identify themselves as entrepreneurs

with at least three years of business experience; they had to be Romanian citizens; and they had to be between 18 and 35 years old. The age criterion was chosen for theoretical reasons. People born between 1988 and 2001 are the first generation to have grown up entirely in a post-communist Romania, while their parents grew up under communism. This makes them an ideal group for studying how entrepreneurial mindset develops in the absence of family entrepreneurial tradition. A total of thirteen participants were selected through purposive sampling (Saunders et al., 2016). The participants came from different sectors, including automotive services, IT, property management, garment production, trade, and photography.

The analytical method used is reflexive thematic analysis, which is well suited for identifying patterns across a set of interviews (Smith et al., 2009).

Data were collected through semi-structured individual interviews. The interview guide covered the following topics: what motivated participants to become entrepreneurs; how they define the entrepreneurial mindset; what role they think genetics plays; how their family upbringing influenced them; and what role education, work experience, and role models played. Interviews were done in Romanian or English, depending on what the participant preferred. The data were analysed using reflexive thematic analysis (Braun and Clarke, 2006, 2019).

Table 1: Sample characteristics

Characteristic	Detail
Number of participants	13
Age range	22–35 years
Birth cohort	1988–2001
Gender	10 male, 3 female
Location	Iași, Romania
Business experience	Minimum 3 years
Sectors	Automotive, IT, property management, garment manufacturing, trade, photography, other
Sampling method	Purposive
Data collection	Semi-structured interviews (Romanian and English)

Source: authors' own research

4. Findings

The analysis produced two main themes. Each theme represents a different way in which participants developed an entrepreneurial mindset without the support of family entrepreneurial tradition. Theme 1, negative parental identification, was the most common pattern, appearing in eight of the thirteen participants. Theme 2, early real-money market participation, was the main developmental mechanism for five participants. In several cases, both themes were present at the same time.

4.1. Theme 1: Negative Parental Identification

The most consistent pattern in the data was that participants did not become entrepreneurs because of positive examples in their families, but because they wanted to live differently from their parents. In most cases, the parent generation was seen as capable and intelligent but limited. Their parents had not been able to develop entrepreneurial careers because the political system did not allow it. Many of these parents were now living with regret. Participants described their own decision to become entrepreneurs as a direct response to seeing this situation. This is what the authors call *negative parental identification*: becoming an entrepreneur not by following a role model, but by refusing to repeat a trajectory.

P1, aged 28, who runs an automotive service business, gave one of the clearest descriptions of this mechanism. His parents, a doctor and a former rally driver, were not entrepreneurs:

“My parents were not entrepreneurs. Even though I saw in them some entrepreneurial capabilities, they were limited by the fear of taking certain risks. Previous generations, in general, are inclined towards stability, seeking security in life and being satisfied with being employees. I saw them as capable, but also quite scared of failure and with certain regrets, now in their old age. My motivation came from the fact that I set out to take certain risks rather than have regrets.”

When asked what had prevented his parents from being entrepreneurs, P1 gave a direct answer:

“Certainly, living in the communist era where being an entrepreneur was not possible played a significant role. In the best-case scenario, you could be a section manager in a factory, but we cannot really consider that entrepreneurship. In general, free thinking and individual initiative were quite limited.”

This account shows how the mechanism works. The parent’s non-entrepreneurship is not explained as a personal weakness, but as something imposed by the political context. And the child’s entrepreneurship is presented as completing something the parent could not do. It is also interesting that P1 chose Horatio Pagani as his role model – a man who was an employee at Lamborghini, was prevented from developing his ideas there, and then created his own company. This is the same story P1 tells about himself and his father.

P6, aged 35, who runs an IT business and whose parents were a doctor and a teacher, described the same situation in simpler terms:

“Growing up in a family where my parents were a doctor and a teacher, I did not have a direct entrepreneurial influence. I wanted to have control over my work and be able to make a direct impact through my own business. While they were not entrepreneurs themselves, their support and guidance helped me develop a strong work ethic.”

P7, who had no entrepreneurs in his family at all, described how the family environment can transmit limiting beliefs that work against entrepreneurial thinking:

“I am quite certain that family, especially education, can influence both positively and negatively towards the entrepreneurial mindset. I can firmly mention a phrase that many of us probably heard when we were young: "Be content with what you have" – which can have a negative influence and act as scissors that cut off a thought or its inception.”

P7 also explained that he attributed his entrepreneurial drive to his own nature, since he had no entrepreneurial family model to point to. This is a significant pattern: when

there is no positive family example available, participants often explain their entrepreneurial motivation as something that came from inside themselves. Bandura's (2012) social cognitive theory helps explain this: both positive and negative examples shape behaviour, and in the absence of positive ones, the negative examples, such as the regret and limitation of a parent's employee life, can be equally powerful.

P8, aged 29, whose parents were both teachers, described very clearly how his family failed to prepare him for entrepreneurship:

"Coming from a family with weak financial education, I could say that education was at the level of a financial counter-example. Although my family was excellent intellectually, they prepared me well in terms of personal growth but not for entrepreneurship. They gave me the capacity to learn and acquire knowledge, but they did not make me an entrepreneur."

P8 also described how his family and social environment had passed on limiting beliefs about money, such as "Money does not bring happiness" and "Money does not grow on trees". He had to actively work against these beliefs through years of self-directed study before he could develop an entrepreneurial mindset. This shows that negative parental identification can work at the level of beliefs and values, not only at the level of biographical choices.

P4, aged 28, who runs a property management company, described his motivation in terms of escaping the limitations of employment:

"I did not like having to report to someone or have a boss checking my every move. Ever since I became aware of the concept of money, I always wanted to reach a point where it would not be solely dependent on whether we had money or not."

P12, aged 32, gave the most developed version of this idea, describing employment itself as the opposite of what he wanted to be:

"The lack of the entrepreneurial approach leads to the typical problems of a fixed salary grid, selling time for money, often for less than the value of one's work, with limited freedom and creativity. There is no such thing as an ideal job or career. You create your ideal activity, and the entrepreneurial approach is the only context in which you can do that."

In summary, these accounts all describe the same basic mechanism. When the parent generation was prevented from entrepreneurship by the communist system, and when their children could see the costs of this regret, dependence, limited freedom, unfulfilled potential, this created a strong motivation to choose a different path. The drive to become an entrepreneur came not from admiration for an entrepreneurial parent, but from the decision not to become what the parent had become.

4.2. Theme 2: Early Real-Money Market Participation

In five cases, participants described early direct experience with real economic transactions as an important developmental mechanism. These experiences happened when participants were between 7 and 16 years old. They were very different from formal education or from the games and toys that parents sometimes use to teach children about money. They involved real money, real markets, and real consequences, which created the kind of experiential learning that Rae (2006) and Cope (2005) identify as the most effective way to develop entrepreneurial competence.

The clearest example is P10, who learned about business by going with his grandmother to the local agricultural market:
“Working in the garden, having the patience to wait for a seed to bear fruit, monetizing that produce at the agricultural market, and spending that money were the first and most important activities in developing my entrepreneurial skills. Overcoming the inner resistance of the ego to sell the products displayed on your stall in the market is also crucial.”
P10 explicitly connected this early experience to his entrepreneurial mindset. He described learning communication skills, how to approach customers, and how to solve problems through these real market interactions. His grandmother was not an entrepreneur; the market itself was the learning environment.
P7 provided a remarkable example of spontaneous entrepreneurial behaviour at the age of 7 or 8:
“My mother managed to buy me a second-hand bicycle. After a week of riding it every day, I got bored and seeing the desire and request of other kids who did not have a bicycle, I rented it to them for 1 leu per block tour.”
This episode is interesting for several reasons. P7 was not taught to do this by anyone. He identified a demand, created a service, set a price, and managed a small business spontaneously. He came from a family with no entrepreneurial tradition. And when he recalled this story as an adult, he connected it to his later entrepreneurial development. The logic of seeing an opportunity and acting on it was already present in him as a young child, developed not through family teaching but through direct contact with the economic reality around him.
P4 started earning money at the age of 16 by working as a photographer at events. He described clearly what this experience taught him:
“I think it helped me a lot that I started earning my own money at a young age. With their support, I reinvested everything I earned into equipment and gear. Around the age of 17, I bought my first professional-grade camera, which cost around 10,000 lei. These experiences taught me to organise my finances, understand the importance of reinvestments, and also that "to make money, you have to spend/invest money". To progress, you need to have financial organisation, and that is a practical, tangible thing.”
P4 learned about capital allocation, the importance of reinvesting, and financial organisation through real economic activity, not through a classroom. His parents were not entrepreneurs, but by guiding him to reinvest his earnings rather than spend them on consumption, they helped him develop a genuinely entrepreneurial relationship with money.
P11, aged 34, described how his childhood participation in agricultural and household economic activities shaped his entrepreneurial development:
“My own evolution as an entrepreneur has been a continuous and systematic process, starting from childhood when I was involved in agricultural activities, household chores, and engaging in buying and selling the necessary items for my parents’ household.”
P13 described a similar experience: "One of them I had since I was little was looking to do something that was needed for money like gathering fruits to sell them to my neighbours." And P5 described how even everyday negotiations within the family helped him develop a commercial way of thinking: "The negotiations of the times to enter the house, the negotiations of the pocket money, that ‘Product’ that I always had to show and that I wanted my parents, my clients from those times, to ‘buy’ it."

What connects all these cases is the presence of *real economic stakes*: real money, real decisions, and real consequences. This is fundamentally different from the simulated economic activities – board games, toy cash registers, piggy banks – that the family socialisation literature describes as tools used by entrepreneurial parents to develop their children's mindsets (Maziriri et al., 2022). As Gibb (2002) argues, real entrepreneurial learning comes from real immersion in economic life, not from simulating it.

4.3. The Relationship Between the Two Pathways

The two pathways are not separate and often appear together. P7, P10, and P4 all show signs of both: they came from non-entrepreneurial families (Theme 1) and they also had early experiences with real money and markets (Theme 2). This suggests a coherent logic: when positive family transmission is absent because of communism, some people develop entrepreneurial motivation through negative identification with the parental trajectory, and at the same time they develop practical economic competence through early market participation.

P8 shows what happens when neither pathway is available in childhood: he had no entrepreneurial parents, no early market experience, and he inherited limiting beliefs about money from his family and community. He only developed an entrepreneurial mindset much later in life, through years of intensive self-directed reading and study. He described this process as rebuilding his entire relationship with money and economic thinking from the beginning. This negative case supports the general argument: when both substitute pathways are absent, the development of an entrepreneurial mindset takes longer and requires much more personal effort.

As a contrast, the three participants who did have entrepreneurial parents (P2, P9, P13) all described positive family transmission. P9 said his father was his biggest inspiration, and P13 said he grew up "seeing the advantages of being your own boss" through direct observation. These cases confirm that when the family channel is intact, positive transmission works as the literature describes. The substitute pathways described in this paper appear specifically when the family channel is not available.

5. Discussion

The findings of this study contribute to the entrepreneurial mindset literature in two ways. First, they show that the model of family socialisation described in most existing research, where entrepreneurial parents pass on values, knowledge, and motivation to their children, works well only in specific contexts. In stable Western market economies, this positive transmission model describes well how entrepreneurial mindsets develop. But in Romania, where communism broke the chain of intergenerational transmission, most participants did not have entrepreneurial parents, and so this model does not apply. Instead, participants developed entrepreneurial motivation through a different mechanism: seeing the costs of the employee-bound lives of their parents and deciding to choose a different path. The parent generation's visible regret, limited freedom, and unfulfilled potential became a motivation for the next generation rather than a neutral background.

This finding extends Shepherd and Haynie (2009), who showed that identity conflicts in family contexts can drive entrepreneurial choices. The present study identifies a prior mechanism: entrepreneurial aspiration built not against an inherited business

role, but against the image of a limited, employee-bound life the participant is determined to avoid. Bandura's (2012) social cognitive theory is consistent with this finding, since it recognises that negative models can be just as influential as positive ones. However, this mechanism has not been studied in transition economies, where negative models are produced by political history rather than individual family circumstances.

Second, the findings document early real-money market participation as a distinct mechanism for entrepreneurial mindset development. This is different from what the literature usually describes. Existing research on family socialisation focuses on deliberate activities by entrepreneurial parents – games, competitions, exposure to business conversations (Maziriri et al., 2022). What this study found is a third category: direct participation in real markets, often without any formal design or entrepreneurial family background, that produces genuine economic learning. In Romania, the agricultural market and the informal economy provided access to this kind of real economic experience precisely for young people whose families could not offer entrepreneurial role models or business knowledge.

These findings support Welter's (2011) contextualisation argument: what drives entrepreneurial mindset development depends on the institutional history of the place. Romania is not unique; other post-communist countries in Central and Eastern Europe such as Poland, Hungary, the Czech Republic, the Baltic states have experienced similar interruptions of entrepreneurial tradition. The pathways identified here may be relevant in those contexts too.

For entrepreneurship education policy, the findings have a practical message. Many entrepreneurship education programmes that are used in Eastern Europe were designed for Western contexts where students typically have more family exposure to business, more positive entrepreneurial role models, and more formal economic knowledge. If the actual developmental backgrounds of students in Romania and similar countries look more like what this study describes, motivation driven by wanting to avoid an employee trajectory, and early practical economic experience as the main source of business knowledge, then programmes should be designed to match these realities. This might mean using biographical reflection about family trajectories as a motivational tool, building on students' existing market experience, and prioritising real market immersion over classroom instruction.

6. Conclusions

This paper argued that communism's interruption of entrepreneurial family tradition in Romania did not prevent the development of entrepreneurial mindsets. Based on thirteen interviews with the first post-communist generation of Romanian entrepreneurs, the study identified two substitute pathways: negative parental identification, where motivation comes from refusing to repeat the limited lives of parents who could not be entrepreneurs under communism; and early real-money market participation, where children develop practical business understanding through real economic activities outside any family entrepreneurial tradition.

The study makes two contributions. Theoretically, it shows that the antecedents of the entrepreneurial mindset depend on historical and institutional context, and that when the normal family transmission pathway is broken, people develop systematic alternative pathways that existing theory has not explained. Empirically, it provides a qualitative study of how entrepreneurial mindsets developed in the Romanian post-

communist generation, based on detailed interview data that allows the mechanisms to be traced through individual life histories.

The findings of this study are exploratory in nature. With thirteen participants from one city, the study does not claim to build or validate theory. Instead, it identifies two patterns that appear consistently in the data and that existing theory has not described. These patterns — negative parental identification and early real-money market participation — are offered as empirical observations that future research may develop further, test in other contexts, or use as a basis for more formal theoretical work. Researchers working in other post-communist countries are encouraged to examine whether similar patterns appear in their contexts, and under what conditions they may be stronger or weaker. Two further limitations relate to the composition of the sample. First, all participants are currently active entrepreneurs. People who had similar family backgrounds but did not become entrepreneurs, or who tried and failed, are not represented in the data. This means the study can describe pathways that led to entrepreneurship but cannot explain why some people with the same background chose a different path. Second, the study has no comparison group of non-entrepreneurs. Without this, it is not possible to say with certainty that the two pathways identified — negative parental identification and early market participation — are specifically linked to entrepreneurial outcomes, or whether they are simply common experiences among young people who grew up in post-communist Romania regardless of whether they became entrepreneurs. Future research using a comparative design, including both entrepreneurs and non-entrepreneurs from similar backgrounds, would help to clarify this

Future research should test whether the two pathways found in this study are also present in other post-communist countries. It would also be useful to study whether these pathways work differently for women, since research suggests that women's entrepreneurial development in transition economies follows different patterns. Longitudinal studies that follow people from childhood to adulthood would provide stronger evidence about how early economic experiences connect to later entrepreneurial mindset development. Studies comparing first-generation entrepreneurs (with no entrepreneurial parents) and second-generation entrepreneurs (who inherited family business tradition) would also help to clarify the specific role of each pathway.

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TOWARDS SUSTAINABLE DIGITAL ORGANISATIONS: INTRAPRENEURSHIP AS A STRATEGIC DRIVER OF INNOVATION AND RESILIENCE

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Abstract: *This paper examines the intrapreneurial perspective within sustainable digital organisations, with a particular focus on the role of human capital and employee behaviour in shaping organisational innovation processes. The objective of the study is to analyse how the involvement and openness of individuals across different hierarchical levels contribute to the development and innovation of digital organisations. Human capital can be regarded as a key driver of any organisation, encompassing the recruitment of competent personnel, the implementation of management policies and practices, and the broader professional development of individuals factors that collectively determine not only financial growth but also long-term organisational evolution.*
The study adopts a systematic literature review methodology, drawing on academic sources retrieved from Google Scholar and Scopus, covering publications from the past ten years (2015–2025), in order to capture evolving perspectives over time. Only peer-reviewed articles published in English were considered, using keywords such as "intrapreneurship", "digital transformation", "sustainable organisations", and "human capital". The paper's primary contribution lies in proposing a human capital-centred perspective that positions intrapreneurial behaviour as a strategic driver of innovation and resilience in sustainable digital organisations an angle that remains underexplored in the existing literature, which tends to focus predominantly on management systems rather than on employee-level dynamics. The findings suggest that intrapreneurship and employee initiative may contribute to the development strategies of digital organisations. Importantly, the paper highlights that senior management should pay greater attention to intrapreneurial behaviour and its strategic advantages, as in practice these aspects are frequently overlooked despite their significant organisational value.

Keywords: *intrapreneurship; human capital; sustainable digital organisations; digital transformation; organisational resilience; innovation*

JEL Classification: *M13; O31; Q01; L26*

1. Introduction

Digital transformation and the increasing need for sustainable development are the two main transformative forces defining the modern business environment. Organisations across all industries face growing pressure to innovate technologically

while simultaneously adopting sustainable and responsible practices (Verhoef et al., 2021).

Human capital continues to be the primary driver of organisational performance in this context. Ultimately, it is people their initiatives, skills, and entrepreneurial spirit who determine whether a business succeeds in navigating these dual challenges. As Leitão et al. (2020) argue, employees represent the central focus of any organisation seeking to build long-term competitive advantages through digitalisation and connectivity.

Intrapreneurship — broadly defined as the entrepreneurial behaviours and initiatives undertaken by employees within existing organisations has emerged as a critical mechanism connecting human capital, innovation, and sustainability. However, the existing literature tends to focus predominantly on management systems and leadership structures, affording comparatively little attention to the daily contributions and experiences of employees at various hierarchical levels. This represents a notable gap, given that it is precisely these individuals who constitute the engine of real organisational change.

The present paper addresses this gap by exploring the theoretical foundations of intrapreneurship and its strategic role within sustainable digital organisations. As opposed to prior literature that have primarily directed attention toward management structures and leadership frameworks, this paper shifts attention toward the employee level, suggesting that intrapreneurial behaviour at all hierarchical levels represents a practical and overlooked source of sustainable digital transformation. In terms of contribution, this study is essentially a conceptual integration, drawing on contributions from intrapreneurship, digital transformation, and sustainability literature. The mechanisms presented above are intended to establish an preliminary foundation for further empirical investigation rather than a rigorously confirmed theory. As opposed to much of the existing literature reviews on intrapreneurship and digital transformation, which have mainly focused on large-scale quantitative analyses or top-management perspectives, this paper provides a ground-level view grounded in real organisational practice. The limitations observed in real organisational settings particularly the gap between management priorities and employee-level intrapreneurial behaviour have influenced the direction of this study, differentiating it from more abstract theoretical contributions in the field. The paper is structured as follows: Section 2 presents the methodological approach; Section 3 examines the conceptual foundations of intrapreneurship; Section 4 explores the defining characteristics of sustainable digital organisations; Section 5 offers an exploratory conceptual integration of intrapreneurship as a strategic driver; Section 6 presents conclusions, limitations, and directions for future research.

2. Methodology

This study employs a systematic literature review as its primary methodological approach. The aim of this method is to identify, evaluate, and synthesise existing academic research relevant to the intersection of intrapreneurship, digital transformation, and organisational sustainability. Systematic literature reviews are widely recognised in management research as a rigorous and transparent means of mapping the conceptual landscape of an emerging field (Tranfield et al., 2003).

The literature search was conducted using two primary academic databases: Google Scholar and Scopus. These platforms were selected for their broad coverage of

peer-reviewed management, entrepreneurship, and sustainability journals. The search was restricted to publications from the past ten years (2015–2025), a timeframe chosen deliberately to capture the evolving nature of scholarly perspectives on digital transformation and sustainable development, while ensuring the currency and relevance of the sources reviewed.

The following keywords and keyword combinations were used in the search process: "intrapreneurship", "corporate entrepreneurship", "digital transformation", "sustainable organisations", "human capital", "organisational resilience", "ESG", and "innovation". Boolean operators (AND, OR) were applied to refine search results and ensure comprehensive coverage of the relevant literature.

Inclusion criteria required that articles be: (1) published in peer-reviewed academic journals or conference proceedings; (2) written in English; (3) directly relevant to at least two of the core themes of this study. Articles were excluded if they focused exclusively on entrepreneurship outside organisational boundaries, or if they addressed sustainability solely from an environmental engineering perspective without reference to organisational behaviour or management.

The selection process involved an initial screening of titles and abstracts, followed by a full-text review of the most relevant sources. Key works were further identified through backward citation tracking that is, by examining the reference lists of selected articles to identify foundational studies. This process yielded a final corpus of sources that form the theoretical basis of the present paper. The multiple database search through Google Scholar and Scopus generated over 13,000 results in total. Subsequently, 19 sources were found to be directly related to the core themes of the current study after the inclusion and exclusion criteria were applied methodically and augmented by title, abstract, and full-text screening. These sources are included in the reference list.

3. Intrapreneurship: Conceptual Foundations

The concept of intrapreneurship was formally introduced by Pinchot (1985), who described intrapreneurs as individuals within existing organisations who assume direct responsibility for transforming ideas into tangible outcomes through proactive initiative and risk-taking. Drucker (1986) further positioned the concept within the broader framework of entrepreneurial management, and it subsequently gained increasing scholarly prominence.

A significant theoretical contribution was made by Antoncic and Hisrich (2003), who defined intrapreneurship as emergent behavioural intentions and behaviours related to departures from the customary ways of doing business in existing organisations. Their multidimensional model identified eight key components, including self-renewal, risk-taking, innovativeness, and proactiveness — dimensions that together capture the full scope of intrapreneurial action at both individual and organisational levels.

It is worth noting that, despite increased scholarly interest, the field remains conceptually fragmented. The absence of a universally accepted definition has been highlighted by a number of authors, with some scholars preferring the term corporate entrepreneurship to describe similar organisational-level phenomena (Kuratko, 2017). Nonetheless, regardless of the terminology employed, there is broad agreement that intrapreneurship constitutes an essential source of organisational survival, competitive advantage, and strategic renewal (Neessen et al., 2019).

More recently, researchers have begun examining intrapreneurship in the context of digital transformation. Leitão et al. (2020) argue that motivated employees equipped with dynamic and digital competences play a central role in improving organisational performance and building long-term competitive advantages. Rather than viewing intrapreneurship solely as an innovation tool, this emerging perspective positions it as a strategic human capital capability essential for navigating the complexities of the modern digital economy.

4. Sustainable Digital Organisations

A sustainable digital organisation can be understood as a company that deliberately integrates digital transformation with environmental, social, and governance (ESG) principles as part of its core strategy. Since sustainability and digitalisation are closely interconnected, these organisations pursue both imperatives concurrently rather than treating them as separate agendas (Verhoef et al., 2021).

Digital transformation enables organisations to monitor their environmental impact, enhance stakeholder involvement, and improve governance structures through the application of technologies such as artificial intelligence, cloud computing, and data analytics (Xu et al., 2023). At the same time, a genuine commitment to sustainability provides organisations with a long-term strategic orientation that extends beyond short-term financial performance, encompassing broader social and environmental responsibilities. As George, Merrill, and Schillebeeckx (2021) argue, digital sustainability refers to the capacity of organisations to deploy digital innovations in ways that generate economic value while simultaneously addressing environmental and social challenges.

Research increasingly confirms that digital transformation has a significant positive impact on ESG performance. Liu and Wang (2025) suggest, based on an extensive analysis of firm-year observations, that digitalisation improves sustainability outcomes through both direct and indirect channels, with innovative capabilities serving as a key intermediary. The World Economic Forum (2023) similarly highlights that digital transformation and ESG represent mutually reinforcing strategic directions rather than competing organisational priorities.

Within this context, sustainable digital organisations are characterised by five key features: digital agility, ESG integration, innovation orientation, organisational resilience, and stakeholder centricity (Teece et al., 1997; Leitão et al., 2020). These characteristics reinforce one another, creating an organisational environment in which innovation and sustainability co-evolve. It is precisely within such environments that intrapreneurial behaviour is most likely to emerge and flourish (Ciasullo et al., 2025).

5. Intrapreneurship as a Strategic Driver: An Exploratory Conceptual Integration

The literature review carried out in Sections 3 and 4 identified three recurrent themes that appeared consistently throughout the examined sources: the role of employees in fostering innovation, the ability of organisations to adapt in the face of disruption, and the integration of sustainability as a strategic orientation. These themes informed the development of the three mechanisms proposed in the present section. Building on the conceptual foundations established in the preceding sections, this section offers an exploratory integration of intrapreneurship within the sustainable

digital organisational context. Rather than proposing a fully formalised theoretical framework, the aim is to identify and discuss three primary mechanisms through which intrapreneurial behaviour may contribute to sustainable digital transformation: the amplification of innovative capacity, the enhancement of organisational resilience, and the embedding of sustainability as a lived organisational orientation.

5.1. Amplifying Innovative Capacity

The most direct mechanism through which intrapreneurship contributes to sustainable digital organisations is the amplification of innovative capacity. In this context, innovation extends beyond the development of new products or services to encompass process improvements that reduce environmental impact, social innovations that enhance stakeholder value, and business model innovations that generate long-term competitive advantage.

Employees who indicate intrapreneurial behaviour, characterised by proactive initiative, willingness to take calculated risks, and the capacity to identify opportunities within organisational boundaries, serve as natural catalysts for innovation across these dimensions (Antoncic and Hisrich, 2003). The availability of digital tools further amplifies this function: collaborative platforms facilitate cross-functional knowledge exchange, data analytics provide actionable insights for opportunity identification, and digital prototyping tools accelerate iterative experimentation (Hua et al., 2024). The interaction between individual intrapreneurial agency and organisational digital capability thus creates a dynamic environment capable of sustaining a continuous flow of meaningful innovations.

5.2. Enhancing Organisational Resilience

The second mechanism concerns the contribution of intrapreneurial behaviour to organisational resilience — understood as the dynamic capacity to absorb disruption, reconfigure organisational routines, and adapt to environmental uncertainty (Teece et al., 1997). Sustainable digital organisations operate under conditions of rapid technological change, evolving regulatory requirements, and shifting stakeholder expectations. In such conditions, resilience depends not only on robust technological infrastructure but equally on the human capacity for adaptive and creative problem-solving.

Intrapreneurs contribute to organisational resilience through two complementary roles. As organisational sensors, their proactive information-seeking and boundary-spanning networks enable early detection of environmental signals before they escalate into critical disruptions. As adaptive agents, their tolerance for experimentation equips the organisation to respond creatively rather than reactively to change (Hornsby et al., 2023). The involvement of employees across different hierarchical levels in these processes is particularly significant, as it distributes adaptive capacity throughout the organisation rather than concentrating it exclusively at senior management level.

5.3. Embedding Sustainability as Organisational Orientation

The third mechanism concerns the role of intrapreneurial employees in embedding sustainability as a genuine and practised organisational orientation, rather than a compliance-driven exercise. Employees who suggest intrapreneurial initiative are well-positioned to identify sustainability-oriented opportunities and mobilise internal

resources in pursuit of them — often prior to such opportunities being recognised through formal strategic planning processes (Shabbir, 2023).

This mechanism is particularly significant in organisations where ESG orientation and digital culture are mutually reinforcing. Ciasullo et al. (2025) stated that organisations scoring highly on both dimensions exhibit significantly greater intrapreneurial behaviour and sustainable performance outcomes. This finding underscores a practical reality that is frequently overlooked: when senior management actively cultivates an environment that values both digital capability and sustainability commitment, intrapreneurial behaviour is more likely to emerge and be directed toward meaningful organisational goals.

6. Conclusions

This paper has examined the role of intrapreneurship as a strategic driver of innovation and resilience within sustainable digital organisations. Through a systematic review of academic literature published between 2015 and 2025, three primary mechanisms have been identified through which intrapreneurial behaviour contributes to sustainable digital value creation: the amplification of innovative capacity, the enhancement of organisational resilience, and the embedding of sustainability as an organisational orientation.

The central finding of this paper is that human capital and specifically the intrapreneurial behaviour of employees across different hierarchical levels may represent an important and frequently underutilised resource in the pursuit of sustainable digital transformation. While senior management attention has historically been directed toward structural and technological dimensions of transformation, the evidence reviewed suggests that employee-level initiative and intrapreneurial engagement may prove equally significant for organisational outcomes. Organisations that create enabling conditions including autonomy, psychological safety, access to digital resources, and ESG-aligned incentives are likely to achieve more meaningful and sustained progress toward their sustainability and innovation objectives (Rigtering et al., 2024). At a practical level, organisations aiming to develop intrapreneurial behaviour should consider targeted approaches that extend beyond formal procedures. For instance, managers could allocate time of regular team meetings — such as the final ten minutes of weekly sessions — to focused discussion points, encouraging employees to share what went well and what could be improved. Such practices redirect emphasis from purely operational targets to the behaviours and development of each individual. Similarly, team-building activities and open feedback cultures can create a safe environment necessary for employees to express creative suggestions freely and without hesitation

6.1. Limitations

Several limitations of the present study warrant acknowledgement. First, as a theoretical contribution based on a literature review, the mechanisms identified in this paper have not been empirically tested and therefore remain exploratory in nature. The relationships proposed are derived from the synthesis of existing literature rather than from primary data collection. Second, the literature reviewed, while broad in scope, is not exhaustive; the selection process may have introduced a degree of subjectivity in the identification and prioritisation of key sources. Third, the paper does not fully address the potential tensions and trade-offs that may arise

when intrapreneurial activities are directed toward competing sustainability objectives, or when digital and sustainability transformations generate conflicting organisational demands.

6.2. Directions for Future Research

Future research should prioritise the empirical validation of the conceptual mechanisms proposed in this paper. Mixed-method research designs — combining in-depth qualitative case studies with large-sample quantitative analyses — would be particularly well-suited to examining how intrapreneurial behaviour manifests across different organisational and national contexts. The Romanian and broader Central and Eastern European context represents a promising avenue for empirical investigation, given the region's dynamic trajectory of digital transformation and growing sustainability awareness. Additionally, future studies should examine the specific role of middle management as enablers or inhibitors of intrapreneurial activity, as well as the conditions under which senior management attention to intrapreneurial behaviour translates into measurable organisational outcomes.

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THE IMPACT OF DIGITAL TRANSFORMATION ON THE PERFORMANCE OF SMES IN ROMANIA: EMPIRICAL EVIDENCE ON COMPETITIVENESS AND ORGANIZATIONAL EFFICIENCY

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Abstract: *Digital transformation has become a strategic determinant of firm performance in competitive and technology-driven business environments. For small and medium-sized enterprises, the adoption of digital tools and digitally enabled processes is essential for improving internal efficiency, strengthening competitiveness, and increasing organizational adaptability. This paper examines the impact of digital transformation on the performance of SMEs in Romania, with particular emphasis on competitiveness and organizational efficiency. The study proposes a quantitative research design based on survey data collected from Romanian SMEs operating in different economic sectors. The analytical framework considers several dimensions of digital transformation, including process digitalization, the use of management software, e-commerce adoption, digital communication with customers, and the integration of digital tools into managerial decision-making. These dimensions are examined in relation to performance indicators such as operational efficiency, responsiveness to market changes, customer relationship quality, decision-making effectiveness, and perceived competitive position. The paper also develops a theoretical framework linking digital transformation with firm performance by drawing on the theory of the firm, transaction cost economics, behavioral economics, innovation theory, and industrial organization. The expected contribution is twofold: first, it clarifies the mechanisms through which digital technologies may improve efficiency and competitiveness; second, it provides a structured empirical model that can be applied to assess digital maturity and performance outcomes among Romanian SMEs. The study is relevant for managers seeking to implement digital strategies and for policy-makers interested in supporting SME digitalization, productivity, and sustainable development.*

Keywords: *digital transformation; SMEs; competitiveness; organizational efficiency; Romania.*

JEL Classification: *O33; L25; M15; M13*

1. Introduction

Digital transformation has become one of the defining processes of contemporary economic activity. It changes how firms organize production, manage information, communicate with customers, coordinate supply chains, and create economic value. Although digitalization initially referred to the adoption of information technologies in specific organizational functions, current research approaches digital transformation as a broader process that affects business models, organizational capabilities, and competitive strategies. In this sense, digital transformation is not simply a technological phenomenon, but a strategic and organizational phenomenon that requires managerial commitment, changes in routines, new capabilities, and continuous learning (Bharadwaj et al., 2013; Vial, 2019; Verhoef et al., 2021).

The relevance of digital transformation is particularly high for small and medium-sized enterprises. SMEs are often more flexible than large firms, but they also face structural constraints related to finance, skills, managerial expertise, technological infrastructure, and market access. In such conditions, digital technologies may become both an opportunity and a challenge. They may help SMEs reduce administrative burdens, improve decision-making, automate routine activities, develop new customer channels, and access wider markets. At the same time, the implementation of digital tools may be limited by investment costs, lack of digital skills, uncertainty regarding returns, cybersecurity concerns, and organizational resistance to change.

From a theoretical perspective, the impact of digital transformation on SME performance can be understood through several complementary frameworks. The theory of the firm suggests that organizations emerge and operate in ways that reduce the costs of market transactions. Coase (1937) emphasized the role of transaction costs in explaining the existence and boundaries of firms, while Williamson (1985) developed a more detailed framework regarding governance structures and contractual relations. Applied to digital transformation, these perspectives suggest that digital technologies may reduce search, communication, monitoring, and coordination costs, thereby improving organizational efficiency.

Digital transformation is also connected to managerial decision-making. Simon (1947) argued that decision-makers operate under bounded rationality, meaning that they make decisions with limited information, limited cognitive capacity, and imperfect knowledge of alternatives. This is highly relevant for SMEs, where digitalization decisions are often made by owner-managers or small managerial teams that may lack specialized digital expertise. Behavioral economics further deepens this perspective. Kahneman and Tversky (1979) showed that decisions under risk are influenced by psychological biases and subjective evaluations, while Thaler (2015) highlighted the role of behavioral factors in economic choices. These approaches help explain why some SMEs delay or avoid digital investments even when potential benefits are considerable.

The topic is also linked to the literature on technological progress, innovation, and growth. Solow (1956) demonstrated the importance of technological progress for economic growth, while Mokyr (1990) emphasized the historical role of technological creativity in economic development. Aghion and Howitt (1992) further advanced the theory of growth through creative destruction, suggesting that innovation replaces obsolete processes and stimulates long-term productivity. In this logic, digital transformation can be interpreted as a firm-level manifestation of technological

renewal, through which SMEs replace traditional routines with more efficient and data-driven practices.

In Romania, the study of digital transformation among SMEs is particularly important. SMEs represent a major component of the business environment and contribute to entrepreneurship, employment, regional development, and economic resilience. Nevertheless, their digital maturity remains uneven across sectors and regions. Some SMEs have adopted digital tools such as e-commerce platforms, cloud solutions, accounting software, customer relationship management systems, and digital marketing channels, while others still rely on traditional processes and limited digital infrastructure. This heterogeneity creates a relevant research problem: to what extent does digital transformation contribute to the competitiveness and organizational efficiency of Romanian SMEs?

Against this background, the present paper aims to develop a comprehensive theoretical and empirical framework for analyzing the impact of digital transformation on SME performance in Romania. The paper focuses on two dimensions of performance: competitiveness and organizational efficiency. Competitiveness refers to the capacity of SMEs to maintain or improve their market position, respond to customer needs, differentiate products and services, and access new markets. Organizational efficiency refers to the capacity to optimize processes, reduce costs, improve information flows, accelerate decision-making, and allocate resources more effectively. The paper contributes to the literature by integrating classical economic theories with contemporary research on SME digitalization and by proposing a structured methodology for empirical investigation.

This paper contributes to the existing literature by proposing an integrated model that links digital transformation, organizational readiness, and SME performance in the specific context of Romanian SMEs, combining transaction cost theory, behavioral decision-making, and competitiveness perspectives within a unified empirical framework.

2. Theoretical Background and Literature Review

2.1. Digital Transformation as a Multidimensional Organizational Process

Digital transformation is often defined as a process through which digital technologies generate significant changes in organizational processes, value creation mechanisms, and strategic orientations. Vial (2019) conceptualizes digital transformation as a process in which digital technologies trigger organizational responses that alter value creation paths. Verhoef et al. (2021) emphasize that digital transformation goes beyond digitization and digitalization because it involves changes in business models, customer interaction, organizational structures, and market behavior. This distinction is important. Digitization refers mainly to the conversion of analog information into digital form, digitalization refers to the use of digital technologies to improve processes, while digital transformation implies deeper strategic and organizational change.

For SMEs, digital transformation may include a wide range of practices: the adoption of cloud-based applications, enterprise resource planning systems, digital payment solutions, customer relationship management systems, e-commerce platforms, digital marketing tools, data analytics, automation, and online collaboration tools. The adoption of these technologies can support both internal and external

organizational processes. Internally, digital tools can streamline administrative tasks, reduce duplication, increase transparency, and support faster access to information. Externally, digital tools can improve communication with customers and suppliers, expand market reach, and increase the ability of firms to respond to changing demand. The effects of digital transformation depend on the alignment between digital tools, organizational routines, and managerial capabilities.

2.2. Theory of the Firm, Transaction Costs and Organizational Efficiency

The theory of the firm provides a strong foundation for understanding the relationship between digital transformation and organizational efficiency. Coase (1937) argued that firms exist because using the market involves costs, including search costs, negotiation costs, and monitoring costs. Williamson (1985) expanded this analysis by developing transaction cost economics and by emphasizing the role of governance structures in reducing uncertainty and opportunism. From this perspective, digital transformation can be interpreted as a mechanism that reduces internal and external transaction costs.

Digital tools can reduce search costs by enabling faster access to information about suppliers, customers, markets, and competitors. They can reduce coordination costs by facilitating communication among employees and departments. They can reduce monitoring costs by generating digital records, performance indicators, and real-time data. They can also support better contractual and relational governance by improving transparency and traceability in interactions with partners. For SMEs, such effects are important because limited resources make efficiency improvements particularly valuable.

At the organizational level, digital technologies can support process standardization and workflow automation. Management software can centralize information related to sales, inventory, accounting, human resources, and customer interactions. E-commerce platforms can automate ordering and payment processes. Digital communication tools can accelerate information flows and reduce delays. These mechanisms contribute to organizational efficiency by reducing manual work, limiting errors, and improving the speed of decision-making. Therefore, transaction cost economics offers a coherent explanation for the expected positive relationship between digital transformation and organizational efficiency.

2.3. Decision-making, Behavioral Factors and Digital Adoption

The decision to adopt digital technologies is not purely technical or financial. It is also a managerial decision shaped by information, perceptions, expectations, organizational culture, and risk tolerance. Simon's (1947) concept of bounded rationality is particularly relevant for SMEs because many small firms do not have specialized digital departments or formal innovation strategies. Digital decisions may be made by entrepreneurs or managers who rely on experience, intuition, informal information, and limited evaluations of alternatives.

Behavioral economics adds another important layer of interpretation. Kahneman and Tversky (1979) demonstrated that decision-makers evaluate gains and losses asymmetrically and that risk perception may influence choices in systematic ways. In the context of digital transformation, managers may overestimate the risk of implementation failure, underestimate long-term efficiency gains, or avoid investment because benefits are uncertain and delayed. Thaler (2015) further

emphasizes that economic behavior is shaped by biases, habits, and contextual influences rather than by perfect rationality.

These ideas are particularly important when analyzing digital transformation in SMEs. A manager may recognize the potential usefulness of e-commerce or cloud software, yet still postpone adoption because of concerns about cost, cybersecurity, employee resistance, or lack of knowledge. Similarly, firms may adopt basic digital tools, such as email or social media, but fail to integrate more advanced systems into core processes. Therefore, digital maturity depends not only on external technological opportunities, but also on managerial beliefs, skills, learning capacity, and organizational readiness.

2.4. Digital Transformation, Innovation and Competitiveness

Digital transformation is closely linked to innovation and competitiveness. The growth literature has long emphasized the role of technological progress in productivity and economic development. Solow (1956) placed technological progress at the center of long-term growth, while Mokyr (1990) showed that technological creativity has historically enabled major transformations in production and economic organization. Aghion and Howitt (1992) developed the concept of growth through creative destruction, in which new technologies and innovations replace obsolete methods and stimulate productivity improvements.

At the firm level, digital transformation can be understood as a process of technological renewal. SMEs that adopt digital tools may replace slow, manual, and fragmented routines with integrated and data-based processes. This can improve productivity, reduce errors, and support innovation in products, services, and customer interaction. Digital technologies may also enable SMEs to create new value propositions, such as online sales channels, personalized services, faster delivery, and digital customer support.

Competitiveness is also shaped by market structure and strategic interaction. Tirole's (1988) work on industrial organization provides a theoretical foundation for understanding how firms compete through differentiation, pricing, innovation, and strategic behavior. Digital transformation can improve the competitive position of SMEs by enabling them to reach customers more efficiently, increase visibility, differentiate offerings, and respond quickly to competitors. In markets where customers increasingly expect digital interaction, the absence of digital capabilities may become a competitive disadvantage.

Empirical research supports these theoretical arguments. Cenamor et al. (2019) show that digital platform capabilities can help entrepreneurial SMEs compete by strengthening network capabilities and strategic flexibility. Eller et al. (2020) find that SME digitalization is associated with benefits such as improved customer relationships, process efficiency, and business performance, while also identifying challenges related to resources, skills, and implementation complexity. OECD (2021) similarly emphasizes that digital technologies can support SME productivity, resilience, and market access, provided that firms have the capabilities required to use them effectively.

2.5. Romanian SMEs and the Relevance of Digital Maturity

The Romanian context provides a relevant setting for examining the link between digital transformation and SME performance. Romanian SMEs operate in a business environment characterized by competitive pressures, regional disparities, evolving

customer expectations, and uneven access to digital skills and infrastructure. Digitalization can support their modernization, but the effects of digital adoption may vary significantly depending on firm characteristics, sector, managerial competence, and available resources.

Previous research suggests that digital transformation among Romanian SMEs remains uneven. Toanca (2016) highlights the importance of digital transformation for Romanian SMEs and points to the need for greater awareness and adoption of digital practices. Popescu et al. (2016) examine digital adoption among Romanian service and IT&C SMEs, emphasizing differences between sectors and the importance of digital capabilities for business development. Rusu et al. (2023) analyze acceptance of digital transformation in Romania and show that the success of digital adoption depends on both organizational and behavioral factors.

These studies indicate that the Romanian SME sector requires further empirical investigation. It is not sufficient to ask whether firms use digital tools; it is necessary to examine how deeply these tools are integrated into organizational processes and whether they generate performance improvements. A firm may have a website or social media presence but still lack digitalized internal processes, data-driven decision-making, or integrated customer management systems. Therefore, this paper distinguishes between basic digital presence and more advanced digital transformation.

3. Research Design and Methodology

3.1. Research Objectives and Hypotheses

The main objective of this paper is to analyze the relationship between digital transformation and the performance of SMEs in Romania. The paper focuses on two performance dimensions: organizational efficiency and competitiveness. Organizational efficiency refers to the ability of firms to optimize internal processes, reduce time and cost inefficiencies, improve information flows, and support better resource allocation. Competitiveness refers to the ability of firms to strengthen market position, improve customer interaction, differentiate products and services, and respond effectively to market changes.

Based on the theoretical framework and previous empirical studies, the paper proposes the following research hypotheses. H1: A higher level of process digitalization is positively associated with organizational efficiency in Romanian SMEs. H2: The use of digital management tools is positively associated with the quality of managerial decision-making. H3: E-commerce adoption and digital customer communication are positively associated with SME competitiveness. H4: The relationship between digital transformation and performance is influenced by organizational readiness, including managerial support, employee digital skills, and openness to innovation.

These hypotheses reflect the assumption that digital transformation affects firm performance through multiple mechanisms. Process digitalization improves efficiency by reducing repetitive manual tasks and increasing workflow transparency. Management software supports decision-making by improving access to information. E-commerce and digital communication improve competitiveness by increasing customer reach and market responsiveness. Organizational readiness

moderates these effects because digital tools generate benefits only when firms have the skills and routines required to use them effectively.

3.2. Research Approach and Data Collection

The study adopts a quantitative research design. A quantitative approach is appropriate because it allows the identification of measurable relationships between digital transformation variables and performance indicators. The empirical research is based on survey data collected from SMEs operating in different sectors of the Romanian economy. The target respondents are owners, managers, administrators, or employees with decision-making responsibilities and knowledge of the firm's digital practices.

The questionnaire is structured into several sections. The first section collects general information about the firm, including sector of activity, size, age, and market orientation. The second section measures the degree of digital transformation by asking respondents to evaluate the use of digital tools in internal processes, management, communication, sales, and customer relationships. The third section measures organizational performance, focusing on perceived improvements in efficiency, decision-making, customer interaction, market responsiveness, and competitiveness. The final section examines organizational readiness, including digital skills, managerial support, and perceived barriers to digitalization.

The use of self-reported survey data is common in SME research, especially when objective financial data are difficult to obtain. However, this approach requires careful questionnaire design in order to reduce ambiguity and improve reliability. Items should be formulated clearly, measured on comparable scales, and connected to constructs identified in the literature. The proposed questionnaire dimensions are consistent with previous studies on digital transformation and SME digitalization (Vial, 2019; Eller et al., 2020; OECD, 2021; Rusu et al., 2023).

3.3. Variables and Operationalization

The dependent variable of the study is SME performance, conceptualized through two dimensions: organizational efficiency and competitiveness. Organizational efficiency may be measured through items referring to faster information processing, reduced administrative time, improved workflow coordination, lower operational errors, and better resource allocation. Competitiveness may be measured through items referring to improved customer access, stronger market visibility, faster response to customer needs, product or service differentiation, and perceived market position.

The main independent variable is digital transformation. It is operationalized through several dimensions: process digitalization, management software use, e-commerce adoption, digital communication with customers, and integration of digital tools in decision-making. Process digitalization refers to the extent to which operational and administrative processes are supported by digital tools. Management software use refers to applications used for accounting, inventory, customer relationship management, human resources, planning, or reporting. E-commerce adoption refers to online sales or digital transaction mechanisms. Digital communication refers to the use of websites, social media, email marketing, online customer support, and other digital channels.

Organizational readiness is treated as a contextual factor. It includes managerial commitment, employee digital skills, openness to innovation, perceived ease of

digital implementation, and the availability of financial resources for digital investments. These factors are important because digital transformation is not automatically converted into performance gains. Firms that adopt technologies without sufficient skills or managerial support may experience limited benefits.

3.4. Data Analysis Procedures

Data analysis should proceed in several stages. First, descriptive statistics are used to summarize the characteristics of the sample and the level of digital adoption among SMEs. This includes frequencies, means, and standard deviations for the main variables. Second, reliability analysis may be applied to evaluate the internal consistency of scales measuring digital transformation, organizational readiness, efficiency, and competitiveness. Third, correlation analysis can be used to identify associations between the variables.

Regression analysis is proposed to test the relationship between digital transformation and SME performance. Organizational efficiency and competitiveness can be used as dependent variables, while process digitalization, management software use, e-commerce adoption, and digital communication can be used as independent variables. Organizational readiness may be included as a moderating or control variable. Firm size, sector, age, and market orientation may also be included as controls, as these factors can influence both digital adoption and performance.

This methodological design is appropriate for the objectives of the study because it allows the paper to test whether digital transformation is significantly associated with performance outcomes. It also allows the identification of which dimensions of digital transformation are most strongly related to competitiveness and efficiency. Nevertheless, the study must acknowledge the limitations of cross-sectional survey data. Such data can identify associations, but they cannot fully establish long-term causality. Future studies could use longitudinal data or mixed methods to better capture the evolution of digital transformation over time.

4. Expected Results and Discussion

The expected results of the study suggest that digital transformation is positively associated with SME performance in Romania. More specifically, SMEs that adopt digital tools more extensively are expected to report higher levels of organizational efficiency and competitiveness. This expectation is consistent with previous research showing that SME digitalization can generate efficiency gains, improve customer relationships, and strengthen strategic flexibility (Cenamor et al., 2019; Eller et al., 2020; OECD, 2021).

A first expected relationship concerns process digitalization and organizational efficiency. Firms that use digital workflows, electronic records, automated administrative processes, or integrated information systems are likely to experience faster information processing, better coordination, and fewer operational errors. The strongest efficiency gains appear in administrative coordination and customer interaction rather than in deep process restructuring (Coase, 1937; Williamson, 1985).

A second expected relationship concerns digital management tools and decision-making. SMEs that use software for accounting, planning, inventory, customer relationship management, or reporting may have better access to relevant

information and may make decisions faster and more accurately. This is consistent with Simon's (1947) view that organizational decisions are constrained by information and cognitive limitations. Digital tools cannot eliminate bounded rationality, but they can reduce uncertainty and provide managers with more structured information.

A third expected relationship concerns e-commerce, digital communication, and competitiveness. In Romania, digital competitiveness appears to depend more strongly on customer-facing digital tools than on advanced internal digital integration. In terms of industrial organization, digital capabilities may influence the competitive position of firms by enabling differentiation, market expansion, and strategic flexibility (Tirole, 1988). This interpretation is also supported by Cenamor et al. (2019), who emphasize the role of digital platform capabilities in SME competitiveness.

However, the expected findings should not be interpreted as implying that digital transformation automatically produces performance improvements. Digital adoption may remain superficial if technologies are not integrated into core processes. A firm may have a website and social media presence without using data for decision-making or without digitalizing internal operations. Similarly, software implementation may fail if employees lack training or if management does not support organizational change. Therefore, organizational readiness is expected to play an important role in transforming digital adoption into performance outcomes.

Behavioral factors may also shape the results. Managers may avoid or delay digital investments because they perceive them as risky or because potential returns are uncertain. Kahneman and Tversky's (1979) prospect theory helps explain why decision-makers may weigh potential losses more heavily than potential gains. In SMEs, where financial resources are often limited, this behavioral mechanism may be particularly strong. The result may be cautious adoption, fragmented digitalization, or preference for low-cost basic technologies rather than integrated digital transformation.

The Romanian context also requires careful interpretation. The uneven digital maturity of Romanian SMEs suggests that digital transformation effects are not uniform across firms. These differences mean that the performance effects of digital transformation are likely to be heterogeneous.

Overall, the discussion suggests that digital transformation can improve SME performance when it is implemented strategically. The strongest performance effects are expected when firms combine technology adoption with managerial support, employee training, process redesign, and clear strategic objectives. In this sense, digital transformation should be seen as a managerial and organizational process, not only as a technological investment.

5. Managerial and Policy Implications

The analysis has several managerial implications. First, SME managers should approach digital transformation as a strategic process rather than as a set of isolated technological purchases. The adoption of digital tools should be linked to clear organizational objectives, such as reducing administrative time, improving customer communication, increasing sales channels, enhancing decision quality, or strengthening competitiveness. Digital investments are more likely to generate value when they are connected to specific performance problems and when their implementation is integrated into business routines.

Second, managers should invest not only in technology, but also in human capabilities. Employee digital skills, managerial understanding, and organizational learning are essential for successful digital transformation. Training programs, internal communication, and gradual implementation can reduce resistance and increase the effective use of digital tools. A digital system that is not understood or accepted by employees may remain underused and may fail to generate performance improvements.

Third, SMEs should prioritize integration. Many firms adopt several digital tools without ensuring that they communicate with each other or support coherent workflows. Fragmented digitalization can increase complexity rather than reduce it. Therefore, managers should evaluate how digital tools fit together and how they support information flows across functions such as sales, accounting, inventory, customer relations, and decision-making.

The study also has policy implications. Public authorities and business support organizations can contribute to SME digital transformation by improving access to digital infrastructure, financing, advisory services, and training programs. Policy measures should not focus only on technology acquisition, but also on digital skills, managerial education, cybersecurity awareness, and sector-specific digital solutions. In addition, support programs should recognize the diversity of SMEs and adapt interventions to firm size, sector, and level of digital maturity.

For Romania, supporting SME digitalization is important for competitiveness, productivity, and regional development. Digital transformation can help SMEs overcome some constraints related to market access and organizational efficiency, but public support is especially relevant for firms with limited resources. A coherent policy framework can reduce digital gaps and improve the capacity of SMEs to participate in a more technology-driven economy.

6. Conclusions

This paper developed a theoretical and methodological framework for analyzing the impact of digital transformation on the performance of SMEs in Romania. The analysis focused on competitiveness and organizational efficiency as two key dimensions of performance. The paper argued that digital transformation can improve SME performance by reducing coordination costs, improving information flows, supporting better decision-making, strengthening customer relationships, and enabling more flexible competitive strategies.

The theoretical contribution of the paper lies in the integration of several complementary perspectives. The theory of the firm and transaction cost economics explain how digital tools may improve efficiency by reducing search, communication, and coordination costs (Coase, 1937; Williamson, 1985). Behavioral and managerial barriers remain important factors influencing digital adoption.

The methodological contribution consists in the proposal of a quantitative empirical model that can be applied to Romanian SMEs. The model includes dimensions of digital transformation, organizational readiness, and performance outcomes. It also proposes hypotheses that can be tested through survey data and statistical analysis. This approach is useful because it moves beyond general discussions of digitalization and provides a structured basis for empirical investigation.

The expected conclusion is that digital transformation represents a relevant driver of SME performance, but its effects depend on the depth of implementation and on

organizational readiness. Digital tools generate value when they are integrated into processes, supported by managerial commitment, and accompanied by employee skills and organizational learning. For Romanian SMEs, digital transformation can support efficiency, competitiveness, resilience, and sustainable development.

Future research should test the proposed model using a representative sample of Romanian SMEs and should examine differences across sectors, firm sizes, and regions. Longitudinal research would also be useful for understanding how digital transformation evolves over time and how its performance effects accumulate. Qualitative case studies could complement survey research by explaining in greater depth how managers experience digital transformation, what barriers they face, and which practices generate the most significant organizational benefits.

7. Limitations and Future Research

The proposed study has several limitations that should be acknowledged. First, the empirical design is based on survey data, which means that some variables are measured through managerial perceptions. Although perception-based indicators are useful in SME research, especially when objective performance data are not available, they may be affected by respondent bias, overestimation of digital maturity, or different interpretations of performance improvement. To reduce this limitation, future empirical applications should use clear scale items and, where possible, combine survey responses with objective indicators such as sales growth, productivity measures, number of online transactions, or cost reductions.

Second, the cross-sectional nature of the proposed research limits the ability to establish causal relationships. Digital transformation is a gradual process, and its performance effects may appear over time rather than immediately after technology adoption. A longitudinal design would allow researchers to observe how SMEs move from basic digital adoption to more advanced digital maturity and how performance outcomes evolve across multiple periods. Such an approach would be particularly useful for identifying whether digital investments generate persistent competitive advantages or only short-term operational improvements.

Third, the Romanian SME sector is heterogeneous. Firms differ by sector, region, size, ownership structure, export orientation, and managerial capabilities. Future research should therefore examine whether the relationship between digital transformation and performance differs between manufacturing, services, trade, tourism, and knowledge-intensive sectors. Sector-specific analyses could offer more precise implications for managers and policy-makers because digital needs and barriers are not identical across industries.

Finally, future studies could complement quantitative analysis with qualitative case studies. Interviews with SME managers would provide deeper insight into the actual barriers, decision processes, implementation challenges, and organizational changes associated with digital transformation. A mixed-method approach would strengthen the understanding of how digital tools are adopted, how employees respond to change, and how firms transform digital investments into measurable performance outcomes.

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MAPPING THE DIGITAL TRANSFORMATION OF HEALTHCARE ECOSYSTEMS: A BIBLIOMETRIC ANALYSIS

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Abstract: *Digital transformation represents one of the most important processes of change influencing healthcare ecosystems. The integration of digital technologies such as artificial intelligence, advanced data analytics, blockchain, digital twin and telemedicine platforms has generated significant changes in the way medical services are delivered and managed. These technologies contribute to the optimisation of medical processes, the improvement of clinical data management, and the increased accessibility of healthcare services. The aim of this paper is to analyse the role of digital transformation in the healthcare field through a conceptual and bibliometric approach. The literature analysis was conducted using the Scopus database, and the selection of articles followed the PRISMA protocol. The initial search generated 2,554 articles, which were reduced to 1,526 after applying filtering criteria. Following the screening and filtering process based on citation impact, 40 articles were selected for the final analysis. The results of the analysis highlight that digital transformation in healthcare has evolved from a necessity-driven response to COVID-19 to an opportunity-driven process. Research highlights both the benefits and risks of emerging technologies, the need for intelligent governance, and the growing role of patients as active value co-creators. However, the perspective of end beneficiaries, particularly their satisfaction with digitalized medical services in the most frequently cited papers, remains largely absent. Two key research directions emerge: understanding how private actors drive digital transformation in healthcare and examining how corporate beneficiaries adopt digital medical services to support employee well-being and organizational performance.*

Keywords: *digital transformation; digital health; healthcare innovation; artificial intelligence; digital maturity*

JEL Classification: *I11; O33; L86*

1. Introduction

Healthcare systems worldwide, faced with unprecedented structural challenges such as population aging, the rising incidence of chronic diseases, and shortages of medical personnel, increasingly view digital transformation as a viable solution to the limitations of the traditional care model (Davenport and Kalakota, 2019; De Benedictis et al., 2023). The literature highlights that digital transformation in healthcare is not limited to the adoption of digital technologies but involves a complex process of organizational, managerial, and institutional change (Dal Mas et al., 2023). By enabling the development of innovative models for delivering medical

services (Kraus et al., 2021), it becomes a key driver of efficiency and competitiveness in healthcare organizations. Although medical innovations may face resistance from end users (Iyanna et al., 2022), prior research shows that they have contributed to rethinking how care processes are structured, helping to overcome traditional barriers such as limited access to services and information fragmentation (Gopal et al., 2019). This progress is prompting developed countries, such as Germany, to accelerate their own digital transformation processes in healthcare (Kraft et al., 2024). Healthcare ecosystems are considered complex adaptive systems composed of interdependent actors such as healthcare providers, patients, institutions, technologies, digital infrastructures, applications, and regulations. Together, these elements form a dynamic network capable of delivering integrated and efficient healthcare services within a continuously evolving social and economic context (Meskó et al., 2017). The literature emphasizes that entities with a high level of digital maturity are better able to leverage the potential of emerging technologies and to create innovative models for delivering medical services (Santarsiero et al., 2023). This advantage manifests across all three essential stages of the healthcare process: prevention, treatment, and recovery—stages well established in public health and healthcare management (Dimitrov, 2016; Meskó et al., 2017). Nagarajan et al. (2024) highlight that trust is a central element in the functioning of healthcare ecosystems, as it underpins the safe and effective use of digital technologies. When trust is present, these technologies can expand access to healthcare services, including in rural or infrastructure-limited areas (Kruse et al., 2018), and significantly enhance the efficiency of healthcare systems (Kraus et al., 2021).In the literature, the performance of healthcare ecosystems is closely linked to the development of the digital health concept, defined as an integrative framework of digital technologies aimed at optimizing healthcare services, improving health management efficiency, and enhancing the patient experience (Stoumpos, Kitsios & Talias, 2023). Artificial intelligence emerges as a central component in this process due to its ability to process large volumes of data and identify relevant patterns for developing predictive models useful in resource planning, workflow optimisation, and managerial decision-making (Reddy et al., 2019). The literature also highlights the role of other emerging technologies, such as blockchain and advanced data analytics tools, in strengthening the digital infrastructure of healthcare systems. For example, Cerchione et al. (2023) emphasize the potential of blockchain technology to enhance the security and traceability of medical data—an essential element for the interoperability of information platforms and for improving interactions among providers, beneficiaries, and regulatory authorities. In this context, digital health is shaping into an integrative paradigm capable of bringing together and harmonizing various emerging technologies within the logic of healthcare digital transformation, assigning them the role of support tools that enhance decision-making and operational processes without replacing medical expertise and judgment (Davenport & Kalakota, 2019).Despite the rapid growth of the digital health literature, many studies point out that empirical research on the impact of digital transformation on healthcare organizations remains limited (Kraus et al., 2021). This gap is even more evident in the context of emerging economies, where a deeper understanding is needed of how digital technologies influence organizational performance and healthcare service delivery models.

Based on these considerations, the aim of this paper is to analyse the literature on digital transformation in healthcare through a conceptual and bibliometric approach.

The literature analysis was conducted using the Scopus database and the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) protocol for the selection of relevant articles (Page et al., 2021). In addition, the bibliometric analysis carried out using VOSviewer software enabled the identification of the main research directions and the conceptual relationships structuring the digital health literature.

2. Digital Health Transformation Literature: Current Stage and Key Research Gaps

The digital transformation of healthcare systems represents a rapidly evolving field of research. The literature highlights that the integration of digital technologies into healthcare systems contributes to improving organizational efficiency and optimizing clinical processes (Kraus et al., 2021).

One of the central concepts analysed in the literature is *digital health*, which refers to the use of digital technologies for the delivery and management of healthcare services. This concept encompasses a wide range of technologies, including electronic health records, telemedicine platforms, mobile health applications, and medical data analytics systems (Meskó et al., 2017).

Numerous studies show that the use of digital technologies can improve access to healthcare services and enhance the efficiency of healthcare systems. For instance, telemedicine platforms enable the remote delivery of medical services, thereby increasing accessibility, particularly in rural areas or regions with limited access to healthcare infrastructure (Kruse et al., 2018).

Moreover, the digitalization of healthcare systems contributes to improved management of medical data. Electronic health records allow rapid access to clinical information and facilitate information exchange between different healthcare institutions (Kouroubali & Katehakis, 2019).

In recent years, research on digital transformation in healthcare has increasingly focused on the use of emerging technologies. Artificial intelligence is one of the technologies with the greatest potential to transform healthcare systems, as it enables the analysis of large volumes of medical data and supports clinical decision-making processes (Reddy et al., 2019). However, the literature emphasizes that artificial intelligence should complement physicians' work and enhance medical decision-making without replacing professional expertise (Davenport & Kalakota, 2019). In addition to artificial intelligence, other emerging technologies such as blockchain and advanced medical data analytics are frequently discussed in the digital health literature. Blockchain technology can enhance the security of medical data and improve the interoperability of healthcare information systems (Cerchione et al., 2023).

Another important concept examined in the literature is the digital maturity of healthcare organizations. Digital maturity reflects the ability of organizations to integrate digital technologies into their organizational strategies and operational processes (Santarsiero et al., 2023). Organizations with a high level of digital maturity are better positioned to leverage the potential of emerging technologies and to develop innovative healthcare service delivery models.

Furthermore, the literature highlights that digital transformation can generate competitive advantages for healthcare organizations. The integration of digital

technologies can improve operational efficiency, optimize medical processes, and support the development of innovative service delivery models (Iyanna et al., 2022). In conclusion, the literature emphasizes that digital transformation is a key factor in modernizing healthcare systems and improving the quality of medical services. However, the analysis also reveals significant gaps in academic research. Most existing studies focus on digital technologies and healthcare systems in developed economies, while empirical research on the impact of digital transformation on healthcare organizations in emerging economies remains limited (Kraus et al., 2021).

3. Theoretical Perspectives on Healthcare Digitalization: Adoption Models, Capabilities, and Performance Links

Digital transformation in healthcare can be analysed through several theoretical frameworks commonly used in the management and information systems literature. These frameworks enable a better understanding of how organisations adopt and integrate digital technologies, as well as their impact on organisational performance. In the literature, the adoption of digital technologies is frequently examined through the Technology–Organization–Environment (TOE) framework, the Resource-Based View (RBV), the dynamic capabilities theory, and the diffusion of innovations theory (Tornatzky and Fleischer, 1990; Barney, 1991; Teece et al., 1997; Rogers, 2003).

The Technology–Organization–Environment (TOE) model, proposed by Tornatzky and Fleischer (1990), is one of the most widely used theoretical frameworks for analysing the adoption of digital technologies within organizations. According to this model, the adoption and implementation of digital technologies are influenced by three main categories of factors: technological, organizational, and environmental.

Technological factors refer to the characteristics of available digital technologies, such as their complexity, compatibility with existing systems, and relative advantages. In the healthcare sector, these technologies include electronic health records, telemedicine platforms, artificial intelligence, and medical data analytics tools.

Organizational factors relate to the internal characteristics of organizations, such as organizational structure, available resources, employees' digital competencies, and the level of digital maturity. Healthcare organizations with adequate technological resources and skilled personnel are better positioned to adopt and integrate digital technologies into their operational processes.

Environmental factors include external pressures such as government regulations, market competition, and technological developments. In healthcare, these factors encompass data protection regulations, public policies supporting digitalization, and patient demands for accessible digital healthcare services.

Recent studies highlight that the TOE model is frequently used to analyse digital transformation in healthcare, as it allows for the simultaneous evaluation of technological, organizational, and institutional factors influencing technology adoption (Dubey et al., 2021).

The Resource-Based View (RBV) is one of the most influential theoretical perspectives in strategic management literature. According to this theory, an organization's competitive advantage is determined by its resources and capabilities (Barney, 1991).

In the context of digital transformation, digital resources, technological infrastructure, and employees' digital skills can be considered strategic assets that contribute to building competitive advantage. Healthcare organizations that possess advanced digital resources are better able to develop innovative medical services and improve the quality of care provided to patients.

Recent studies suggest that digital resources can enhance organizational performance by facilitating decision-making, optimizing operational processes, and improving patient experience (Wang & Pan, 2022). In this context, digital transformation can be understood as a process of developing and leveraging strategic digital resources.

Dynamic capabilities theory extends the Resource-Based View by emphasizing the ability of organizations to integrate, build, and reconfigure internal and external resources in response to changing environments (Teece et al., 1997).

In the context of digital transformation, dynamic capabilities enable organizations to adapt their processes and integrate new digital technologies into their operations. Healthcare organizations must develop capabilities that support the effective integration of digital technologies into both clinical and administrative processes.

Recent research highlights that the development of dynamic capabilities is essential for the success of digital transformation initiatives, as it allows organizations to respond rapidly to technological changes and evolving external conditions (Aslam et al., 2025).

The diffusion of innovations theory, proposed by Rogers (2003), explains how new technologies and innovations are adopted and spread within organizations and societies. According to this theory, the adoption of innovations is influenced by the characteristics of the technology, users' perceptions of its benefits, and the social and organizational context.

In healthcare, the adoption of digital technologies is influenced by factors such as relative advantage, compatibility with existing systems, and the complexity of the implemented technologies. For example, the adoption of artificial intelligence in medical processes depends on healthcare professionals' perceptions of its benefits and its compatibility with existing clinical workflows.

This theory provides a useful framework for analysing how digital technologies are adopted in healthcare organizations and for understanding the factors influencing digital transformation processes.

The integration of these theoretical frameworks enables the development of a conceptual model that explains the relationship between digital transformation and organizational performance in healthcare. The proposed conceptual model highlights that the adoption of digital technologies and the development of digital capabilities contribute to increasing the digital maturity of healthcare organizations.

In turn, digital maturity can generate perceived functional benefits, such as improved operational efficiency, optimized decision-making processes, and enhanced quality of healthcare services. These benefits can contribute to the development of competitive advantage and to the overall improvement of organizational performance in the healthcare sector.

4. Methodology

4.1. Research Design for the Bibliometric Study

This study employs a methodological approach based on a systematic literature review and bibliometric analysis, with the aim of identifying the main research directions related to digital transformation in healthcare. The methodology combines the PRISMA protocol with bibliometric analysis techniques conducted using VOSviewer software.

This methodological approach enables the analysis of the conceptual structure of the literature and the identification of relationships among the key concepts used in research on healthcare digitalization.

The data used in this research were collected from the Scopus database, one of the most important bibliographic databases used in academic research. Scopus was selected due to its extensive coverage of scientific publications and its relevance for bibliometric studies.

The identification of relevant articles was carried out using a keyword-based search strategy related to digital transformation in healthcare. The search was conducted in the title, abstract, and keywords fields using the following query:

("digital transformation" OR "digital health" OR "healthcare digitalization") AND healthcare

The initial search in the Scopus database yielded 2,554 articles. To ensure the relevance of the studies included in the analysis, several filtering criteria were applied.

The following filters were used:

- publication period: 2018–2025
- document type: article and review
- language: English
- relevant subject areas: Business, Management, Economics, Decision Sciences, and Medicine
- sorting: most cited

After applying these filters, the number of articles was reduced to 1,526.

The final selection of articles included in the analysis was conducted in accordance with the PRISMA protocol.

The PRISMA protocol allows for transparent documentation of the article selection process and ensures the reproducibility of the research.

The article selection process included the following stages:

1. **Identification of articles**: At this stage, 2,554 articles were identified in the Scopus database.
2. **Application of filtering criteria**: After applying filters related to publication period, document type, and relevant subject areas, 1,526 articles remained.
3. **Screening of articles**: In this stage, the titles and abstracts of the articles were analysed to assess their relevance to the research objectives.
4. **Final selection**: Following the screening process, 40 articles were selected and included in the final bibliometric analysis.

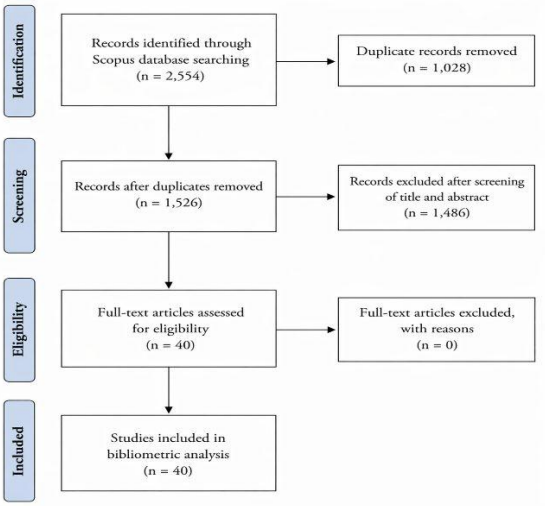


Figure 1: Article selection process according to the PRISMA protocol
Source: Author's own elaboration based on Scopus data and PRISMA protocol.

4.2. Procedure

To analyse the conceptual structure of the literature on digital transformation in healthcare, a bibliometric analysis was conducted using VOSviewer software. VOSviewer is a widely used tool in bibliometric studies for analysing relationships among publications, authors, and concepts within the scientific literature. The software enables the creation of visual maps that illustrate relationships between concepts through network analysis techniques. In this study, the *co-occurrence analysis of keywords* method was applied, allowing the identification of relationships among the keywords used in the selected articles.

The bibliometric analysis process included the following steps:

1. exporting bibliographic data from the Scopus database in CSV format;
2. importing the data into VOSviewer software;
3. selecting the *co-occurrence of keywords* analysis type;
4. setting a minimum threshold for keyword occurrence;
5. generating the conceptual map of relationships between key concepts.

The co-occurrence analysis enabled the identification of thematic clusters and the interpretation of conceptual relationships within the digital health literature.

The results of the bibliometric analysis are presented in Figure 2, which illustrates the co-occurrence network of keywords identified in the analysed articles.

4.3. Constraints of the Applied Procedure

Although the analysis provides a relevant perspective on the literature regarding digital transformation in healthcare, the study has several limitations. First, the literature analysis was conducted exclusively based on articles indexed in the Scopus database. While Scopus is one of the most comprehensive academic databases, relying on a single database may lead to the exclusion of relevant studies published elsewhere. Second, the selection of articles was based on specific filtering criteria, which may limit the number of studies included in the final analysis.

Nevertheless, the use of the PRISMA protocol and bibliometric analysis enhances the transparency and methodological rigor of the research.

5. Findings on Digital Transformation Research Trends

The bibliometric analysis conducted in this study aims to identify the main research directions related to digital transformation in healthcare. The analysis was carried out using VOSviewer software, applying the *co-occurrence analysis of keywords* method, which enables the identification of relationships among the concepts used in the scientific literature. The data used for the bibliometric analysis were extracted from the Scopus database and include a final set of 40 articles selected according to the PRISMA protocol. These articles were imported into VOSviewer to generate a conceptual map highlighting the relationships among the keywords used in the literature on digital transformation in healthcare. The results of the bibliometric analysis are presented in Figure 2, which illustrates the co-occurrence network of keywords identified in the analysed articles.

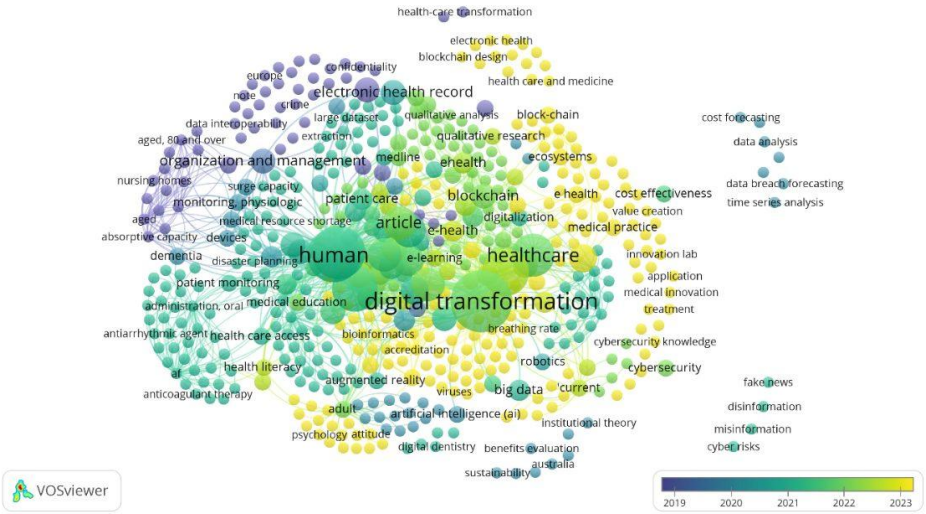


Figure 2: Co-occurrence network of keywords (VOSviewer)
Source: Author's own elaboration using VOSviewer, based on Scopus data.

The analysis highlights the existence of several thematic clusters reflecting the main research directions in the field of digital health.

The conceptual map generated using VOSviewer indicates that the literature on digital transformation in healthcare is structured around central concepts such as *digital transformation, healthcare, human, patient care, electronic health record,* and *artificial intelligence*.

The concept of *digital transformation* emerges as one of the most prominent nodes in the network, emphasizing the central role of digitalization in research on healthcare systems. At the same time, the concept of *healthcare* is associated with terms reflecting the application of digital technologies in the medical field, such as *patient care, medical practice,* and *health information systems*.

The frequent presence of the concept *electronic health record* highlights the importance of medical information systems in the digitalization of healthcare services. Electronic health records represent one of the most critical digital infrastructures used for managing medical information and facilitating data exchange between healthcare institutions.

The analysis also reveals a significant increase in interest in the use of artificial intelligence and data analytics technologies in healthcare. These technologies are applied in medical image analysis, clinical decision support, and the development of predictive models used in diagnosis and treatment.

The co-occurrence network of keywords allows the identification of several thematic clusters, each representing a distinct research direction in the field of digital transformation in healthcare.

The first cluster includes concepts such as *digital transformation, healthcare, patient care,* and *organization and management*. This cluster reflects research analysing the impact of digital transformation on healthcare management and service delivery. The prominence of this cluster highlights the increasing importance of organisational transformation and strategic management in healthcare digitalisation processes, suggesting that digital transformation extends beyond technology adoption and involves significant organisational change (Kraus et al., 2021; Iyanna et al., 2022).

Studies within this cluster focus on how digital technologies contribute to optimizing medical processes, improving coordination of healthcare services, and developing innovative models of service delivery.

The second cluster is associated with concepts such as *electronic health record, data interoperability, health information systems,* and *large datasets*. This cluster reflects research on the digitalization of medical information and the development of IT infrastructures within healthcare systems. This cluster underlines the critical role of data interoperability and information exchange in the development of integrated digital healthcare systems, emphasising the growing importance of medical information infrastructures (Kouroubali & Katehakis, 2019; Kruse et al., 2018).

Medical information systems enable the collection and management of clinical data and facilitate information exchange between institutions. In this context, interoperability is a key factor in the development of digital health ecosystems.

Another important cluster identified in the analysis includes concepts such as *artificial intelligence, blockchain, big data,* and *robotics*. This cluster reflects the growing interest in the use of emerging technologies in healthcare. The prominence of emerging technologies within this cluster suggests a shift in the literature from basic digitalisation towards predictive, data-driven, and intelligent healthcare systems, particularly through the increasing use of artificial intelligence and advanced analytics (Reddy et al., 2019; Davenport & Kalakota, 2019).

These technologies contribute to the development of more efficient and adaptive healthcare systems. For example, artificial intelligence supports medical decision-making through the analysis of large volumes of clinical data, while blockchain enhances the security of medical data.

The final cluster highlights research on the development of digital health ecosystems and the integration of digital technologies into organizational processes. This cluster highlights the growing relevance of collaboration, innovation, and value co-creation within digital health ecosystems, reflecting the need for stronger integration between healthcare providers, technological actors, and institutional stakeholders (Dal Mas et al., 2023; Stoumpos et al., 2023).

Studies in this area analyse how digital transformation supports the development of new collaboration models among healthcare stakeholders, including hospitals, private clinics, technology companies, and research institutions.

The analysis indicates that research on digital transformation in healthcare has evolved significantly in recent years. Initially, the literature focused primarily on the development of IT infrastructure and medical data management systems.

Currently, research is increasingly oriented toward the use of emerging technologies and the development of digital health ecosystems. In this context, digital transformation is analysed not only from the perspective of technology adoption but also in terms of its impact on organizational models and the overall performance of healthcare systems.

6. Discussions

The results of the bibliometric analysis highlight that the literature on digital transformation in healthcare is characterized by rapid development and increasing diversification of research directions. The co-occurrence network analysis of keywords identified four main research directions: the digital transformation of healthcare organizations, the development of medical information systems, the use of emerging technologies, and the development of digital health ecosystems. These findings are consistent with recent studies emphasizing the multidimensional nature of healthcare digitalization (Kraus et al., 2021; Iyanna et al., 2022).

The literature analysis indicates that digital transformation extends beyond the mere adoption of digital technologies, involving significant organizational and institutional changes. In this regard, the research findings can be interpreted through the Technology–Organization–Environment (TOE) framework, which highlights that the adoption of digital technologies is simultaneously influenced by technological, organizational, and environmental factors (Dubey et al., 2021).

At the same time, the results emphasize the important role of digital resources and technological infrastructure in the digital transformation of healthcare organizations. This finding aligns with the Resource-Based View perspective, according to which organizational performance depends on the resources and capabilities that organizations can strategically leverage (Wang & Pan, 2022). In the context of healthcare digitalization, IT infrastructure, medical information systems, and employees' digital competencies can be considered strategic resources that contribute to the development of competitive advantage.

The findings also underline the importance of developing dynamic capabilities within healthcare organizations. The integration of digital technologies requires organizations to adapt existing structures and develop new digital competencies. From this perspective, dynamic capabilities enable organizations to integrate and reconfigure existing resources in order to respond to technological changes and evolving environmental demands (Aslam et al., 2025).

Another important result of the bibliometric analysis is the growing interest in the use of emerging technologies such as artificial intelligence, blockchain, and advanced data analytics in healthcare. These technologies are discussed in the literature as tools that can enhance clinical decision-making and optimize operational processes within healthcare systems (Reddy et al., 2019; Davenport & Kalakota, 2019).

However, the literature also emphasizes that the implementation of these technologies must support healthcare professionals and contribute to improving the

quality of medical services. In this context, artificial intelligence is viewed as a decision-support tool that complements, rather than replaces, medical expertise (Topol, 2019).

The results further highlight the importance of developing digital health ecosystems, which involve collaboration among various stakeholders, including hospitals, private clinics, technology companies, and research institutions. Recent literature suggests that such ecosystems can facilitate innovation and information exchange within healthcare systems (Cerchione et al., 2023; Dal Mas et al., 2023).

From a managerial perspective, the findings suggest that healthcare organizations must adopt a strategic approach to digital transformation. The implementation of digital technologies should be supported by the development of employees' digital skills, investments in technological infrastructure, and the adaptation of existing organizational models (Santarsiero et al., 2023).

From a theoretical perspective, this study contributes to the digital health literature by integrating bibliometric analysis with established theoretical frameworks such as the Technology–Organization–Environment framework, the Resource-Based View, and dynamic capabilities theory. The study also contributes by structuring the fragmented literature on digital transformation in healthcare into four major thematic clusters, highlighting the multidimensional nature of digital health ecosystems and organisational transformation processes (Dubey et al., 2021; Wang & Pan, 2022; Aslam et al., 2025).

At the same time, the literature analysis reveals significant gaps in academic research. Most existing studies focus on the technological aspects of digital transformation and on healthcare systems in developed economies. Therefore, there is a growing need for empirical studies examining the impact of digital transformation on healthcare organizations in emerging economies (Kraus et al., 2021).

Consequently, future research could explore the relationship between the digital maturity of healthcare organizations, perceived functional benefits, and organizational performance. Such analyses could contribute to a better understanding of how digital transformation influences performance in healthcare organizations.

7.Conclusions and Future Research Directions

The results of the analysis of the most cited articles and reviews from the period 2018–2025 indicate a clear orientation toward technologies used in health ecosystems, viewed predominantly from the perspective of healthcare service providers. These aspects are addressed in numerous studies in the context of the COVID-19 pandemic, which leads us to the idea that we have witnessed *a necessity-driven digital transformation.* Another group of studies examines the technologies used in various branches of medicine, particularly in oral care, ophthalmology, and laboratory services, highlighting both the benefits and the risks of their implementation for providers and beneficiaries within health ecosystems, as well as the need for intelligent governance. We note the emergence of studies focused on the need to audit the digital capabilities of healthcare organizations, given that many hospitals accumulated high levels of *technical debt*, especially during the COVID-19 pandemic. The identification of this type of studies, along with more recent ones centered on the shift in the patient's role, from a passive actor to an active one, a co-creator of value within health ecosystems, leads us to the idea that

digital transformation is increasingly becoming an *opportunity-driven* process. In this regard, we can highlight the contribution of articles published in business journals, which focus primarily on the patient-centered approach and on the development of health business models oriented toward the co-creation of economic and social value. Nevertheless, our analysis reveals a notable absence of the perspective of end beneficiaries, for example regarding their satisfaction with the digital transformation of medical services.

As a result of the analysis conducted, at least two future research directions can be outlined. The first direction could focus on private economic actors within health ecosystems, known as promoters of digital transformation, supported by greater financial potential, increased decisional flexibility, and the ability to rapidly experiment with emerging technological models. Such research could examine how these organizations accelerate technology adoption, how they manage associated risks, and the extent to which they contribute to reducing digital gaps within health ecosystems. The second direction could consider the perspective of corporate beneficiaries, who are increasingly interested in digital medical services for their employees as part of organizational care for well-being and retention. In this context, a relevant research direction could explore the criteria used to select digital medical services, and the ways in which these solutions influence organizational culture, productivity, and employer-branding strategies.

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ERDF SUPPORT FOR SME COMPETITIVENESS 2014–2020: FINANCIAL ABSORPTION VERSUS POLICY EFFECTIVENESS — A COMPARATIVE ANALYSIS ACROSS EU MEMBER STATES

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Abstract: *The European Regional Development Fund (ERDF) allocated EUR 42.73 billion to Thematic Objective 3 (SME competitiveness) across 203 operational programs in 26 EU member states during the 2014–2020 programming period. This article examines the gap between financial absorption — a near-complete 99.7% by programme closure — and actual improvements in SME competitiveness. Drawing on two primary ESIF open datasets (Finance Planned Details and EU Payments Timeseries, March 2026 update) merged with the findings of the European Court of Auditors Special Report 8/2022 (ECA, 2022), this study conducts a comparative analysis across all EU member states. The results reveal four structural weaknesses: (1) a critical-mass problem caused by extreme variation in per-SME support amounts (from EUR 392,000 in Austria to under EUR 1,000 in Ireland); (2) a late spending rush, with 50% of all payments concentrated in 2020–2022; (3) a systematic preference for non-repayable grants over financial instruments; and (4) the absence of mandatory alignment between ERDF programs and national SME strategies. The article argues that financial absorption is an indicator of administrative compliance, not of policy effectiveness, and proposes design reforms for the 2028–2034 programming cycle.*

Keywords: *ERDF; SME competitiveness; cohesion policy; financial absorption; structural funds; 2014–2020; EU regional development*

JEL Classification: *R11; R58; H72; L25; O38*

1. Introduction

The European Regional Development Fund represents one of the most significant public investment mechanisms ever deployed at supranational level. In the 2014–2020 programming period, ERDF allocated EUR 201.5 billion across eleven thematic objectives, of which EUR 42.73 billion — approximately 21% — was directed specifically toward improving the competitiveness of small and medium-sized enterprises through Thematic Objective 3 (TO3). With nearly 25 million SMEs operating across the EU, employing 63% of the workforce and generating 52% of value added (Eurostat, 2022), the policy rationale for this investment is compelling.

Yet the empirical record raises a fundamental question: did this unprecedented financial commitment actually improve SME competitiveness? The European Court of Auditors, in Special Report 8/2022 (ECA, 2022), concluded that the 2014–2020 ERDF support stimulated SMEs' willingness to invest but that its effectiveness in increasing competitiveness was hampered by systematic weaknesses in programme design. Of 22 directly funded SMEs examined in depth, a majority showed no demonstrable improvement across the four competitiveness dimensions assessed: market position, internationalization, financial situation and innovation capacity.

This article addresses the gap between the financial dimension of ERDF TO3 — near-complete absorption of planned funds by all member states — and its policy effectiveness. It makes three original contributions. First, it provides the first comprehensive comparative analysis of ERDF TO3 financial absorption across all 26 participating member states, using two merged primary ESIF open datasets updated to March 2026 (European Commission, 2026a; European Commission, 2026b). Second, it identifies structural patterns — geographic concentration, temporal spending dynamics and instrument design — that systematically undermine effectiveness regardless of absorption performance. Third, it formulates evidence-based recommendations for the 2028–2034 programming cycle, currently under design.

The remainder of the article is structured as follows. Section 2 reviews the theoretical framework connecting ERDF investment, SME competitiveness and cohesion policy objectives. Section 3 describes the data sources and methodology. Section 4 presents the comparative empirical results. Section 5 discusses the structural causes of the absorption-effectiveness gap. Section 6 draws conclusions and policy recommendations.

2. Theoretical Framework and Literature Review

2.1. The ERDF as a Policy Instrument for SME Competitiveness

The legal foundation of ERDF intervention in support of SME competitiveness is Article 173 of the Treaty on the Functioning of the European Union, which requires the Union and its member states to ensure conditions for industrial competitiveness. For the 2014–2020 period, TO3 — 'Improving the competitiveness of SMEs' — was operationalized through four investment priorities: supporting entrepreneurship, developing new business models oriented toward internationalization, advancing product and service development capacities, and enabling SMEs to access regional, national and international markets (Widuto, 2019).

The theoretical rationale for public intervention rests on market failure arguments. The European Commission recognizes that markets do not naturally generate optimal levels of SME innovation and competitiveness, particularly because knowledge externalities — the returns from research and development accruing to firms other than the investor — reduce private incentives below socially optimal levels (Griffith et al., 2001). ERDF support is intended to correct this failure by reducing the cost of investment for SMEs that would otherwise be credit-constrained or risk-averse.

However, the literature reveals a persistent tension between the redistributive logic of cohesion policy and the competitiveness logic of SME support. Cohesion policy channels the largest share of structural funds toward less developed regions precisely because those regions have the greatest development gaps — yet those same regions typically have the weakest SME ecosystems, the lowest innovation capacities and the most limited absorptive capacity for public support (Boschma, 2005; Rodriguez-Pose, 1999). The present analysis tests whether this structural tension manifests in the 2014–2020 data.

2.2. Defining and Measuring SME Competitiveness

Competitiveness at firm level lacks a single agreed definition, with the Institute for Management Development (IMD, 2004) cataloguing no fewer than 14 distinct formulations in the academic literature. For the purposes of this article, we adopt the multidimensional framework developed by Buckley et al. (Buckley et al., 1998),

which distinguishes three components: competitive performance (past and current market outcomes including profitability, market share and export intensity), competitive potential (internal factors determining future performance, such as R&D capacity and human capital), and competitive process (managerial capabilities and strategic processes that translate potential into performance).

The ERDF monitoring framework operationalizes this through four output indicators: operations and market position (sales growth, market share, costs, profitability, labor productivity); internationalization (export intensity, export share, entry into new foreign markets); financial situation (financial autonomy, current ratio); and capacity to innovate (product/service innovation, R&D activities). The ECA Special Report 8/2022 (ECA, 2022) applied precisely these four dimensions to the 22 audited projects, providing the benchmark against which the present article's financial analysis is evaluated.

2.3. The Absorption-Effectiveness Gap in Structural Funds Research

The tension between financial absorption and policy effectiveness is well-documented in the structural funds literature. Milio (Milio, 2007) demonstrated that absorption capacity — the administrative and institutional ability of member states to access and spend EU funds — is a poor predictor of development outcomes. According to Ederveen et al. (Ederveen et al., 2006), structural funds contribute to economic growth only within environments characterized by high institutional quality. This suggests that while fund absorption is a prerequisite, it is not a standalone guarantee of policy effectiveness.

More recent contributions have focused specifically on the spending rush phenomenon — the acceleration of expenditure toward the end of eligibility periods driven by the n+2/n+3 decommitment rules — as a source of quality deterioration. Dabla-Norris et al. (Dabla-Norris et al., 2012) documented this pattern across multiple EU programming periods, finding that projects approved in the final two years of each period consistently show lower economic returns than those approved in earlier years. The present analysis provides the first quantitative documentation of this phenomenon specifically for ERDF TO3 across all participating member states.

The grant-versus-financial-instruments debate constitutes a related strand of the literature. Tirole (Tirole, 1987) and, more recently, Bosi and Seegmuller (Bosi and Seegmuller, 2010) have shown theoretically that repayable forms of public support create stronger incentive structures for beneficiary selection and investment discipline than non-repayable grants. The European Commission's own evaluations have consistently recommended shifting ERDF SME support toward loans and guarantees, a recommendation that the 2014–2020 data show was largely ignored in practice.

3. Data Sources and Methodology

3.1. Primary Data Sources

This study draws on two primary datasets extracted from the European Commission's ESIF Open Data Portal, complemented by the audit findings of the European Court of Auditors' Special Report 8/2022 (ECA, 2022). The first dataset is the ESIF 2014–2020 Finance Planned Details file (European Commission, 2026a) (extracted 18 March 2026), which contains planned financial allocations for all ESIF programs across all thematic objectives, funds, programme categories and region types. Filtered to ERDF allocations under Thematic Objective 3, the dataset yields

258 records corresponding to 203 distinct operational programs across 26 Member States, with a total planned EU contribution of EUR 42.73 billion. The second dataset is the ESIF 2014–2020 EU Payments Timeseries (European Commission, 2026b) (daily update, 19 March 2026), which contains annual implementation data — planned EU amounts, cumulative payments and payment rates — for all 586 ERDF programs across 29 programme countries and 13 years (2014–2026). The time-series nature of this dataset enables, for the first time, the reconstruction of the full absorption trajectory of TO3 programs from programme launch to final closure.
The two datasets were merged using Programme Title and Member State as the matching key, achieving 100% coverage: all 203 TO3 programs identified in the planned dataset were located in the payments timeseries. For each programme, the most recent annual record (latest period flag) was selected to represent the final state of implementation.

3.2. Analytical Framework

The analysis proceeds in three stages. In the first stage, planned allocations are aggregated by member state, region category and development cluster to establish the distributional profile of TO3 investment. In the second stage, absorption rates are calculated at programme level using the EU Payment Rate on Planned EU Amount indicator from the payments dataset and aggregated by member state to produce a comparative absorption matrix. In the third stage, the temporal dimension is reconstructed using all annual observations across the 2014–2026 horizon, enabling the identification of spending pattern dynamics at both EU aggregate and member state level.
Member states are classified into three development clusters based on the predominant region category of their TO3 allocations: 'Less developed' (LD share > 70% of TO3 EU allocation), 'More developed' (MD share > 70%), and 'Mixed'. This classification allows examination of whether absorption patterns and programme design choices differ systematically across the cohesion gradient.
A key methodological note concerns the interpretation of absorption rates above 100%, observed in Lithuania (105.9%) and France (up to 101.5% in specific programs). These values reflect the inclusion of REACT-EU and CRII+ additional allocations mobilized in response to COVID-19, which supplemented the original 2014–2020 budgetary framework without revising the baseline planned amounts recorded in the Finance Planned Details dataset (European Commission, 2026a).

3.3. Limitations

Several limitations constrain the analysis. First, the absorption rate captures financial execution but not the quality or economic impact of supported investments. Second, the programme-level planned amounts in the Finance Planned Details dataset (European Commission, 2026a) represent only the TO3 portion of multi-fund programs (ERDF/ESF, ERDF/CF), while the payments timeseries (European Commission, 2026b) reports the full programme, introducing a structural mismatch that prevents direct comparison at programme level; member state aggregates are used throughout to mitigate this. Third, the analysis covers the full population of ERDF TO3 programs but relies on the ECA Special Report 8/2022 (ECA, 2022) for project-level effectiveness evidence, which was based on a sample of 24 projects in four member states (Germany, Italy, Poland and Portugal).

4. Empirical Results

4.1. The Distributional Profile of ERDF TO3 Allocations

The 2014–2020 ERDF TO3 allocations exhibit marked geographic and structural concentration. The five largest beneficiaries — Poland (EUR 7.37bn), Italy (EUR 6.66bn), Portugal (EUR 4.01bn), Greece (EUR 3.54bn) and Hungary (EUR 2.98bn) — collectively absorbed EUR 24.56 billion, representing 57.5% of total TO3 EU contributions.

Table 1: Comparative ERDF TO3 Analysis: Planned vs. Actual Absorption per Member State, 2014–2026

Member State	TO3 EU Plan. (bn EUR)	Avg. Absorpt.	Max Absorpt.	Min Absorpt.	Nr. Prog.	Dev. Cluster	% fund. reg. <75% GDP
Poland	7.366	84.5%	99.3%	90.0%	18	Less dev.	100%
Italy	6.657	63.3%	99.3%	94.9%	24	More dev.	100%
Portugal	4.011	69.4%	99.7%	98.0%	8	Less dev.	100%
Greece	3.541	74.9%	100.0%	100.0%	14	Mixed	100%
Hungary	2.982	70.0%	100.0%	100.0%	2	Less dev.	100%
Spain	2.588	67.2%	99.0%	81.1%	21	Mixed	100%
UK	2.165	56.0%	95.6%	78.9%	6	Mixed	100%
Germany	2.140	53.7%	99.9%	99.2%	14	Mixed	100%
Romania	1.874	88.8%	96.9%	93.8%	2	Less dev.	100%
France	1.619	47.9%	101.5%	40.3%	30	Mixed	100%
Croatia	1.294	85.0%	100.0%	100.0%	1	Less dev.	100%
Czechia	1.204	60.0%	100.0%	100.0%	1	Less dev.	100%
Bulgaria	1.082	98.8%	99.3%	96.0%	6	Less dev.	100%
Slovakia	0.832	64.3%	97.0%	97.0%	1	Less dev.	100%
Lithuania	0.567	85.0%	105.9%	105.9%	1	Less dev.	100%
Slovenia	0.436	72.5%	95.7%	95.7%	1	Mixed	100%
Latvia	0.353	85.0%	98.9%	98.9%	1	Less dev.	100%
Sweden	0.350	48.9%	98.4%	90.4%	9	More dev.	100%
Estonia	0.275	84.4%	99.9%	99.9%	1	Less dev.	100%
Finland	0.273	50.0%	99.2%	97.7%	3	More dev.	100%
Belgium	0.251	48.3%	81.3%	59.9%	3	Mixed	100%
Austria	0.170	18.6%	98.3%	98.3%	1	More dev.	100%
Malta	0.065	90.0%	98.9%	97.8%	2	Mixed	100%
Denmark	0.062	55.0%	100.0%	100.0%	1	More dev.	100%
Cyprus	0.050	85.0%	100.0%	100.0%	1	More dev.	100%
Ireland	0.020	50.0%	100.0%	100.0%	2	More dev.	100%
EU-26 AVERAGE	42.73	98.4%	105.9%	40.3%	203	—	67.6%

Sources: ESIF Open Data Portal — Finance Planned Details (18.03.2026) & EU Payments Timeseries (19.03.2026) (European Commission, 2026a; European Commission, 2026b). Own processing.

All five countries operate predominantly in less developed regions and benefit from co-financing rates between 69% and 88%. By region category, 67.6% of all TO3 EU funds (EUR 28.89 billion) were allocated to less developed regions (GDP per capita below 75% of EU average), 18.0% to more developed regions and 12.5% to transition regions. This distribution reflects both the cohesion policy targeting logic and the higher co-financing rates available to poorer regions — a structural feature that, as argued in Section 5, also creates perverse incentives in programme design. Table 1 provides the full comparative overview across all 26 member states. Two cases at opposite ends of the distribution illustrate the extent of variation in programme design. At one end, Ireland committed EUR 20.4 million to TO3 across two programs, targeting over 67,000 SMEs — an average of under EUR 1,000 per firm, far below any threshold of effectiveness. At the other end, Austria committed EUR 170.5 million to a single programme, with an average support of approximately EUR 392,000 per beneficiary SME, representing a concentrated intervention with a higher probability of reaching the critical mass required for competitiveness improvement.

4.2. The Absorption Paradox: Near-Complete Spending, Limited Impact

The most striking finding of the merged dataset analysis is the coexistence of near-complete financial absorption with documented effectiveness shortfalls. At program closure, the weighted average absorption rate for ERDF TO3 across all 26 member states stands at 98.4%. Seventeen of the 26 participating states achieved absorption rates of 99% or above. Only Belgium (81.3%), France (92.2%), the United Kingdom (95.6%), Romania (96.9%) and Slovenia (95.7%) recorded absorption below 97%.

This near-universal absorption performance is remarkable given that the ECA Special Report 8/2022 (ECA, 2022) found that, in the sample of 22 directly supported SMEs examined, a majority did not demonstrate measurable improvement across the four competitiveness dimensions. Specifically: only 14 of 22 showed sales growth; only 6 of 22 improved their market share; only 9 of 22 increased international exposure; and only 3 of 22 demonstrated any improvement in long-term R&D capacity. The simultaneous presence of 98.4% absorption and less-than-majority effectiveness in a rigorously audited sample constitutes the core empirical paradox this article addresses.

Table 2 presents the temporal evolution of ERDF TO3 absorption across the full 2014–2026 horizon. Absorption progressed slowly through the first half of the programming period before accelerating sharply in the final years, tracing a trajectory that is both typical of n+2 decommitment pressure and analytically troubling in its implications for investment quality.

Table 2: Annual Evolution of ERDF TO3 Absorption at EU-27 Level, 2014–2026

Year	Nr. Prog.	Amount paid (bn EUR)	Absorption Rate (%)	Annual growth (pp)
2014	203	0.72	0.7%	—
2015	203	4.85	2.5%	+1.8pp
2016	203	14.77	7.7%	+5.2pp
2017	203	26.24	13.3%	+5.6pp
2018	203	45.73	23.1%	+9.8pp
2019	203	69.63	35.2%	+12.1pp
2020	203	101.01	50.8%	+15.6pp
2021	203	140.52	64.8%	+14.0pp
2022	203	173.45	78.5%	+13.7pp
2023	203	200.66	90.6%	+12.1pp
2024	203	219.35	99.1%	+8.5pp
2025	203	220.64	99.7%	+0.6pp
2026	203	220.64	99.7%	+0.0pp

Source: ESIF Open Data Portal — EU Payments Timeseries (19.03.2026) (European Commission, 2026b). 203 ERDF TO3 programmes from 26 member states.

4.3. The Spending Rush Phenomenon

The temporal pattern documented in Table 2 is striking in its regularity. As late as 2018 — four years into the seven-year programming period — TO3 absorption stood at only 23.1% of planned EU amounts. By 2020, the midpoint of the effective implementation window, absorption had reached 50.8%. The decisive acceleration occurred between 2020 and 2024, when EUR 118.3 billion in additional payments were processed — representing 53.6% of all TO3 spending compressed into four years.

This pattern is consistent with the n+2 decommitment rule, under which unspent ERDF commitments are automatically cancelled two years after the year of budgetary commitment (European Parliament and Council, 2013; European Parliament and Council, 2021). Administrative systems that are slow to launch calls, process applications and certify expenditure in the early years face intensifying pressure in the final years, leading to the relaxation of quality criteria and the approval of projects that would not have passed more rigorous assessment under less time-constrained conditions. The COVID-19 amendments — CRII, CRII+ and REACT-EU — further distorted this pattern by introducing exceptional flexibility provisions in 2020, effectively enabling member states to reallocate unspent TO3 funds to emergency SME support without the usual competitiveness focus.

4.4. Geographic and Structural Patterns

Cross-member-state analysis reveals three structural patterns with direct implications for programme effectiveness.

First, the critical-mass problem is geographically differentiated. Member states that distributed TO3 support among the largest numbers of SMEs — Ireland (67,000+), France (161,200) and Spain (299,200) — achieved the lowest average support per beneficiary, mathematically reducing the likelihood of reaching investment thresholds that generate measurable competitiveness improvements (ECA, 2022).

Member states with more concentrated approaches — Austria (435 SMEs), Estonia (approximately 1,200 SMEs) and Luxembourg — delivered substantially higher per-firm support, consistent with the ECA finding that an average of EUR 42,000 per project across the EU is insufficient to fund the combination of investments required for competitiveness improvement.

Second, the development cluster analysis reveals that less developed member states systematically direct a higher proportion of their TO3 funds toward individual productive investment — primarily equipment replacement — rather than toward the combination of R&D capacity building, internationalization support and management development that the literature identifies as drivers of sustainable competitiveness (Boschma, 2005; Rodriguez-Pose, 1999). This reflects both the lower baseline capacity of SMEs in these regions and the incentive structure created by high co-financing rates, which make any eligible expenditure attractive regardless of strategic value.

Third, the grant-versus-instruments imbalance is universal but more pronounced in less developed regions. The weighted average co-financing rate of 72.4% in less developed regions — compared to 50–55% in more developed regions — amplifies the 'free money' effect documented by Tirole (Tirole, 1987), under which beneficiaries make investment decisions they would not make with own funds, systematically reducing investment quality.

5. Discussion: The Structural Causes of the Absorption-Effectiveness Gap

5.1. The Absence of Strategic Alignment

The root cause of the absorption-effectiveness gap identified in this analysis is structural: for the 2014–2020 period, the ERDF regulation (European Parliament and Council, 2013) did not require member states to align their TO3 programs with national or regional SME competitiveness strategies. In contrast, Thematic Objective 1 (Research and Innovation) required member states to develop Smart Specialization Strategies (RIS3) as a precondition for funding access — a requirement that demonstrably improved the strategic coherence of TO1 interventions. The absence of an equivalent enabling condition for TO3 meant that managing authorities designed programs to disburse funds within eligibility deadlines rather than to address the specific factors limiting SME competitiveness in their regions.

This structural weakness is confirmed by the ECA finding (ECA, 2022) that the Commission had only limited means to ensure that ERDF TO3 funding targeted sectors with the highest growth potential. In multiple member states, programme calls were designed to fund any eligible SME investment rather than investments addressing identified competitiveness bottlenecks. The result, documented across our full 26-country dataset (European Commission, 2026a; European Commission, 2026b), is a convergence of absorption rates that masks a divergence of strategic intent and programme quality.

5.2. The Non-Competitive Selection Problem

A second structural cause is the systematic use of non-competitive selection procedures. The ECA Special Report 8/2022 (ECA, 2022) found that ERDF project funding mostly took place through open calls in which every application meeting

minimum selection criteria received financing. Non-competitive selection procedures, however administratively expedient and legally sound, are structurally incompatible with the allocation of scarce public funds to SMEs with the highest growth and competitiveness potential. The empirical consequences of this incompatibility are documented throughout the dataset. In member states adopting broad-coverage approaches — Ireland, France, Spain — the per-SME support amounts fall below any threshold of strategic relevance. France exemplifies the critical-mass problem most acutely: distributing EUR 1.62 billion across 30 operational programs and 161,200 beneficiary SMEs reduces the average intervention to EUR 10,050 per firm, a sum insufficient to finance any investment with a credible prospect of altering competitive position in a sustained manner. A competitive selection procedure that directed the same total amount to the 10% of SMEs with the highest growth potential would, by definition, have delivered a tenfold increase in per-firm intensity.

5.3. The Grant Dominance and Moral Hazard

The preference for non-repayable grants over financial instruments represents the third structural cause of effectiveness shortfalls. The ECA (ECA, 2022) found that ERDF financing took the form of grants in most cases, despite evidence from the EIB and COSME programs that loan guarantees and equity instruments generate higher leverage effects and better investment discipline.

Our data reveal an important nuance: none of the audited SMEs cited difficulty accessing external financing as a principal obstacle to competitiveness. This undermines the standard market failure justification for grant support — that SMEs cannot access credit markets on reasonable terms (European Commission, 2006; European Commission, 2010). If credit access is not the binding constraint, then non-repayable grants are poorly targeted: they subsidize investments that would have been made without public support (the deadweight problem documented in 74 of 22 ECA projects (ECA, 2022)), while failing to create the financial discipline that repayable instruments would impose.

The displacement effects documented in five of the 22 ECA projects (ECA, 2022) — where ERDF support to one SME measurably reduced the market share of competing non-beneficiary SMEs in the same regional market — further illustrate the perverse consequences of indiscriminate grant provision. In such cases, ERDF support does not create net competitiveness improvement at regional level but merely redistributes existing competitive positions, reducing the overall social return on public investment.

5.4. The COVID-19 Disruption and Its Implications

Superimposed on these structural weaknesses, the COVID-19 pandemic introduced a further confounding variable whose effects on programme absorption and investment quality are difficult to disentangle from the underlying programmatic dynamics. The CRII, CRII+ and REACT-EU regulations, adopted in 2020, provided exceptional flexibility that allowed member states to redirect unspent TO3 funds toward emergency SME support — working capital, liquidity provision and employment retention — without the usual competitiveness focus. Italy illustrates this dynamic most sharply: the revision of programme targets saw the number of supported SMEs expand from approximately 130,000 to over 630,000, with the

inevitable consequence that average per-firm support fell from EUR 51,000 to under EUR 10,000 — a fivefold dilution of intervention intensity.

While the emergency justification for this redirection is understandable, its legacy for competitiveness outcomes is negative: the bulk of COVID-19 ERDF support funded activities — working capital, hygiene equipment, and remote working infrastructure — that do not contribute to the sustained competitiveness improvements that TO3 was designed to deliver (European Commission, 2020). Our timeseries data (European Commission, 2026b) show the financial footprint of this disruption clearly: the exceptional acceleration of payments in 2020–2021 coincides precisely with the COVID-19 emergency reallocation period.

6. Conclusions and Policy Recommendations

6.1. Summary of Main Findings

This article has demonstrated, through the first comprehensive comparative analysis of ERDF TO3 implementation across all 26 participating member states, that financial absorption and policy effectiveness are largely orthogonal dimensions of structural fund performance. A 98.4% average absorption rate — one of the highest in ERDF history — coexists with documented effectiveness shortfalls at project level (ECA, 2022), structural design weaknesses at programme level and systematic misalignment between fund distribution and competitiveness targeting at member state level (European Commission, 2026a; European Commission, 2026b).

Six structural findings emerge from the analysis. First, the critical-mass problem is pervasive: the EUR 42,000 average support per SME at EU level is insufficient to fund the combination of investments required for durable competitiveness improvement (Buckley et al., 1998). Second, the spending rush is universal: 53.6% of all TO3 payments were compressed into 2020–2024, systematically reducing investment quality under deadline pressure (Dabla-Norris et al., 2012). Third, the grant dominance creates moral hazard: high co-financing rates reduce beneficiary investment discipline and generate deadweight and displacement effects (Tirole, 1987). Fourth, the absence of strategic alignment allowed managing authorities to prioritize administrative absorption over economic targeting (Milio, 2007). Fifth, geographic concentration in less developed regions — while consistent with cohesion policy logic — amplifies all four structural weaknesses (Boschma, 2005; Rodriguez-Pose, 1999). Sixth, COVID-19 emergency reallocations further diluted the competitiveness focus of an already weakened instrument (European Commission, 2020).

6.2. Recommendations for the 2028–2034 Programming Cycle

Four policy recommendations follow from these findings, targeted at the ongoing design of the next ERDF programming period (European Parliament and Council, 2021).

First, mandatory strategic alignment should be introduced as an enabling condition for TO3 funding — analogous to the RIS3 requirement for TO1. Managing authorities should be required to demonstrate, ex ante, that their SME competitiveness programs address identified structural bottlenecks in their regional economy and target sectors with measurable growth potential.

Second, competitive selection should be made the default procedure for ERDF SME grants. Non-competitive selection — funding all applications meeting minimum criteria — should require explicit justification and Commission approval. This single reform would, by design, concentrate available resources on the SMEs with the highest competitiveness potential.

Third, the instrument mix should shift systematically toward repayable aid. The Commission's recommendation to prioritize financial instruments over grants for SME competitiveness support has been consistently confirmed by the evidence (Bosi and Seegmuller, 2010; Tirole, 1987). A minimum allocation threshold — analogous to the low-carbon economy instrument requirement — should be introduced for financial instruments within TO3 budgets.

Fourth, the n+2 decommitment rule should be complemented by front-loading incentives that reward early and high-quality project approval rather than penalizing only late spending (Dabla-Norris et al., 2012). Performance bonuses for member states that demonstrate above-average competitiveness outcomes in mid-term evaluations would create incentives for quality-oriented rather than absorption-oriented programme management.

6.3. Directions for Future Research

This article establishes the financial-analytical foundation for the research programme. Two directions for subsequent work are identified. First, Article 2 of the planned series will examine the grant-versus-instruments question in depth, drawing on the ESIF categorization dataset to map the instrument mix per member state and correlate it with competitiveness outcome indicators from the ESIF common output indicators. Second, a case study of Romania — the largest beneficiary among EU-13 member states with a 96.9% absorption rate but significant documented implementation challenges — will provide a NUTS-2 regional analysis within the framework established here.

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NON-REPAYABLE SUBSIDIES AND FINANCIAL PERFORMANCE OF BENEFICIARY FIRMS: EVIDENCE FROM THE WESTERN DEVELOPMENT REGION OF ROMANIA, 2014–2023

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Abstract: *This article examines the financial performance of firms that received non-repayable subsidies under the 2014–2020 EU programming period in the Western Development Region of Romania, drawing on longitudinal data spanning 2014–2023. Drawing on aggregated ORBIS data (Bureau van Dijk) — operating revenue, value added, net income, EBITDA, total assets, equity and employment — converted to RON at annual average BNR exchange rates, and contextualised against INS and Eurostat regional benchmarks, the study addresses three research questions: (i) how did the financial performance of subsidised firms evolve between 2014 and 2023? (ii) what is their relative contribution to the regional economy? (iii) what growth differential is observable between the beneficiary sub-population and the regional economy over the 2014–2023 period, and which among subsidy additionality, selection bias, or sectoral composition effects offers the most plausible descriptive account of that differential? Results show that aggregate turnover grew 4.8× (RON 493M → RON 2,370M) and value added 5.5× (RON 133M → RON 738M), consistently outpacing the 2.35× growth of regional GVA. Their share in regional GVA doubled from 0.24% to 0.57%. Net profitability remained stable at 8.8–12.7%. Labour productivity in subsidised firms, while growing substantially, remained at approximately 35–43% of the regional average throughout the decade, a pattern consistent with employment-intensive rather than high value-added growth, partly attributable to employment conditionalities embedded in applicant guides.*

Keywords: *non-repayable subsidies; cohesion policy; ERDF; firm performance; value added; Western Development Region; Romania; 2014–2023*

JEL Classification: *G38; H81; R11; R58; L25; O18*

1. Introduction

The question of whether public subsidies improve the long-term financial performance of recipient firms remains contested in the cohesion policy literature. Non-repayable grants provide immediate capital access and bridge financing gaps yet may reduce investment efficiency and create dependence on public support (Stiglitz & Weiss, 1981; Aghion & Bolton, 1997). The Western Development Region of Romania — comprising Timiș, Arad, Caraș-Severin and Hunedoara — is a particularly relevant context: eligible for structural fund support under the Convergence Objective, its firms that successfully accessed subsidies represent a selected sub-population that passed project selection criteria, implemented investment projects and were subject to monitoring obligations.

Three research questions structure the analysis: RQ1 — How did aggregate financial performance of subsidised firms evolve between 2014 and 2023? RQ2 — What is their relative contribution to the regional economy, and how did this evolve? RQ3 — What growth differential is observable between subsidised firms and the regional economy across financial, value-added and employment dimensions, and which alternative explanations — subsidy additionality, selection effect, or sectoral composition — are consistent with the descriptive evidence?

The original contribution is threefold: (i) the first longitudinal financial profile of ERDF subsidy beneficiaries in the Western Region using ORBIS data across the full 2014–2023 period; (ii) a multi-level comparison framework linking firm-level indicators with regional macroeconomic benchmarks; (iii) descriptive longitudinal evidence of systematically above-average growth trajectories in the beneficiary sub-population, with explicit acknowledgement that causal attribution to subsidy additionality, selection effects, or sectoral composition cannot be determined from aggregate population-level data.

2. Theoretical Framework and Literature Review

2.1. Economics of Public Subsidies to Firms

The theoretical case for public subsidies rests on the market failure framework. Berger & Udell (1998) documented that young and small firms face a financial life-cycle problem in which access to external debt is severely limited, creating a financing gap only public intervention can bridge. In less developed regions, this is compounded by underdeveloped local financial markets (Honohan, 2010). Against this, moral hazard theory (Aghion & Bolton, 1997) argues that non-repayable grants reduce the incentive for efficient investment selection. Lach (2002) found that subsidies increased R&D investment but partially crowded out private investment; Bronzini & Iachini (2014) document positive investment effects but no short-run profitability impact for Italian SME subsidies.

The cohesion policy literature generally finds positive but modest regional growth effects (Becker et al., 2010; Pellegrini et al., 2013). Criscuolo et al. (2019) found significant positive effects on employment and investment from UK regional policy, but not on productivity — a result directly relevant to the research questions addressed here.

2.2. Value Added as the Core Performance Metric

Value added (VA) — operating revenue minus purchased goods and services costs — measures the genuine economic contribution of the firm to national income. It aligns directly with the GVA aggregate published by Eurostat, enabling a methodologically coherent multi-level comparison. The comparison between ORBIS value added per employee and regional GVA per employee (INS) is methodologically appropriate as a scale benchmark because both numerators are value-added measures and both denominators are headcount measures. This comparison is used solely to establish the relative productivity position of the beneficiary sub-population within the regional economy and does not imply that observed differentials are attributable to subsidy effects. VA is robust to sectoral differences in input intensity, making it the appropriate primary metric for a heterogeneous population of subsidised firms spanning multiple sectors.

2.3. The Western Region in the National Context

In 2014, the Western Region's GVA stood at RON 54.9bn. By 2023 it grew to RON 129.1bn — a 2.35× increase in nominal terms. In comparative regional terms, this growth was below Nord-Vest (2.60×) and Centru (2.40×), and well below Bucharest-Ilfov (2.77×), which widened the absolute dominance gap with all other regions. The Western Region's employment base showed structural stability: total employees across all active local units remained essentially flat at approximately 403–434 thousand throughout 2014–2023, reflecting a mature labour market with limited workforce expansion but improving productivity.

This macroeconomic context is essential for interpreting the performance of subsidised firms: growth above the regional trend is consistent with subsidy-related additionality, while growth in line with the trend is consistent with a selection effect only.

3. Data Sources and Methodology

3.1. Primary Data Sources

Three primary datasets are triangulated. First, ORBIS (Bureau van Dijk) provides aggregated financial data for all Western Region firms receiving non-repayable subsidies in 2014–2020: turnover, value added, net income, EBITDA, total assets, equity and employees, for the period 2014–2023. ORBIS data are expressed in USD; conversion to RON uses annual average BNR exchange rates presented in Table 1. Second, INS (2024) provides aggregate turnover of all active local units in the Western Region by firm-size class (2007–2023, million RON), as well as employment data by firm-size class and development region. Third, Eurostat (2025) (series nama_10r_3gva, NUTS 2) provides GVA at current prices in million RON for all eight Romanian development regions (2007–2023).

An important methodological note concerns the comparability of these sources. ORBIS aggregates cover exclusively the sub-population of subsidised firms, while INS and Eurostat aggregates cover the entire regional economy including all firm categories and sectors. Comparisons between these sources are therefore used to establish the relative scale and growth trajectory of subsidised firms within the broader regional context, under the implicit assumption that: (i) both numerators are value-added measures; (ii) both denominators are headcount measures; (iii) the comparison serves as scale-benchmarking, not causal attribution; and (iv) the sectoral composition of the regional economy is broadly stable over the period.

Table 1. Annual average RON/USD exchange rates (BNR, 2014–2023)

Year / Rate RON–USD	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
BNR annual avg. (RON/USD)	3.3492	4.0057	4.0592	4.0510	3.9398	4.2608	4.2440	4.9204	4.6917	4.5742

Sources: National Bank of Romania (BNR), average annual exchange rates 2014–2023.

3.2. Key Variables and Indicators

Five categories of indicators are constructed. First, absolute financial performance indicators (million RON): operating revenue, value added, net income, EBITDA, total assets, and equity — each derived from ORBIS USD aggregates converted at the BNR annual average rate. Second, profitability ratios: net margin, EBITDA margin, and ROE. Third, employment and productivity indicators: labour productivity

computed as value added per employee (thousand RON per employee) for both subsidised firms and the regional average. Fourth, relative contribution indicators: shares of subsidised firms in regional turnover, GVA and employment (INS). Fifth, growth indices (base 2014 = 100) for all key series, enabling direct comparison of growth trajectories between subsidised firms and the regional economy.

3.3. Methodological Limitations and Scope of Inference

Three fundamental limitations constrain the analysis. First, ORBIS data are aggregated at population level — not a firm-level panel — precluding causal identification strategies such as difference-in-differences, propensity score matching or regression discontinuity design. This study is explicitly a descriptive and exploratory analysis; all results are interpreted as descriptive associations, not causal estimates. Second, no distinction is made by sector, CAEN code, programme axis, grant value, or firm-size class (micro vs. small vs. medium), given data constraints at this aggregation level; firm-size heterogeneity is a specific limitation since the productivity profile of a micro-firm beneficiary differs structurally from that of a medium enterprise. Third, the comparison between ORBIS aggregates and INS aggregates conflates genuine subsidy effects with the characteristics of the selected beneficiary population; disentangling them requires a firm-level counterfactual with a matched control group of non-beneficiary firms, identified as priority for future research.

4. Empirical Results

4.1. Financial Performance of Subsidised Firms (2014–2023)

Table 2 presents the complete longitudinal financial profile across the full 2014–2023 decade. Operating revenue grew from RON 493.4M in 2014 to RON 2,370.3M in 2023 — a 4.8-fold nominal increase. Value added grew from RON 133.1M to RON 738.2M (5.5×), outpacing turnover and indicating improving value-added content. Net income expanded from RON 43.7M to RON 209.4M (4.8×). The total asset base expanded 6.2× (RON 426.3M → RON 2,628.2M). Employment more than doubled from 2,920 to 5,921 employees, with consistent year-on-year growth including during COVID-19 (2020–2021). The years 2021 and 2022, now fully reconstructed from the complete ORBIS extract, confirm the continuity of the growth trajectory: operating revenue reached RON 1,958.5M and RON 2,082.8M respectively, while value added progressed to RON 555.9M and RON 616.8M.

Table 2. Aggregate financial indicators of subsidised firms, Western Development Region, 2014–2023 (mil. RON)

Indicator	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Operating Revenue (mil. RON)	493.4	661.7	766.2	1,078.7	1,108.8	1,389.0	1,529.4	1,958.5	2,082.8	2,370.3
Value Added (mil. RON)	133.1	171.8	202.2	267.5	291.4	399.8	464.2	555.9	616.8	738.2
Net Income (mil. RON)	43.7	68.0	95.3	124.2	140.8	169.8	170.2	215.6	206.0	209.4
EBITDA (mil. RON)	82.1	116.5	149.5	188.6	208.5	277.9	319.7	356.3	385.0	428.8
Total Assets (mil. RON)	426.3	560.2	623.0	859.7	1,122.2	1,369.6	1,713.3	2,353.9	2,391.2	2,628.2
Equity Capital (mil. RON)	183.9	252.3	276.4	370.3	454.8	566.5	693.7	874.3	807.4	930.3
No. of Employees	2,920	3,235	3,548	3,879	4,274	4,783	5,038	5,414	5,750	5,921

Sources: ORBIS (Bureau van Dijk, 2025); BNR annual average exchange rates. Values converted from USD to RON using rates in Table 1.

4.2. Profitability and Labour Productivity

Table 3 presents derived profitability and productivity ratios for the complete 2014–2023 period. Net profitability was remarkably stable across the decade, ranging between 8.8% and 12.7%. The years 2021 and 2022 show net margins of 11.0% and 9.9% respectively, reflecting the onset of inflationary pressures on input costs. ROE remained high throughout (22.5–34.5%). The EBITDA margin (16.6–20.9%) signals strong operational cash generation capacity.
Labour productivity in subsidised firms grew from RON 45,600 per employee in 2014 to RON 124,700 in 2023 (2.74× nominal). The intermediate years 2021 and 2022 record productivity levels of RON 102,700 and RON 107,300 per employee. However, regional average labour productivity grew from RON 130,900 to RON 312,700, remaining consistently 2.5–3.0× above the subsidised firm average. The productivity ratio oscillated between 0.35 and 0.43 with no convergence trend, reaching 0.43 in 2021 before reverting to 0.38 in 2022 and 0.40 in 2023 — the central structural finding of this study.

Table 3. Profitability ratios and labour productivity — subsidised firms vs. regional average, 2014–2023

Indicator	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Net Margin (%)	8.9	10.3	12.4	11.5	12.7	12.2	11.1	11.0	9.9	8.8
EBITDA Margin (%)	16.6	17.6	19.5	17.5	18.8	20.0	20.9	18.2	18.5	18.1
ROE (%)	23.8	27.0	34.5	33.5	31.0	30.0	24.5	24.7	25.5	22.5
Labour Prod. — subsidised (th. RON/emp.)	45.6	53.1	57.0	69.0	68.2	83.6	92.1	102.7	107.3	124.7
Labour Prod. — regional avg. (th. RON/emp.)	130.9	140.3	150.9	167.0	190.3	212.8	218.8	238.2	279.0	312.7
Productivity Ratio (subsidised/regional)	0.35	0.38	0.38	0.41	0.36	0.39	0.42	0.43	0.38	0.40

Sources: ORBIS (Bureau van Dijk, 2025); BNR; INS (2024). Regional labour productivity = regional GVA (INS) / total regional employees (INS).

4.3. Regional Contribution and Growth Dynamics

Table 4 presents the shares of subsidised firms in the regional economy and comparative growth indices. In 2014, subsidised firms accounted for 0.50% of regional turnover and 0.24% of regional GVA. By 2023 these had risen to 1.11% and 0.57%. The years 2021 and 2022 reveal that the GVA share peaked at 0.57% in 2021, dipped marginally to 0.55% in 2022 — reflecting faster growth of the regional GVA denominator — before stabilising at 0.57% in 2023. The growth differential is consistent and substantial: the CA index of subsidised firms reached 480.4 by 2023 versus 219.3 for total regional turnover; the VA index reached 554.6 versus regional GVA 235.2. Employment in subsidised firms expanded by 102.8% while total regional employment contracted marginally (index 98.5).

Table 4. Share of subsidised firms in the Western Region economy and growth indices (base 2014=100), 2014–2023

Indicator	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Share in regional CA (%)	0.50	0.62	0.65	0.84	0.79	0.95	1.09	1.18	1.04	1.11
Share in regional GVA (%)	0.24	0.29	0.31	0.37	0.36	0.44	0.52	0.57	0.55	0.57
Share in regional employment (%)	0.70	0.76	0.82	0.89	1.00	1.12	1.24	1.32	1.43	1.43
Index CA — subsidised (2014=100)	100.0	134.1	155.3	218.6	224.7	281.5	310.0	396.9	422.1	480.4
Index CA — Western Region	100.0	109.1	119.9	131.4	143.5	149.6	143.2	170.0	205.4	219.3
Index VA — subsidised (2014=100)	100.0	129.1	151.9	201.0	218.9	300.4	348.8	417.7	463.4	554.6
Index GVA — Western Region	100.0	108.6	118.8	132.1	148.3	165.0	162.3	177.6	205.0	235.2
Index employees — subsidised	100.0	110.8	121.5	132.8	146.4	163.8	172.5	185.4	196.9	202.8
Index employees — region	100.0	101.3	103.1	103.6	102.0	101.5	97.2	97.6	96.2	98.5

Sources: ORBIS (Bureau van Dijk, 2025); BNR; INS (2024). Growth indices: base year 2014 = 100. Regional CA and GVA from INS Tempo Online.

5. Discussion

5.1. Performance or Selection?

Three non-mutually exclusive explanations are consistent with the data. A first possible explanation is a genuine subsidy effect: if selection and composition effects are held constant, grants may have reduced the cost of capital investment and enabled capacity expansion at rates not achievable under market financing alone — a hypothesis consistent with the 6.2× asset base growth observed over the study period, but which cannot be confirmed or quantified from aggregate population-level data alone. A selection effect: project selection criteria favour firms with above-average growth potential, so observed outperformance partly reflects ex-ante quality rather than subsidy impact. A composition effect: subsidised firms' sectoral tilt towards manufacturing and agro-industry generates structurally higher nominal growth than the regional average. Given that population-level aggregated data preclude formal disentanglement of these three mechanisms, the results should be interpreted as descriptive evidence consistent with the coexistence of all three effects.

5.2. The Productivity Paradox and the Employment Conditionality Effect

The persistence of the productivity gap — subsidised firms at approximately 35–43% of the regional average throughout the decade despite substantially above-average growth — constitutes the central structural finding of this study. The complete 2021–2022 data reinforce this conclusion: even as productivity in subsidised firms reached RON 102,700 and RON 107,300 per employee, the regional benchmark had already moved to RON 238,200 and RON 279,000.

Two interpretations are relevant. The first concerns sectoral profile: subsidised firms are predominantly in labour-intensive manufacturing, agro-processing or food industry — priority sectors of the 2014–2020 Regional Operational Programme — whose lower per-employee VA is a structural feature of the sector. The second concerns the employment conditionality embedded in programme design: the applicant guides governing ERDF TO3 grants imposed an explicit employment retention requirement, structurally in tension with the productivity objective of the

instrument. A firm that expands its workforce in response to a regulatory requirement will, all else equal, experience a dilution of value added per employee even when absolute VA increases. This possibility — that support instruments may have favoured employment expansion rather than efficiency gains — cannot be excluded and constitutes an important caveat in the interpretation of the productivity results.

5.3. Employment Dynamics: The Full Decade Picture

Table 5 presents the complete employment trajectory for the 2014–2023 period. Employment in subsidised firms grew by 102.8% between 2014 and 2023 (index 202.8), compared to a 1.5% contraction in total regional employment (index 98.5). The chain growth indices confirm that the workforce expansion trajectory was not disrupted by the COVID-19 shock: 2021 (1.075) and 2022 (1.062) both register positive growth. By contrast, total regional employment contracted in 2020 (0.957) and 2022 (0.985) before recovering in 2023 (1.024).

Table 5. Employment in subsidised firms versus total employment in the Western Region, 2014–2023

Indicator	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Employees in subsidised firms	2,920	3,235	3,548	3,879	4,274	4,783	5,038	5,414	5,750	5,921
Total employees — Western Region	419,228	424,847	432,289	434,461	427,650	425,688	407,355	409,270	403,310	412,921
Share subsidised / total (%)	0.70 %	0.76 %	0.82 %	0.89 %	1.00 %	1.12 %	1.24 %	1.32 %	1.43 %	1.43 %
Chain growth index — subsidised	—	1.108	1.097	1.093	1.102	1.119	1.053	1.075	1.062	1.030
Chain growth index — Western Region	—	1.013	1.018	1.005	0.984	0.995	0.957	1.005	0.985	1.024
Fixed-base index subsidised (2014=100)	100.0	110.8	121.5	132.8	146.4	163.8	172.5	185.4	196.9	202.8
Fixed-base index Western Region (2014=100)	100.0	101.3	103.1	103.6	102.0	101.5	97.2	97.6	96.2	98.5

Sources: ORBIS (Bureau van Dijk, 2025) for subsidised firm employment; INS (2024), Tempo Online, employees by development region. Own processing.

5.4. Implications for 2021–2027

Three design implications follow for the 2021–2027 programming period. The financial maturity principle suggests that the additionality test for grant allocations should incorporate a forward-looking productivity component. The intermediary capacity principle follows from the consistent profitability of subsidised firms (net margins 8.8–12.7%, ROE above 22% throughout the decade), demonstrating substantial debt-absorption capacity in the beneficiary population. The complementarity principle recognises that the employment trajectory documented here is consistent with subsidies functioning as effective net job-creation vehicles, though this employment expansion came at the cost of productivity dilution.

5.5. Two-Phase Growth Dynamic

The complete longitudinal data reveal two structurally distinct growth phases. Phase 1 (2014–2019) coincides with the active subsidy deployment period, with value added growing at a CAGR of +24.6% per year. Phase 2 (2019–2023) represents a consolidation period: growth decelerated but remained substantially above the regional average, with value added CAGR of +16.6% versus regional GVA CAGR of

+9.4% — a premium of 7.2 percentage points. The 2021–2022 data confirm that subsidised firms navigated the post-COVID inflationary environment without structural deterioration: EBITDA margins remained in the 18.2–18.5% range and employment continued to expand.

6. Conclusions

This study provides the first complete longitudinal financial profile of ERDF subsidy beneficiaries in the Western Development Region, triangulating ORBIS/BNR (Bureau van Dijk, 2025) and INS (2024) data across the full 2014–2023 period. The findings address the three research questions as follows.

RQ1 — Financial performance evolution: subsidised firms exhibited substantial and consistent growth across all financial dimensions. Turnover grew 4.8× (RON 493M → RON 2,370M), value added 5.5× (RON 133M → RON 738M), and total assets 6.2× (RON 426M → RON 2,628M). Net profitability remained stable at 8.8–12.7% and ROE above 22% throughout. Employment more than doubled (2,920 → 5,921), with uninterrupted year-on-year growth including during COVID-19.

RQ2 — Relative regional contribution: the share of subsidised firms in regional GVA doubled from 0.24% (2014) to 0.57% (2023); the employment share grew from 0.70% to 1.43%. The 2021 data confirm that the doubling of relative economic weight was achieved before the end of the study period.

RQ3 — Growth differential and productivity: subsidised firms grew materially faster than the regional economy (VA ratio 2.36:1; CA ratio 2.19:1 relative to regional growth), documenting a sustained descriptive growth differential whose causal attribution to subsidy additionality, selection effects, or sectoral composition cannot be determined from the available aggregate data. Labour productivity reached RON 124,700 per employee by 2023 (from RON 45,600) but remained at approximately 35–43% of the regional average with no convergence trend. The complete 2014–2023 data confirm that this persistent gap is a structural feature of the beneficiary population, not a temporary artefact.

The principal research limitation — use of population-aggregated ORBIS data precluding causal identification — defines the agenda for future work: (i) firm-level panel construction with propensity-score-matched controls; (ii) disaggregation by sector, programme axis and grant amount; (iii) separate tracking of employment and productivity outcomes in the 2021–2027 monitoring framework.

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ECO-INNOVATION PERFORMANCE IN THE EU-27: A DESCRIPTIVE AND COMPARATIVE ANALYSIS BASED ON THE ECO-INNOVATION INDEX

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Abstract: *Eco-innovation represents a key driver of the European Union's transition towards a resource-efficient, low-carbon economy. This paper provides a descriptive and comparative assessment of eco-innovation performance across EU Member States over the period 2014–2024, using the Eco-Innovation Index (EII). The analysis draws on official EU-27 time-series data and employs descriptive statistical measures to examine cross-country dynamics, complemented by ranking and change analyses to identify leading, lagging, and catching-up countries. The results indicate a clear upward trend at the EU level, with the EU-27 aggregate index increasing from 100 in 2014 to 127.5 in 2024. Cross-country statistics point to broadly shared progress, as both the mean EII rises from 90.31 in 2014 to 120.88 in 2024 and the median from 84.7 to 116.5. Nevertheless, substantial heterogeneity persists, as evidenced by the wide range of values in 2024 (min 58.8 vs max 180.8). Finland, Denmark, Austria, Luxembourg, and Sweden lead the 2024 ranking, while Bulgaria, Hungary, Poland, Romania, and Greece remain at the lower end of the distribution. Long-run change estimates point to rapid improvements in countries such as Lithuania, Ireland, and Malta, contrasted with modest increases or even decline in some cases (e.g., Romania). Overall, the findings suggest strong aggregate progress alongside persistent structural disparities, bringing into discussion the need for differentiated policy support and further research into the underlying drivers and component dimensions of eco-innovation performance.*

Keywords: *eco-innovation; Eco-Innovation Index; European Union; circular economy.*

JEL Classification: *O31; Q55; Q56*

1. Introduction

Innovation, traditionally viewed as a driver of economic growth, is increasingly complemented by eco-innovation, reflecting a broader shift from conventional growth toward sustainable growth (Peyravi, Peleckis and Jakubavičius, 2023). Within the European context, the discussion is explicitly connected to the EU's eco-innovation agenda, associated policy support measures, and the objectives of the Green Deal and the transition toward a circular economy. Eco-innovation constitutes a key mechanism for addressing the European Union's pressing environmental challenges while simultaneously supporting sustainable economic growth (Henriques, Viseu and Sousa, 2025).

The link between circular economy and eco-innovations is discussed in numerous studies (Pichlak and Szromek, 2022; Peyravi et al., 2024; Afolabi, 2025; Bui et al., 2026). Eco-innovation is seen as a key organisational enabler of the circular economy (CE) because it provides the product, process, and organisational changes needed to replace linear *take–make–dispose* systems with closed-loop material flows (Pichlak and Szromek, 2022). Environmental orientation (internal and external) strengthens both eco-product and eco-process innovation, which in turn increases circular economy practices and improves sustainable performance (Bui et al., 2026). Afolabi (2025) examines the effects of eco-innovation, economic complexity, and digitalization on circular economy performance and demonstrates that all three factors significantly enhance circularity, with digitalization exerting the strongest and most consistent influence across all levels of circular economy development. Eco-innovation plays a particularly important role in countries with lower circular economy performance, while economic complexity delivers greater gains in more advanced economies. These findings suggest that the circular transition is highly context-dependent and requires differentiated policy approaches.

The qualitative study of Hojnik et al. (2023) highlights the pivotal role of digitalization and demographic change in advancing eco-innovation and supporting the transition toward a circular economy. Based on in-depth interviews with companies actively engaged in eco-innovative and circular practices, the findings show that digital technologies enhance transparency, process control, and resource efficiency, thereby reducing energy consumption and environmental impacts. Additionally, demographic shifts influence firms to adapt products and services to evolving consumer needs, reinforcing the strategic alignment between eco-innovation, digital transformation, and circular economy implementation.

Empirical evidence from manufacturing firms shows that product and process innovation improve eco-efficiency primarily through closed-loop production practices, while cleaner production practices play a weaker mediating role. Zhang et al. (2025) demonstrate that closed-loop production significantly mediates the relationship between innovation and eco-efficiency, highlighting that strategic circular practices are more effective than operational cleaner production measures in achieving environmental sustainability.

Another study (Parrilli, Balavac-Orlic and Radicic, 2025) that examines eco-innovation in European SMEs through the lens of *business innovation modes*, shows that firms adopt distinct combinations of science-based (STI) and learning-based (DUI) practices whose effectiveness varies across European macro-regions. The findings reveal that eco-innovation outcomes depend not only on firm-level practices but also on institutional and technological contexts.

The main objective of the paper is to assess the evolution and distribution of eco-innovation performance in the European Union (EU-27) during the period 2014–2024, using the total Eco-Innovation Index (EII), through a descriptive and comparative statistical analysis, in order to identify aggregate trends, differences between Member States, and the dynamics of progress (leaders vs. catching-up).

2. Theoretical background

In the literature, several researchers have focused on identifying and explaining the determinants of eco-innovation. In their analysis, Eryigit and Özcüre (2015) conceptualize eco-innovation as a strategic response that enables firms to achieve

environmental sustainability while enhancing long-term competitiveness, particularly in developing economies. The authors emphasize that eco-innovation is driven by regulatory pressure, market demand, and stakeholder expectations. Empirical evidence for the EU shows that both internationalisation and digitalisation are key drivers of eco-innovation. Vasconcelos-Garcia and Carrilho-Nunes (2024) demonstrate that foreign direct investment initially hampers eco-innovation but exerts a positive effect after two years. In contrast, digitalisation consistently enhances eco-innovation, supporting the *twin transition* hypothesis, whereby digital transformation complements the shift towards low-carbon and resource-efficient practices. Based on using the method of moment quantile regression, Usman et al. (2024) show that digitalization is a strong and consistent driver of eco-innovation across all quantiles. Natural resources display an asymmetric effect, stimulating eco-innovation at lower quantiles but constraining it at higher ones, reflecting inefficient resource use. By contrast, globalization generally exerts a negative impact on eco-innovation, highlighting the need for digital-led and resource-efficient policies to support sustainable innovation.

Considering a large European sample of SMEs and large firms, Rodríguez-Rebés et al. (2024) reveal that organisational innovation—especially new methods of organising work responsibilities and decision-making—is a key driver of eco-innovation in SMEs. Unlike large firms, SMEs' organisational eco-innovation is less influenced by regulation or energy costs and more by leadership, training, reputation concerns, and flexible internal practices, highlighting the importance of organisational capabilities for sustainable innovation. Abdesselam, Kedjar and Renou-Maissant (2024), identify key drivers of eco-innovation related to founders' environmental education and professional experience, as well as voluntary environmental practices such as corporate social responsibility. The authors develop a typology of five eco-innovator profiles, showing that these start-ups differ significantly in their motivations, access to finance, and innovation strategies, with important implications for tailored public policies supporting eco-innovative entrepreneurship. Also, social trust, as an informal institution, is viewed as promoting firms' environmental innovation (Liao and Wei, 2026).

Drawing on a longitudinal case in the European renewable energy sector, Csedő, Zavarkó and Magyari (2023) show that open eco-innovation networks must evolve when market and regulatory uncertainty undermine partners' willingness to participate. Rather than relying on existing complementarities and exploitation of a mature technology, effective network renewal is driven by bridging actors who redirect collaboration toward exploration and future complementarities (e.g., expanding use cases and partner bases) to reduce market-failure risk and sustain sustainable-development impact.

The role of eco-innovation in shaping economic and environmental performance represents another direction that researchers have exploited. According to Ho and Lwesya (2025), eco-innovations aim not only to reduce negative ecological impacts but also to foster long-term economic and societal sustainability. The study of Qureshi, Ahsan and Gull (2022) demonstrates that country-level eco-innovation plays a crucial role in reducing corporate CO_2 emissions in Europe, both from firms' own operations and along their value chains. The findings indicate that a supportive institutional environment for eco-innovation—shaped by public policies, innovation inputs, and financial and regulatory frameworks—encourages firms to adopt eco-innovative strategies. In a recent study, Hamid, Wang and Zang (2026) examine

whether AI development, eco-innovation efficiency, the stringency of environmental policy, and green growth improve environmental sustainability in the G7, using the load capacity factor within the load capacity curve framework. It finds that eco-innovation efficiency supports sustainability, while AI, stricter policies, and green growth are associated with lower ecological load capacity, and the LCC hypothesis does not hold for G7 economies. Another recent evidence from EU countries (Wang et al., 2026) shows that financial development tends to increase the ecological footprint, while both energy transition and eco-innovation significantly reduce environmental pressure. Moreover, the interaction between financial development and energy transition, as well as eco-innovation, reveals that financial development has an indirect effect of improving environmental quality when it is aligned with green energy investments and innovation. These findings highlight the importance of integrating financial policies with energy transition and eco-innovation strategies to achieve sustainable development. Other studies (Haseeb et al., 2026) also reinforce the idea that eco-innovation and clean/renewable energy reduce ecological footprint, while financial development increases it. On the other hand, Lasisi et al. (2022) provided evidence from leading eco-innovation economies and showed that environmental-related technologies contribute positively to economic growth but environmental technological innovations exert growth-inhibiting effects.

In their research, Rousselière et al. (2024) have extended the Porter Hypothesis by demonstrating that the economic outcomes of eco-innovation among European SMEs are heterogeneous and highly context-dependent. Using cross-country survey data, the authors show that certain types of eco-innovation—such as energy efficiency, material savings, and the use of renewable energy—are associated with reduced production costs, while others yield no immediate economic returns. Moreover, the impact of eco-innovation is shaped by environmental policy instruments and by the adoption behavior of competing firms, highlighting the importance of differentiated and territorially embedded policy approaches to promote both environmental and economic performance.

Jiang et al. (2024) find that renewable energy (including biofuels), eco-innovation, carbon taxes, and environmental policy stringency are associated with lower CO_2 emissions (and improved air-quality outcomes), supporting progress toward carbon neutrality. In contrast, natural resource dependence and financial development tend to increase emissions, potentially slowing decarbonization unless finance is redirected toward green investment.

Another research topic related to eco-innovations, which has sparked the interest of many authors, focuses on typologies and differences between EU states: clusters, classes, convergence/divergence. In this context, eco-innovation indices provide valuable insights into how eco-innovation evolves across countries over time, helping to identify trends, patterns, and relative performance (Park et al., 2017).

Mačiulytė-Šniukienė and Sekhniashvili (2021) show that eco-innovation is positively associated with economic performance and environmental performance across EU member states. The authors also document cross-country differences in eco-innovation, GDP, and environmental quality, and argue that expanding eco-innovation support could help improve both growth and environmental outcomes, particularly in lagging countries. Domaracká, Seňová and Kowal (2023) consider that weak coordination and synergy among government, institutions, and SMEs helps explain poorer performance in lagging states.

Costantini, Delgado and Presno (2023) investigated whether EU countries are converging toward similar eco-innovation trajectories by applying a club convergence framework to the EU Eco-Innovation Index. The authors found that eco-innovation does not converge uniformly across the EU; instead, countries form three distinct convergence clubs in the aggregate index, while more clusters emerge when the five underlying dimensions are analysed separately. To explain club membership, the ordered logit model results highlight that GDP per capita increases the likelihood of belonging to higher eco-innovation clubs, whereas economic openness is linked to weaker convergence; R&D intensity, environmental taxation, and firm size are not significant country-level drivers.
In their study, Sobczak, Głuszczuk and Raszkowski (2022) developed a typology of EU countries by jointly analyzing eco-innovation and overall innovation performance and identified four country groups, ranging from leaders in both eco-innovation and innovation (e.g., Finland, Sweden, Germany, Luxembourg, Denmark) to a large group of the poorest eco-innovators/innovators largely from newer EU members. In addition, Rađenović, Janjić and Talić (2024) found dynamic shifts of EU countries between clusters over time, reflecting changing eco-innovation strengths/weaknesses and suggesting the need for adaptive, cluster-tailored policies to improve performance and reduce disparities across the EU. This study of Henriques, Viseu and Sousa (2025) evaluates eco-innovation efficiency across the EU-27 using a Window Slack-Based Measure (WSBM) DEA and club convergence analysis across five dimensions (environmental sustainability, finance/support, firm investments, sales impacts, intellectual assets). Efficiency rose during the pandemic windows but weakened afterward, reflecting shocks and volatility. Convergence tests reject full EU convergence and identify two efficiency clubs, implying persistent structural gaps and a need for tailored policy mixes and cross-club collaboration. More recently, Juracka et al. (2026) evaluated EU member states' eco-innovation performance using the EU Eco-Innovation Index, applied maps, cluster analysis, and correspondence analysis to identify patterns and leaders. Apparently, most countries improved over the period (with Romania as the main exception), while Northern and Northwestern Europe consistently contain top performers.

3. Research methodology

The study is quantitative, descriptive and comparative, at the macro (country) level, using a composite indicator of eco-innovation for the Member States of the European Union. The research tracks the evolution over time (2014–2024) and the differences between countries in the performance of eco-innovation. The indicator analyzed is the Eco-Innovation Index (EII), reported annually, with a base of 2014 = 100 for the EU-27 aggregate. The data were sourced from the official European Commission dataset on the Eco-innovation Index (2014–2024).
The Eco-Innovation Index (EII) (European Commission, 2024) is a composite indicator that evaluates eco-innovation performance relative to the EU average, expressed in index scores. It aggregates indicators across five thematic dimensions: eco-innovation inputs, eco-innovation activities, eco-innovation outputs, resource efficiency outcomes, and socio-economic outcomes. In this study, the analysis focuses exclusively on the overall EII.
The indicator is expressed as an index (EU-27 = 100 in 2014), which allows values to be interpreted as relative performance against a common reference baseline. The analysis is conducted at two levels: (i) the EU-wide trend, based on the aggregate

series, and (ii) the cross-country distribution, examined through annual descriptive statistics for the 27 Member States.

For each year included in the analysis (2014–2024), the following indicators were computed for the distribution of EII values across countries: number of observations (N), mean, median, minimum, maximum, standard deviation, and coefficient of variation (CV). For the final year of the period (2024), the top five and bottom five countries in terms of total EII were identified in order to highlight the persistence of structural disparities between leading and catching-up economies.

The data were processed, and statistics were calculated with Excel and Jamovi statistical analysis tool, version 2.6.

4. EU - level analysis of eco-innovation performance: results and discussions

The evolution of the Eco-innovation index at the aggregate level reveals that the EU 27 increases from 100 (2014) to 127.5 (2024), indicating consistent progress in eco-innovation performance over the last decade.

Table 1: Eco-innovation index (EII) over the period 2014-2024 for EU 27 (base 2014=100)

Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
EII	100	101.9	104.2	104	107.4	108	109.6	115	118.9	123.7	127.5

Source: Eco-innovation index, available at: https://green-forum.ec.europa.eu/eco-innovation_en#eco-innovation-scoreboard

Our analysis continued with descriptive statistics of total EII in the EU (27 countries) for the period 2014–2024.

Table 2: Descriptive statistics of total EII in the EU (27 countries), 2014–2024

Year	N	Mean	Median	Min	Max	Standard deviation	Coefficient of variation
2014	27	90.31	84.7	29.8	161.9	35.37	0.392
2015	27	92.23	88.5	30.4	164.4	34.73	0.377
2016	27	95.48	88.3	33.2	170.0	35.12	0.368
2017	27	95.95	89.4	28.1	166.5	34.29	0.357
2018	27	98.41	92.1	36.0	157.2	33.12	0.337
2019	27	100.47	96.0	36.5	164.2	35.04	0.349
2020	27	102.61	96.7	40.1	166.1	34.73	0.338
2021	27	106.34	102.4	43.1	168.2	34.33	0.323
2022	27	111.93	108.1	48.9	178.6	34.81	0.311
2023	27	116.66	115.1	53.9	179.4	34.31	0.294
2024	27	120.88	116.5	58.8	180.8	34.77	0.288

Source: Authors' processing based on data available at: https://green-forum.ec.europa.eu/eco-innovation_en#eco-innovation-scoreboard

The data highlight an upward trend in eco-innovation performance over the period 2014–2024, both through increasing central values (mean and median) and consistent improvement in minimum levels. In parallel, the dispersion dynamics suggest a moderate but incomplete convergence between Member States: differences remain significant, in particular between the leading and catching-up groups.

The evolution of the mean EII (from 90.31 in 2014 to 120.88 in 2024) across countries indicates that, overall, Member States have experienced a gradual increase in eco-innovation performance over the decade under review. At the same time, the increase in the median (from 84.7 to 116.5) is particularly relevant as it shows that progress is not driven by a few high-scoring economies, but reflects an upward movement at the group level.

At the extremes, the table shows a clear evolution of the minimum: the worst annual performances gradually rise over the period (from 29.8 in 2014 to 58.8 in 2024), suggesting that countries lagging behind the EU average are gradually improving their eco-innovation capacity. This increase in the minimum is a relevant indication of bottom-up convergence, i.e., a reduction of gaps by improving the performance of the worst performers.

On the other hand, the maximum remains consistently at very high values, typically associated with leading countries (Nordic and some Western economies). The persistence of a very high maximum suggests the stability of an eco-innovation *frontier group*: some states maintain a structural competitive advantage (research capacity, innovative ecosystem, resource efficiency performance and socio-economic outcomes).

Therefore, although the minimum increases, the difference between the minimum and the maximum remains large, indicating that polarization does not disappear, but turns into a relatively stable structure: the leaders remain leaders, and the catching-up countries advance, but not enough to completely catch the top.

An interesting result is that the standard deviation (SD) remains relatively high throughout the period, with moderate variations between years. This means that, in absolute terms, the differences between countries continue to be important: even if all improve, the gaps between groups may persist.

However, the coefficient of variation (CV), the ratio of the SD to the annual mean, decreases over time from 0.392 in 2014 to 0.288 in 2024. The standard statistical interpretation is that as the mean level of the EII increases, the relative dispersion becomes smaller, suggesting moderate convergence (relatively smaller differences relative to the overall level achieved). In other words, even if the SD does not decrease drastically, the increase in the mean makes the variability proportionally smaller. At the same time, the min–max difference remains large (e.g., in 2024: 58.8 vs 180.8), so a polarization between leaders and catching-up countries persists.

From a policy standpoint, this finding is significant: although the EU is making overall progress and the general performance level is improving, disparities remain substantial, continuing to justify differentiated interventions such as targeted support for catching-up countries, incentives for input investment, and measures to accelerate technology transfer.

The EU-27 aggregate data indicate an increase of EII to 127.5 in 2024, with a more pronounced acceleration after 2020. We can observe that both the mean and the median increase more rapidly, while the minimum value also rises at a faster pace. This pattern may be associated with the strengthening of the European policy framework supporting the green transition, alongside intensified pressures for energy efficiency and circularity, which are captured in the index components.

In 2024, the Eco-Innovation Index ranking highlights the existence of a core of leading countries, characterized by very high eco-innovative performances. The top 5 leaders in eco-innovation are Finland (180.8), Denmark (177.5), Austria (177.1), Luxembourg (175.1), and Sweden (165.2). At the opposite end, a group of countries

continues to register values significantly below the EU average: Bulgaria (58.8), Hungary (64.4), Poland (69.7), Romania (80.2), and Greece (91.0). This contrast confirms the existence of a persistent polarization between leading states and those in the process of catching up.

The analysis of long-term variation shows that some Member States made remarkable progress between 2014 and 2024 (e.g. Lithuania, Ireland, Malta), while others recorded modest increases or even decreases (e.g. Romania, Hungary). Table 3 shows the absolute variation in the EII for the countries that recorded the largest and smallest increases, respectively.

Table 3: Descriptive statistics of total EII in the EU (27 countries), 2014–2024

The largest increases in EII score		**The smallest increases in EII score**	
Country	**Change 2014 - 2024**	**Country**	**Change 2014 - 2024**
Lithuania	53.3	Romania	-4.5
Ireland	50.1	Hungary	5.0
Malta	46.0	Finland	18.9
Italy	39.2	Poland	19.5
Netherlands	38.5	Sweden	20.0
Latvia	38.3	Luxembourg	20.2
France	38.0	Denmark	23.5
Czechia	36.5	Spain	25.7
Slovenia	36.1	Estonia	26.5
Austria	36.1	Belgium	28.0

Source: Authors' processing based on data available at: https://green-forum.ec.europa.eu/eco-innovation_en#eco-innovation-scoreboard

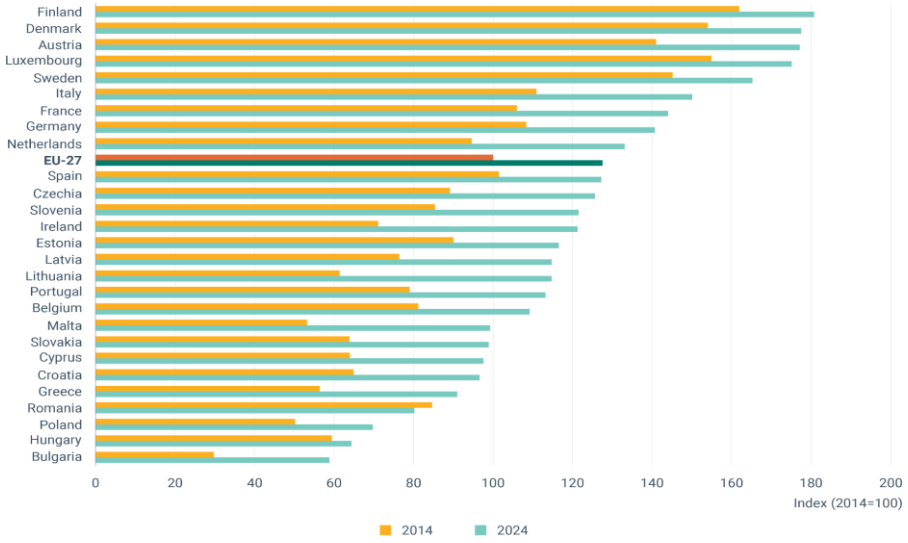


Figure 1: Evolution of the eco-innovation index across EU Member States over the period 2014–2024 (benchmark: EU-27 = 100 in 2014)

Source: Eco-innovation index, available at https://green-forum.ec.europa.eu/eco-innovation_en#eco-innovation-scoreboard

These results suggest that national policies, absorption capacity of European funds and structural reforms can significantly accelerate the development of eco-innovation, even in economies that start from lower initial levels.

Overall, the data point to a substantial improvement in eco-innovation performance across the EU-27 between 2014 and 2024, as evidenced by the upward shift in central tendency measures and the steady rise in minimum values. At the same time, dispersion remains elevated, and the gap between the best-and worst-performing countries persists, indicating the presence of heterogeneous eco-innovation development trajectories.

5. Conclusions

The descriptive analysis of the Eco-Innovation Index (EII) for the EU-27 over the period 2014–2024 highlights a clear upward trend in eco-innovation performance across the European Union. A noticeable acceleration is observed after 2020, a period associated with the intensification of European policies related to the Green Deal and the transition towards a circular and climate-neutral economy. Therefore, the aggregate EU-27 series (2014 = 100) rises to 127.5 in 2024, indicating a sustained improvement in eco-innovation performance at the European level over the past decade. In parallel, the cross-country distribution confirms that this increase is not exclusively the result of a small number of high-performing economies: both the mean and median country scores increase significantly between 2014 and 2024, suggesting a relatively widespread improvement across the EU-27. However, differences between countries remain significant. In 2024, the min–max range remains very wide (from 58.8 to 180.8), indicating the persistence of a structural polarization between eco-innovation leaders and catching-up countries.

The results confirm the existence of a stable core of leaders in 2024 (Finland, Denmark, Austria, Luxembourg and Sweden) and a group of countries performing significantly below the EU average (Bulgaria, Hungary, Poland, Romania and Greece). This pattern suggests that eco-innovation performance in the EU is not following full convergence, but rather partial convergence, in which aggregate progress coexists with persistent differences between groups.

Regarding the long-term dynamics (2014–2024), it is noteworthy that some states have registered substantial leaps (e.g. Lithuania, Ireland, Malta), indicating the real potential for catching-up through public policies and implementation capacity, while other states have evolved slowly or even registered declines (e.g. Romania). Overall, the decrease in the coefficient of variation (CV) over the period suggests moderate convergence, but the amplitude of the min–max differences shows that the gaps remain large enough to require targeted interventions and differentiated support mechanisms.

The analysis has several important implications. For EU policy, the aggregate progress indicates the effectiveness of the general direction of green transition policies, but the persistence of gaps suggests the need for instruments adapted to groups of countries (leaders vs. catching-up), including the transfer of good practices and support for institutional and investment capacities. For catching-up states, the results justify prioritizing measures that accelerate the adoption of eco-innovation and reduce structural differences, as the *bottom-up* progress is visible, but insufficient to decisively reduce polarization.

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REGIONAL INNOVATION DISPARITIES IN ROMANIA: THE ROLE OF R&D, ECONOMIC DEVELOPMENT AND ABSORPTIVE CAPACITY

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Abstract: *Innovation is regarded far and wide as being one of the major forces that determine economic growth across multiple time horizons. The previous statement is applicable at national or country wide levels, yet within country, in the case of this paper, within Romania, distribution can rarely be considered as consistent or evenly spread throughout its regions. After more than two decades since accession into the European Union (and just prior to a conclusion concerning OECD accession approval), policy makers and researchers have yet to offer a pertinent explanation for the puzzle concerning why gaps between the Bucharest-Ilfov region and the remainder of the seven other Romanian regions persists in the manner that it does. Thus, evaluating why innovative performance is more energetic and potent in certain regions than in others, and at what levels such gaps could be closed, are necessary, both for academic and practical scopes. Given this, this paper attempted to answer the following questions: what factors truly explain or determine the constant performance variations across the eight Romanian regions and by how big of a margin can R&D and economic development of specific regions explain this variation? Substantiated by concrete evidence from EUROSTAT datasets on Gross Domestic Expenditure on regional R&D sector and regional Gross Domestic Product at NUTS 2 level, and the 2025 Regional Innobarometer report, the present research proposes a multifaceted characterization of regional innovation achievements. Apart from this, the present research seeks to evaluate and analyze the uneven level of innovation performance across NUTS 2 Romanian regions and provide explanations as to why such gaps have persisted over time. At the same time, this paper is aimed at researching and investigating the factors that determine levels of regional innovation throughout Romania, with the broader part of the research focusing on the roles of economic development and research and development (R&D). A focal point of the present study refers to the evaluation of the literature on regional innovation systems/frameworks and regional disparities currently occurring throughout Romania. As such, the theoretical foundation of the paper builds on empirical literature centered around national and regional innovation systems, the capacity of regions to adopt, adapt and absorb innovative output, the intensity of knowledge regional spillovers.*

Keywords: *regional innovation; research and development; regional GDP; innovative performance.*

JEL Classification: *O18; O30; R11; R58*

1. Literature review

The output of specialty literature on the topic of determinants or factors that impact regional innovative performance has been on the rise over the past few decades. We have been selective in terms of literature to be reviewed for the purpose of this paper. As such, we have selected only strands of research that directly relate to regional innovation disparities, specifically: innovation systems theory applied at regional level, the role of R&D investing upon driving innovation outcomes, regional absorptive capacity and knowledge spillovers.

For the specific situation of Romania, as in the case of other newer EU member states, starting with 2016, EUROSTAT rd_e_gerdreg and EUROSTAT nama_10r_2gdp datasets on Gross Domestic Expenditure on regional R&D sector and regional Gross Domestic Product at NUTS 2 level have become more consistent and thorough, and thus more dependable methodologically; studies published after the 2016 reflect the mature stage of economic cohesion and catch-up across regions (Iammarino, Rodríguez-Pose, & Storper, 2019). At the same time, the choice to focus on literature published after 2016 has also been influenced by other factors such as: the consolidation of EU programs and strategies (EU's entirely operational 2014–2020 Multiannual Financial Framework and Cohesion Policy instruments, already deployed Smart Specialization Strategies (that have been notable for directed the focus of EU wide policies on region-specific policies) (Foray, 2016) and the realignment of viewpoints and policies, from general or all around views and frameworks, to regional or place based focus, of academia and policymakers alike (Rodríguez-Pose, 2018).

As mentioned previously, the year 2016 has marked a detrimental shift in terms of the focus of specialty literature as well. Prior to 2016, the vast majority of academic literature has been aimed at topics such as the knowledge production function (according to this model, innovation productivity and outputs - such as new products, patents, other forms of intellectual property and intellectual property rights-are in fact a function of certain specific inputs such as R&D and talent base/human capital) (Jaffe, 1989), the linear model of innovation (according to this model, knowledge dissipation follows a straightforward and directly causal path: from basic research, knowledge flows and is applied to actual research, and as such, innovation outputs directly follow; in general terms, according to this model, R&D is to be considered as the main driver of innovation) (Griliches, 1998), geographic concentration and agglomeration economies (according to the proponents of these theories, whenever we have agglomeration and spatial proximity within dense urban areas, innovation will certainly blossom; given certain clustering and spillover effects specific to urban environments, regions in which higher numbers and density of firms and institutions will tend to generate more innovation) (Audretsch & Feldman, 2000). What has been published after 2016 is not a rejection of previous assumptions. One assumption made prior to 2016 refers to the necessity of R&D investments as a precondition for innovation to occur. Indeed, post 2016 academic research agrees with such assumptions, but it also proposes that only by itself, R&D investments will not be able to deliver desired innovation output, thus increasing regional gaps in terms of regional innovation (Ma, Ortega-Argilés, Lyons, & Kratena, 2026). Taken together, publications after 2016 concentrate around the following areas that will be further detailed throughout the following paragraphs: regional innovation systems (RIS) theory, the role of R&D

investments on driving innovation outcomes, and regional absorptive capacity and knowledge spillovers.

1.1 Regional Innovation Systems (RIS) Theory

The most prevalent way of studying the topic of regional innovation dynamics is through of regional innovation systems (RIS), a concept initially developed by Philip Cooke (1992) and further expand by Asheim and Gertler (2009). RIS theory is focused upon the way in which two inter-related subsystems behave. The first subsystem is the knowledge generation, and implicitly the diffusion, subsystem, that includes actors such universities, research centers, hubs and institutes, and technology transfer centers or organizations; the second subsystem is the knowledge consumption or exploitation subsystem, mainly consisting of companies, MNC's and/or other such organizations (Trippl & Isaksen, 2017). It is not the size of these subsystems that impacts innovation at regional level, but rather the way in which these interactions unfold, and their overall strength and long-term orientation. A newer addition to RIS theory comes from Asheim, Grillitsch and Trippl (2019); according to the authors, existing policies place greater importance on current regional capacities, strengths or conditions (such as investment allocations for innovation related activities for already existing institutions or industries) rather than promoting the creation of newer capacities. Considering these structural characteristics, the authors reintroduce an idea originally proposed during the early 2000's, that of "constructed advantage": regions reliant on inherited industries and/or institutions will fall behind to regions that have managed to bypass such inherited endowments and which have shifted their focus on the creation of strategically new sources of competitive advantage though regional specific policy design. This particular scenario of "inherited capacities" has a special resonance when it comes to Romania and Romanian, given the numerous communist era capacities that have been inherited by even the more modern generations of nationals and showcases why ill directed funds, without considering regional specificities, will only increase regional innovation gaps.

Another further advancement to RIS theory refers to the use of specific knowledge bases, namely the degree of significance and diversity of this regional knowledge system, as according to authors Trippl, Grillitsch and Isaksen (2017). The authors propose the existence of three systems: "organizationally thick and diversified" system (commonplace for large metropolitan areas, such systems contain high numbers of institutions involved in innovation in one way or another - universities, research institutes, firms, public agencies, and intermediary organizations to mention but a few – and which can operate across multiple sectors and fields of activity); the second system refers to "organizationally thick and specialized" systems (mostly attributable to industrial zones or areas, in which companies, various suppliers, and supporting institutions are tightly interconnected within a specific business sector) and a third system, "thin" innovation systems (Trippl, Grillitsch, & Isaksen, 2017). Here as well we can see a parallel with current day regional realities in Romania. In regions such as the Bucharest-Ilfov scores first in terms of regional innovation performance, thus showcasing traits manifested within "thick" and "diversified" systems. On the other end of the spectrum, the Sout-West Oltenia region exemplifies the traits of "thin" systems.

Another addition to specialty literature post 2016 refers to the intensity and focus of regional innovation policies. Tödtling and Trippl (2018) are in favor of adapting and

aligning the scope of regional frameworks so that they can aid in the development of what the authors call “differentiated knowledge bases”; within these frameworks, proposed policy interventions must match the predominant knowledge base specific to each individual region. The same authors distinguish between analytical knowledge bases and synthetic knowledge bases. Whereas the former refers to the specific scenario of science intensive business sectors (such fintech, biotech, or the ICT sectors), a sector which presupposes the existence of strong linkages, interactions, investments (both public and private) and partnerships between university and specific industry actors within that specific region, the latter (synthetic knowledge bases) refers to the specific scenario in which engineering-intensive manufacturing exists within certain regions; in such scenarios, local business environment favors applied research collaboration (that will have as an outcome the development of products, services, intellectual property rights, sources for increased competitive advantage) and investments aimed at improving vocational skills and abilities for specific trades and professions (Tödtling & Trippl, 2018). In the case of Romania, by having such disparities in terms of regional innovation output, where high paced urban ICT clusters exist concomitantly with manufacturing dominated rural areas, we notice that R&D strategies do not necessarily reflect the distinct economic and institutional traits of each of the eight regions. Policies should factor in the design of novel approaches to innovation-related regional focus and should deploy regionally specific R&D policies value generating procedures.
Diversification, even though not a new concept, still represents a point of interest for post 2016 research on drivers of regional innovation. In essence, the process of branching out of own comfort zones and pivoting or diversifying into market driven alternative sectors can be attained by making use of already existing but recombined competencies and skill-sets (Hassink, Isaksen, & Trippl, 2019), and a real-life application of such tailored policies is the S3 strategy – Smart Specialization Strategy, deployed in the case of Romania as well.

1.2 The role of R&D investments in driving innovation outcomes

The dual relationship between R&D investments and innovation output at national level is extensively used in specialty literature. Outcomes from such investments take the form of patents (higher regional patent counts indicate more focus and more regionally appropriate policy measures, and also good inter-institutional collaborations and partnerships), new product launches and total productivity increase, showcasing that returns from R&D investment are valuable at increasing regional economic growth and development (Bronwyn, Mairesse, & Mohnen, 2010). Such opinions regarding the role of R&D have remained prevalent up until 2016; following this year, a more nuanced, and regionally specific approach has begun surfacing among researchers.
A 2018 extensive analysis of R&D investments and innovation output/performance throughout NACE 2 regions, by using a dataset that covers the 2004-2014 time period, has confirmed that R&D investment intensity is a strong predictor for innovative performance of regions (Evangelista, Meliciani, & Vezzani, 2018). Even though this relationship is demonstrated, the authors clearly point out two crucial aspects that point towards increased benefits and advantages. First, the marginal R&D returns are influenced by the absorptive capacity of regions, thus more well adapted regions that have increased absorptive capacities will generate higher marginal returns. Second, regions that find themselves on the lower positions of

economic development thresholds will find themselves struggling in their efforts to convert R&D input into innovative or creative output, as opposed to stronger regions where such transitions processes occur at higher speeds and adaptation outcomes require shorter period of time. Conversion rate at similar speed as well-developed regions is mostly absent from Romanian regions.

Another viewpoint concerning the role of R&D investments in terms of driving innovation outcomes refers to delineating the components of R&D (based on sources of investment and scope) and evaluating the effects of each component on regional patent application. The first, business R&D, is the most widespread among the three components and is the one most attributable to immediately impacting regional innovation output. The second component, higher education R&D, is attributable with generating the highest number of scientific publications, whereas the third component, government R&D, presents the least consistent effects; such inconsistent effect can be noticed in regions where no knowledge transfer centers, no research institutes and no partnerships between private and public institutions exist (Lhuillery, Raffo, & Hamdan-Livramento, 2017). Such instances are also visible in Romania, given the uneven distribution between government and private R&D spending throughout regions. Expanding on the previous study from Lhuillery, Raffo and Hamdan-Livramento (2017), authors Kaneva and Uhura (Kaneva & Untura, 2018) have determined that the effect of public R&D spending on regional GDP per capita has modest, even though positive, effect. The authors point out that such public R&D investment sources, even though popular, widespread and necessary, act as driver for diminishing private R&D investments within those respective regions. Policies that focus on bridging gaps, developing partnerships, public-private ventures and promoting private R&D investments, instead of simply replacing private R&D spending, are gaining traction and speed, as pointed out by the authors.

A noteworthy research subject detailed after 2016 refer to partnerships and collaborations as a way to connect knowledge producers or developers with knowledge users (which are conditions for creative/innovation output to occur, especially in today's economic and business contexts). Even though this is the desired outcome, authors such as Radosevic and Ciampi Stancova (2018) do point out that most regions face or have faced similar bottlenecks that have prevented these regions from developing and increasing innovation output: first, underdeveloped infrastructure, capabilities and tools used in the knowledge transfer process; second, weak linkages between private institutions (source of capital) and public sector for scientific experimentational; the third bottleneck refers to a mismatch between the technological/development needs of the specific regional industries and the specialization profile of public research systems, institutions and researchers. As in the case of other Easter European countries, or newer entrants onto the EU, numerous examples referring to the lack of initiatives, trust and partnerships between producers of knowledge and users of knowledge byproducts.

1.3 Regional absorptive capacity and knowledge spillovers

Developed during 1990's by authors Daniel Levinthal and Wesley Cohen (1990) and further expanded for regional level use cases by Criscuolo and Narula (Criscuolo & Narula, 2008), the absorptive capacity represents the ability of economic units to take part and undergo through the 3 process steps (namely: recognition, assimilation and commercial exploitation) in order to be able to exploit any forms of external knowledge. In research focused on regional innovation, absorptive capacity has

been used as an explanation for instances when similar R&D investment levels are present, yet innovation outcomes tend to differ from region to region. But absorptive capacity in itself is not enough in order for the effects of R&D investment and adoption to become prevalent at regional levels. Tacit partnerships, manifested through knowledge spillover effects to neighboring regions, represent one form of absorptive capacity that is aided by already established knowledge strategic regions (Aldier, Sena, & Vinci, 2018). Here again, the simple presence of large companies that act as a source for knowledge spillover does not solve the issue of distribution and adaption; in this particular case, spillover effects are dependent upon the absorptive capacity of the economic institution within those respective regions. In areas where there is a low absorptive capacity, the "anchoring" private economic institution will manifest a somewhat of a crowding out effect, by accumulating already scarce specialized human resources and funding, without generating appropriate spillover effects (Grillitsch & Nilsson, 2017).

Another element affecting the absorptive capacity of regions refers to the spatial lens regarding regional innovation. As such, knowledge spillovers will start to decay as distance from sources of information and research hubs increase, and they will do so at faster rates when transferring tacit and complex knowledge; lower rates of spillover decay is expected whenever codified knowledge is being transferred (Moretti, 2021). Given this, the development of strong foundations that will allow for faster knowledge adaptation, such as universities, transfer centers, and research hubs, is mandatory. High R&D intensity within certain regions can indeed reflect innovative output, but at the same time, the cause for such intensity can be attributable to a small number of MNC's, rather than highly innovative regional businesses (Radosevic, Upgrading technology in Central and Eastern European economies, 2017). Numerous regions throughout the EU are in the exact same situation. Mere concentration of output to a handful of MNC's instead of leveling out of chances will have dire consequences if policies and strategies are not adapted to present day challenges.

This paper contributes to the literature by providing a recent comparative regional analysis for Romania, integrating GDP, GERD and Innobarometer data, and highlighting the conditional role of R&D depending on regional absorptive capacity.

2. Romanian regional context

In terms of regional distribution, Romania consists of 4 NUTS 1 macro-regions (numbered from 1 to 4), further divided into 8 NUTS 2 development regions, namely: North-East, South-East, South Muntenia, South-West Oltenia, West, North-West, Center, and Bucharest-Ilfov (EUROSTAT, 2021). Research on data from the 2020-2022 time period published by the Romanian National Institute of Statistics showcases that out of 26986 surveyed companies, only 8.8% (2297 enterprises) of them represented truly innovative enterprises, as opposed to 91.2% non-innovative enterprises; out of the analyzed population, 4.1% of enterprises have deployed and introduced onto their market product innovations exclusively, whereas 1.3% of enterprises have deployed only business process innovation; what is more, only 3.1% of enterprises have managed to partake both in product and business process innovation (Romanian National Institute of Statistics, 2023). The same report has pointed out the fact that most of these companies (53.7%) have activated with the R&D sector, closely trailed by insurance, reinsurance and pension fund activities

(38.9%) and the manufacturing of basic pharmaceutical products and pharmaceutical preparations (35%).
The following table illustrates the economic transformation undertaken by Romania ever since 2015. At the same time, the following table sheds light upon the regional distribution of GDP, expressed in millions of euro (at current prices)

Table 1. Romania GDP (in billion EUR) during 2016-2024 time period

TIME	2016	2017	2018	2019	2020	2021	2022	2023	2024
Romania	167,4 97.13	186,3 99.19	204,7 80.66	223,3 41.43	219,8 39.76	240,9 86.57	280,7 77.44	321,5 77.9	353,6 33.12
North-West	19,67 4.61	22,76 3.82	24,65 1.4	27,23 4.06	27,18 9.16	29,55 5.39	34,01 7.06	39,52 8.68	43,37 2.21
Center	18,90 1.86	21,05 0.68	23,40 3.47	25,12 1.84	24,99 8.04	27,12 5.48	30,36 1.49	35,93 3.92	39,26 5.18
North-East	16,91 4.1	19,32 8.03	21,34 7.89	23,48 1.65	23,66 9.67	25,30 5.02	28,25 8.5	33,99 3.78	37,48 6.18
South-East	17,49 8.97	19,09 4.01	21,03 7.97	22,10 4.94	21,13 4.32	24,02 0.46	27,27 0.58	30,43 5.78	33,30 8.2
South-Muntenia	20,54 6.75	21,92 7.57	24,21 8.13	25,37 1.39	24,74 7.9	27,24 9.09	32,36 1.85	34,26 4.82	37,22 8.15
Bucharest-Ilfov	45,43 2.8	50,56 4.81	54,93 9.63	61,67 6.13	61,07 5.39	67,78 5.03	81,72 8.83	93,68 4.08	104,4 08.96
South-West Oltenia	12,11 1.64	13,89 1.64	15,81 1.88	17,21 9.24	16,66 5.05	18,00 1.56	21,87 6.12	24,63 8.4	26,76 9.2
West	16,29 7.99	17,62 9.36	19,21 1.16	20,97 5.21	20,20 5.21	21,80 3.33	24,71 7.79	28,91 8.4	31,58 4.83

Source: Own adaptation by the authors based on OECD data (OECD, 2026)

Romania's economy has almost doubled in less than a decade, growing from 167 billion euros in 2016 to 353 billion in 2024. Romania, along with other Eastern European Economies, has experienced an accelerated economic growth, in part due to EU fund allocations, structural funds, FDI and knowledge transfers (Kaas, Mellert, & Scholl, 2020). What can be noticed from the previous Table 1 is the fact that the Bucharest Ilfov region accounts for almost roughly 27% GDP in 2016, and around 29%-30% in 2024. We thus understand that even in the case of Romania, economic growth tends to be spatially concentrated, and as in the case of other countries, the capital region usually manages to attract or capture a larger share of output. Despite increased growth rates in regions that are lagging behind, absolute disparities continue to widen, indicating limited real convergence. The previously mentioned dominance of the capital region of Bucharest-Ilfov implies the concentration of human talent, R&D activity (investment, adaptation, transfer) and high-value services of various kinds. Based solely on 2024 GDP levels, the eight Romanian regions can be ranked as follows: Bucharest-Ilfov (104.4 billion euros), North-West (€43.4 billion euros), Center (39.3 billion euros), North-East (37.5 billion euros), South-Muntenia (37.2 billion euros), South-East (33.3 billion), West (31.6 billion euros), South-West Oltenia (26.8 billion euros). Apart from the dominance of the Bucharest-Ilfov region, we also notice that the North-West regions appears to be consolidating its role as the secondary economic pole or hub within Romania.
Apart from GDP related performance, it is equally important to understand the facets and implications of Gross Domestic Expenditure on R&D (GERD). Even though it contains data only starting with 2020, the following table will answer inquiries

regarding the interest at regional levels shown towards R&D related expenditure and R&D related investments:

Table 2. GERD by sector of performance and NUTS 2 region

TIME	2020	2021	2022	2023	2024
Romania	1,026.09	1,141.236	1,303.814	1,675.569	1,624.214 (provisional)
North-West	55.382	74.448	82.847	116.291	-
Center	86.147	97.286	139.14	148.49	-
North-East	65.813	65.018	71.763	83.935	-
South-East	19.741	23.363	26.298	36.259	-
South-Muntenia	87.938	72.67	75.857	135.891	-
Bucharest-Ilfov	565.475	638.002	684.814	770.844	-
South-West Oltenia	17.139	21.739	27.479	41.202	-
West	128.456	148.71	195.617	342.658	-

Source: Own adaptation by the authors based on OECD data (OECD, 2026)

Romania and its respective regions have experienced a significant increase in R&D intensity after the year 2020, likely driven by EU funding cycles and recovery instruments, though the slight decline in 2024 may suggest volatility in funding or absorption capacity. The Bucharest-Ilfov regions dominate this indicator as well, having invested around 770 million euros in R&D. The volatility observed in several regions suggests a dependence on external funding sources rather than stable, fully integrated innovation systems. Taken together, these patterns indicate that R&D investment in Romania is both spatially concentrated and still quite fragile from an institutional perspective, with important implications for regional innovation performance and convergence.

Table 3. Romanian INNOBAROMETER evolution of regional scores in the 2019-2025 time period

Development Region	Innobarometer 2025 score	Innobarometer 2023 score	Innobarometer 2021 score	Innobarometer 2019 score
North-West	50.6	39.69	39.35	44.96
Center	37.42	38.09	35.37	32.93
North-East	43.65	34.83	30.1	31.26
South-East	25.62	30.38	20.51	26.15
South-Muntenia	17.51	27.66	29.78	27.79
Bucharest-Ilfov	65.2	73.3	76.8	65.75
South-West Oltenia	16.97	25.4	31.32	26.15
West	38.63	35.92	38.02	39.24

Source: Own adaptation by the authors based on the 2025 Romanian Innobarometer data (2026)

In addition to quantitative indicators derived from online database EUROSTAT, this current study also draws on the 2025 Romanian Innobarometer (Ministry of Education and Research, National Research Authority, 2026), which provides valuable firm-level and regional insights into innovation behavior, perceived barriers, and institutional constraints, thereby complementing the econometric analysis with qualitative evidence on the functioning of regional innovation systems. The following table summarizes information from the 2025 Romanian Innobarometer:

Over the years, the Bucharest-Ilfov region has reigned supreme, having achieved most fund allocation and innovation related output from all other seven Romanian regions. Even so, the downward trend of the specific regions is evident, noticing a constant reduction of the Innobarometer scores following 2021 (76.8 points in 2021, 73.3 points in 2023 and 65.2 points in 2025). Such a situation could be attributable in part to the growing attractivity and improvement undergone in the North-West and North-East regions (the catch-up dynamics of these two contender regions is driven in part by increased absorptive capacity generated by inflow of talent from all corners of the country and increased funding levels given proper innovation, communication and dissemination networks). A general observation that can be drawn from the previous table refers is that regardless of region, innovation performance has fluctuated (especially for regions that place themselves lower on the innobarleometer) and is dependent upon funding cycles and their intensity, policy adaptation to local specificities and the performance of local institutions.

3. Data and methodology

This study relies on a comparative regional case-study design focused on the eight Romanian NUTS 2 development regions: North-West, Center, North-East, South-East, South-Muntenia, Bucharest-Ilfov, South-West Oltenia and West. The analysis combines secondary quantitative data with descriptive and exploratory statistical techniques in order to assess how differences in economic development and R&D expenditure are associated with differences in regional innovation performance.

Three categories of indicators are employed. First, economic development is proxied by regional Gross Domestic Product (GDP) at current market prices, expressed in million euro, for the 2016–2024 period. Second, research effort is captured through Gross Domestic Expenditure on Research and Development (GERD) by NUTS 2 region, expressed in million euro, for the 2020–2024 period. Third, innovation performance is measured through the Romanian Regional Innobarometer scores for 2019, 2021, 2023 and 2025. Taken together, these indicators allow the paper to compare the economic base of each region, the scale of its R&D effort, and the resulting innovation performance.

The empirical strategy is intentionally simple and transparent, given the limited number of territorial units (eight regions). The analysis unfolds in four steps. First, a descriptive comparison is performed in order to identify the hierarchy of regions by GDP, GERD and innovation score. Second, several derived indicators are calculated in order to improve comparability across regions: GDP growth rate, each region’s share in national GDP, each region’s share in national GERD, and GERD intensity relative to regional GDP. Third, pairwise correlations are used to explore the strength of association between GDP, GERD and innovation performance. Fourth, the paper interprets the Romanian evidence through a focused regional case-study lens, with special emphasis on the contrast between Bucharest-Ilfov, the

country's dominant innovation pole, and the catching-up regions of North-West and North-East.

The year 2023 is used for GERD-based cross-regional comparison because it is the most complete year available across all regions, while 2025 is used for innovation performance as it represents the most recent Innobarometer wave. Given the small sample size (eight regions), the statistical results are interpreted as descriptive evidence rather than causal relationships, aiming to highlight patterns of territorial concentration, divergence and selective convergence.

Although the analysis is primarily descriptive, the use of correlation coefficients provides an initial indication of the strength and direction of relationships between variables.

4. Results

What this study has proposed to do was to understand and answer the following question: why do some Romanian regions innovate more than others, and what role do R&D investment and economic development actually play in that story? Even though both GDP and R&D investment have increased by a lot in recent years, their impact on innovation performance remains uneven across the eight Romanian regions. The evidence points to a strong spatial/territorial concentration of both economic output and R&D inputs in the Bucharest-Ilfov region, which continues to dominate the national innovation landscape. At the same time, while certain regions (namely the North-West and North-East) showcase clear signs of convergence and improved innovation performance, overall regional disparities persist and, in some cases, have widened.

Table 4. Comparative regional indicators of economic development, R&D intensity and innovation performance in Romania

Region	GDP growth 2016–2024	Share in national GDP 2024	Share in national GERD 2023	GERD/GDP (%)	Innobarometer score change 2023–2025
Bucharest-Ilfov	129.82%	29.52%	46.00%	0.74%	-8.10
Center	107.73%	11.10%	8.86%	0.38%	-0.67
North-East	121.63%	10.60%	5.01%	0.22%	+8.82
North-West	120.45%	12.26%	6.94%	0.27%	+10.91
South-East	90.34%	9.42%	2.16%	0.11%	-4.76
South-Muntenia	81.19%	10.53%	8.11%	0.36%	-10.15
South-West Oltenia	121.02%	7.57%	2.46%	0.15%	-8.43
West	93.80%	8.93%	20.45%	1.08%	+2.71

Source: authors calculations

As shown in Table 4, the results confirm that regional innovation in Romania is strongly shaped by territorial concentration. Bucharest-Ilfov remains the dominant pole both in terms of economic output and R&D expenditure, while only a limited

number of regions show visible signs of catching up. The Romanian case therefore illustrates a dual structure: a highly concentrated metropolitan innovation core and a group of regions with uneven and often fragile innovation trajectories.

The first important result concerns the distribution of economic output. In 2024, Bucharest-Ilfov generated approximately 29.5% of Romania's GDP, far above any other region. North-West ranked second with about 12.3%, followed by Center (11.1%), North-East (10.6%) and South-Muntenia (10.5%). South-West Oltenia remained the smallest regional economy, with roughly 7.6% of national GDP. This confirms that innovation disparities emerge in a broader context of asymmetric regional development.

A second result concerns the pace of regional economic expansion between 2016 and 2024. Bucharest-Ilfov recorded GDP growth of approximately 129.8%, while North-East, South-West Oltenia and North-West also more than doubled their regional GDP over the period. By contrast, South-Muntenia, South-East and West expanded at a slower pace. These results suggest that although economic growth has been widespread, leadership remains concentrated in a limited number of regions.

A third result concerns the geography of R&D. In 2023, Bucharest-Ilfov alone accounted for approximately 46.0% of national GERD, highlighting the strong concentration of research effort in the capital region. West ranked second, with about 20.5%, followed by Center (8.9%), South-Muntenia (8.1%), North-West (6.9%) and North-East (5.0%). South-East and South-West Oltenia recorded much smaller shares, at around 2.2% and 2.5%, respectively. This indicates that R&D expenditure is even more spatially concentrated than GDP.

To improve comparability, GERD was related to the size of each regional economy. The resulting indicator shows that West displays the highest R&D effort relative to GDP (1.08%), followed by Bucharest-Ilfov (0.74%), Center (0.38%) and South-Muntenia (0.36%). By contrast, South-East (0.11%), South-West Oltenia (0.15%) and North-East (0.22%) remain less research-intensive. This suggests that only a limited number of regions have developed a strong research-oriented economic structure.

When regional innovation performance is examined through the 2025 Innobarometer, Bucharest-Ilfov remains the leading region with a score of 65.2, followed by North-West (50.6) and North-East (43.65). However, the capital region has experienced a decline compared to previous years, while North-West and North-East have recorded significant improvements. Between 2023 and 2025, North-West increased by +10.91 points and North-East by +8.82 points, whereas Bucharest-Ilfov decreased by -8.10 points, South-Muntenia by -10.15 points, and South-West Oltenia by -8.43 points. This indicates that the Romanian innovation landscape is dynamic, with emerging signs of regional convergence.

From a statistical perspective, the relationship between economic development and innovation performance is relatively strong. The correlation between 2024 GDP and the 2025 Innobarometer score is approximately 0.77, while the correlation between 2023 GERD and innovation performance is around 0.72. However, once Bucharest-Ilfov is excluded, the correlation between GERD and innovation drops significantly to about 0.32, while the GDP–innovation relationship remains moderate (approximately 0.66). This finding suggests that R&D expenditure alone does not fully explain regional innovation outcomes and that its apparent importance at national level is partly driven by the exceptional position of the capital region.

Overall, the Romanian case-study highlights three key insights. First, innovation is highly concentrated geographically, reflecting the accumulation of economic activity, human capital and institutional capacity in a limited number of regions. Second, R&D expenditure is a necessary but not sufficient condition for innovation, as its effectiveness depends on broader regional characteristics such as absorptive capacity, institutional quality and knowledge networks. Third, there is evidence of selective convergence, particularly in North-West and North-East, suggesting that regional innovation gaps are persistent but not immutable. These findings are consistent with the regional innovation systems (RIS) literature, which emphasizes the role of institutional thickness and absorptive capacity in shaping innovation outcomes.

5.Conclusions and discussions

This study set out to investigate why innovation performance differs across Romanian regions and to what extent economic development and R&D investment explain these disparities. By combining regional GDP, GERD and Innobarometer data, the analysis provides a coherent picture of the structural factors shaping regional innovation in Romania.

The findings confirm that innovation is highly concentrated geographically. Bucharest-Ilfov clearly dominates both in terms of economic output and R&D expenditure, accounting for a disproportionately large share of national resources. This concentration reflects the accumulation of human capital, research institutions, advanced services and stronger innovation networks within the capital region. As a result, Romania exhibits a core–periphery structure typical of many emerging European economies, where a single metropolitan region acts as the main innovation hub.

At the same time, the results show that economic growth alone does not automatically translate into higher innovation performance. Although most regions have experienced substantial GDP growth between 2016 and 2024, their ability to convert this growth into innovation outcomes remains uneven. The moderate correlation between GDP and innovation performance suggests that economic development provides a necessary foundation, but it is not sufficient to ensure innovation upgrading.

The role of R&D expenditure is equally nuanced. While a positive relationship between GERD and innovation performance is observed at the national level, this relationship weakens significantly when Bucharest-Ilfov is excluded from the analysis. This indicates that the apparent strength of R&D as a driver of innovation is partly influenced by the exceptional position of the capital region. In other regions, R&D investments appear to generate lower returns, which is consistent with the literature emphasizing the importance of absorptive capacity, institutional quality and effective knowledge transfer mechanisms.

An important insight emerging from the analysis is the presence of selective convergence. Regions such as North-West and North-East have recorded significant improvements in innovation performance, suggesting that regional disparities, although persistent, are not fixed. These regions appear to benefit from improving institutional frameworks, increased inflows of human capital and better integration into national and European innovation networks.

From a policy perspective, the results suggest that a “one-size-fits-all” approach to innovation policy is unlikely to be effective. Instead, regional innovation strategies should be tailored to the specific structural characteristics of each region. In less developed regions, policy efforts should focus on strengthening absorptive capacity, improving institutional quality and fostering collaboration between universities, firms and public authorities. In more advanced regions, policies should support the transition towards higher-value, knowledge-intensive activities and the creation of new innovation-driven growth paths.

Furthermore, the strong concentration of R&D expenditure in Bucharest-Ilfov raises concerns regarding long-term territorial cohesion. Without targeted policy interventions, there is a risk that innovation gaps may persist or even widen. Encouraging a more balanced spatial distribution of R&D activities, promoting inter-regional knowledge spillovers and strengthening regional innovation systems should therefore become key priorities.

Finally, several limitations of this study should be acknowledged. The analysis is based on a relatively small number of observations (eight regions) and relies primarily on aggregate indicators, which limits the possibility of establishing causal relationships. In addition, the use of GERD as a proxy for R&D effort does not capture differences in efficiency or sectoral composition. Future research could extend this work by incorporating firm-level data, patent indicators or econometric modelling approaches to better understand the mechanisms linking R&D, economic development and innovation performance.

Overall, this paper contributes to the understanding of regional innovation disparities in Romania by highlighting the interplay between economic development, R&D investment and structural regional characteristics. The evidence suggests that while R&D and GDP matter, their impact on innovation is strongly conditioned by the broader regional context, reinforcing the need for place-based and differentiated innovation policies.

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RENEWABLE ENERGY CONSUMPTION AND ECONOMIC GROWTH IN ROMANIA: EVIDENCE FROM A TIME-SERIES ECONOMETRIC ANALYSIS

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Abstract: *This study investigates the relationship between renewable energy consumption, economic growth and environmental factors in Romania over the period 1990–2022. Using annual data and a time-series econometric framework, the analysis examines the long-run and short-run dynamics between gross domestic product (GDP), renewable energy consumption, carbon dioxide (CO_2) emissions, energy use, gross capital formation and trade openness. The Autoregressive Distributed Lag model approach is employed to explore cointegration relationships among the variables. The empirical results reveal the existence of a long-run equilibrium relationship between economic growth and the selected explanatory variables. Renewable energy consumption is found to have a positive but statistically insignificant impact on economic growth, suggesting that its contribution remains limited in the Romanian context. At the same time, CO_2 emissions and energy use are positively associated with economic growth, indicating that Romania's economic expansion is still partially dependent on conventional energy sources. Gross capital formation plays a significant role, particularly in the short run. The short-run dynamics confirm the adjustment towards long-run equilibrium, while causality analysis highlights the directional relationships between the variables. Overall, the findings emphasize the need to strengthen renewable energy policies to support sustainable economic growth.*

Keywords: *renewable energy; economic growth; CO2 emissions; ARDL; Romania; energy consumption*

JEL Classification: *Q42; Q43; C32; O44*

1. Literature review

The relationship between economic growth, energy consumption and environmental sustainability has been extensively analyzed in academic literature. In recent decades, increasing attention has been given to the role of renewable energy in promoting sustainable development and reducing environmental degradation.

A substantial body of research has explored the nexus between renewable energy consumption and economic growth. Early contributions by Apergis and Payne (2010) provide evidence of bidirectional causality between renewable energy consumption and economic growth in OECD countries, suggesting a mutually

reinforcing relationship. Similarly, Shahbaz et al. (2012) highlight the positive role of renewable energy in supporting economic growth in developing economies.

Further studies confirm these findings across different regions and methodologies. For instance, Ozturk (2010) emphasizes the importance of energy consumption in economic growth, while Salahuddin and Gow (2014) show that renewable energy contributes to long-term economic expansion in emerging economies. In addition, Al-Mulali et al. (2013) demonstrate that renewable energy reduces environmental degradation while supporting growth.

Another strand of the literature focuses on the environmental consequences of economic growth. The Environmental Kuznets Curve (EKC) hypothesis suggests that environmental degradation initially increases with economic growth and later decreases as income levels rise. This hypothesis has been extensively examined by Stern (2004) and Grossman and Krueger (1995), who provide evidence of non-linear relationships between income and environmental quality.

Recent empirical studies have further investigated the energy–growth–environment nexus using advanced econometric techniques. For example, Shahbaz et al. (2015) and Doğan and Seker (2016) examine the role of renewable energy and trade openness in reducing CO_2 emissions. Their results indicate that renewable energy contributes to environmental sustainability, although its impact on economic growth varies across countries.

In the context of European and transition economies, the relationship between renewable energy, economic growth and environmental indicators is shaped by structural reforms and policy changes. Studies focusing on Eastern European countries, such as Destek (2016), highlight the importance of renewable energy in mitigating environmental degradation, while also emphasizing the heterogeneity across countries.

Moreover, trade openness has been identified as an important factor influencing both economic growth and environmental quality. Frankel and Rose (2005) argue that trade can have both positive and negative environmental effects, depending on the regulatory framework and level of development. Similarly, Halicioglu (2009) finds that trade openness significantly affects CO_2 emissions in developing countries.

Despite the extensive literature, panel data approaches dominate most empirical studies, potentially masking country-specific dynamics. As noted by Pesaran et al. (2001), time-series analyses provide a more detailed understanding of long-run and short-run relationships within individual countries. Therefore, country-specific studies are essential to capture the unique characteristics of national economies.

In the case of Romania, relatively few studies have examined the energy–growth–environment nexus using time-series methods. Given the country's transition from a centrally planned economy to a market-based system and its integration into the European Union, the dynamics between renewable energy, economic growth and environmental indicators are likely to differ from those observed in other regions.

Building on previous findings, the present study focuses on Romania and applies a time-series econometric framework to investigate the relationship between renewable energy consumption, economic growth, CO_2 emissions and other macroeconomic variables. By doing so, the study contributes to the literature by providing country-specific evidence for a transition economy undergoing structural and environmental transformations.

2. Romanian national and regional context

Romania represents an interesting case study in this regard. Over the past three decades, the Romanian economy has undergone profound structural changes associated with the transition from a centrally planned economy to a market-based system, accompanied by integration into the European Union and the adoption of EU energy and environmental policies. These transformations have significantly affected the country's energy consumption patterns, the development of renewable energy sources, and the evolution of carbon emissions.

Given these developments, the present study aims to investigate the relationship between economic growth, renewable energy consumption, CO_2 emissions, energy use, gross capital formation and trade openness in Romania over the period 1990–2022. Using a time-series econometric framework, the paper seeks to identify the long-run and short-run dynamics between these variables and to contribute to the broader literature on the energy–growth–environment nexus.

The contribution of this study is twofold. First, it provides a country-specific analysis focusing on Romania, complementing previous regional studies that relied on panel data approaches. Second, by incorporating multiple economic and environmental variables within a time-series framework, the paper offers additional insights into the role of renewable energy in supporting sustainable economic development in transition economies.

3. Data and methodology

We analyze the relationship between renewable energy consumption, economic growth and environmental factors in Romania using a time-series econometric approach. This framework allows us to examine how the selected variables influence economic growth over time, capturing the dynamic interactions between energy use, environmental indicators and macroeconomic variables within a single country context.

The study is based on annual data for Romania covering the period 1990–2022. The dataset includes the following variables: gross domestic product (GDP), renewable energy consumption, carbon dioxide (CO_2) emissions, energy use, gross capital formation and trade openness. GDP is used as a proxy for economic growth, while renewable energy consumption reflects the transition towards sustainable energy sources. CO_2 emissions and energy use are included to capture environmental pressure and overall energy demand, whereas gross capital formation and trade openness are incorporated as control variables influencing economic performance.

The data was collected from the World Bank, specifically from the World Development Indicators database, which provides consistent and comparable macroeconomic and environmental statistics.

To examine the long-run and short-run relationships between the variables, we employ the Autoregressive Distributed Lag model approach. The ARDL model is particularly suitable for small sample sizes and allows for the inclusion of variables integrated of order I(0) and I(1), making it appropriate for the present analysis.

The Bounds Test proposed by Pesaran, Shin and Smith (2001) is used to investigate the existence of a cointegration relationship among the variables. Prior to this, unit root tests are performed to determine the order of integration of each variable, including the Augmented Dickey-Fuller test and the Phillips-Perron test.

To estimate the short-run dynamics and the speed of adjustment towards long-run equilibrium, an Error Correction Model (ECM) is derived from the ARDL specification. In addition, diagnostic tests are conducted to ensure the validity and robustness of the model, including tests for autocorrelation, heteroskedasticity and model stability. Finally, to explore the direction of causality between the variables, the Granger causality test is applied.

This study investigates the relationship between economic growth, renewable energy consumption and environmental factors in Romania over the period 1990–2022 using a time-series econometric framework. We will investigate two research hypotheses:

H1: Renewable energy consumption has a positive and statistically significant impact on economic growth in Romania.

H2: CO_2 emissions have a significant relationship with economic growth in Romania.

The baseline empirical model is specified as follows:

$$GDP_t = f(REN_t, CO2_t, EN_t, GCF_t, TR_t)$$

In log-linear form:

$$\ln GDP_t = \beta_0 + \beta_1 \ln REN_t + \beta_2 \ln CO2_t + \beta_3 \ln EN_t + \beta_4 \ln GCF_t + \beta_5 \ln TR_t + \varepsilon_t$$

Where:

- GDP= economic growth (GDP)
- REN= renewable energy consumption
- $CO2$= carbon dioxide emissions
- EN= energy use
- GCF= gross capital formation
- TR= trade openness

All variables are transformed into natural logarithms to reduce heteroskedasticity and interpret coefficients as elasticities.

4. Results

The empirical analysis begins with the examination of the stationarity properties of the variables. The results of the Augmented Dickey-Fuller test and Phillips-Perron test indicate that the variables are integrated of order 1, which justifies the application of the Autoregressive Distributed Lag model approach.

Table 1. Augmented Dickey-Fuller test and Phillips-Perron test

Variable	ADF Level	ADF First Diff	PP Level	PP First Diff	Order of Integration
lnGDP	-2,14	-4,05***	-2,55	-3,99***	I(1)
lnREN	-0,24	-4,67***	-0,24	-4,73***	I(1)
lnCO2	-2,00	-4,40***	-2,79	-4,50***	I(1)
lnEN	-0,24	-4,67***	-0,24	-4,73***	I(1)
lnGCF	-1,93	-4,46***	-2,1	-4,42***	I(1)
lnTR	-1,43	-5,34***	-1,48	-5,34***	I(1)

*** p<0.01, ** p<0.05, * p<0.10

Source: authors' computations in Eviews 12

The long-run coefficients reveal that most variables do not have a statistically significant impact on economic growth in Romania.

Table 2. Long-run ARDL Estimates

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnREN	0.7163	47.358	0.1513	0.8810
lnCO2	26.697	121.240	0.2202	0.8280
lnEN	-69.675	153.080	-0.4550	0.6550
lnGCF	36.775	21.326	17.240	0.1000
lnTR	-18.134	38.597	-0.4700	0.6440
C	470.595	1.178.540	0.3990	0.6940

*** p<0.01, ** p<0.05, * p<0.10
Source: authors' computations in Eviews 12

Renewable energy consumption exhibits a positive but statistically insignificant coefficient, suggesting that its contribution to long-term economic growth remains limited. Similarly, CO_2 emissions and energy use are not statistically significant, indicating that their long-run influence on GDP is weak.
Gross capital formation shows a positive coefficient and is close to statistical significance, highlighting the importance of investment in supporting economic performance. Trade openness has a negative but statistically insignificant effect.
Overall, the long-run results suggest that investment plays a more important role than energy-related variables in explaining economic growth in Romania.

Table 3. Short-run ARDL (ECM) Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ΔlnCO2	10.618	22.983	0.4620	0.6490
ΔlnCO2(-1)	0.3951	0.7909	0.5000	0.6230
ΔlnCO2(-2)	-0.9819	0.4927	-19.940	0.0600
ΔlnEN	-12.396	24.727	-0.5010	0.6220
ΔlnGCF	**19.982**	0.6670	29.960	0.0070
ΔlnGCF(-1)	**-13.439**	0.5862	-22.930	0.0330
ΔlnREN	-24.774	18.149	-13.650	0.1870
ΔlnREN(-1)	26.049	16.206	16.070	0.1240
ΔlnTR	-0.3226	0.6147	-0.5250	0.6050
ECM(-1)	**-0.8221**	—	—	**0.0000**

*** p<0.01, ** p<0.05, * p<0.10
Source: authors' computations in Eviews 12

The short-run results indicate that gross capital formation has a strong and statistically significant impact on economic growth in Romania. The contemporaneous effect is positive, while the lagged coefficient is negative, suggesting short-term adjustment dynamics.
CO_2 emissions exhibit a weak and marginally significant effect, indicating limited short-run environmental influence on economic growth. In contrast, renewable energy consumption does not show a statistically significant impact, suggesting that its contribution to short-term economic performance remains limited.

Energy use and trade openness are also found to be statistically insignificant in the short run. Overall, the results highlight that short-term economic growth in Romania is primarily driven by investment activity rather than energy-related factors.
The error correction term (ECM(-1)) is negative and statistically significant, confirming the existence of a stable long-run equilibrium relationship among the variables.
The estimated coefficient (-0.82) indicates that approximately 82% of deviations from the long-run equilibrium are corrected within one period. This suggests a relatively fast adjustment process, meaning that the Romanian economy quickly returns to equilibrium after short-term shocks.

Table 4. ARDL Bounds Test for Cointegration

Test Statistic	Value	Critical Values (n≈30)	I(0)	I(1)
F-statistic	4.610	10%	2.407	3.517
		5%	2.910	4.193
		1%	4.134	5.761

Source: authors' computations in Eviews 12

The results of the Bounds Test confirm the existence of a long-run relationship between economic growth, renewable energy consumption, CO_2 emissions, energy use, gross capital formation and trade openness. The computed F-statistic (4.61) exceeds the upper critical bound, indicating that the null hypothesis of no cointegration can be rejected. This finding suggests that the selected variables move together in the long run and are linked through an equilibrium relationship.

Table 5. Granger Causality Test Results

Null Hypothesis	F-Statistic	Prob.	Conclusion
lnCO2 does not Granger Cause lnGDP	4.21	0.025	Causality
lnEN does not Granger Cause lnGDP	4.08	0.029	Causality
lnCO2 does not Granger Cause lnTR	3.95	0.031	Causality
lnGCF does not Granger Cause lnTR	3.72	0.037	Causality
lnTR does not Granger Cause lnREN	3.58	0.049	Causality
lnTR does not Granger Cause lnGDP	3.12	0.052	Weak causality
lnEN does not Granger Cause lnTR	2.91	0.062	Weak causality
lnREN does not Granger Cause lnGDP	1.98	0.154	No causality
lnGDP does not Granger Cause lnREN	0.41	0.669	No causality

Source: authors' computations in Eviews 12

The results of the Granger causality test reveal several important relationships between the variables. There is evidence of unidirectional causality running from CO_2 emissions and energy use to economic growth, indicating that economic activity in Romania is still influenced by energy consumption and environmental factors.
Additionally, CO_2 emissions and gross capital formation are found to Granger-cause trade openness, suggesting that both environmental pressures and investments play a role in shaping international trade dynamics. A significant causal relationship is also identified from trade openness to renewable energy consumption,

highlighting the role of economic integration in supporting the development of renewable energy.

However, no causal relationship is found between renewable energy consumption and economic growth, indicating that renewable energy has not yet become a significant driver of economic performance in Romania during the analyzed period.

These findings are consistent with previous studies on the energy–growth–environment nexus, while also providing country-specific insights for Romania as a transition economy. In contrast to the findings of Apergis and Payne (2010), who identified a significant relationship between renewable energy consumption and economic growth, the results of this study suggest that renewable energy has not yet reached a sufficient level to significantly influence economic performance. This may be explained by its relatively lower share in the energy mix during the analyzed period.

The empirical results allow us to assess the validity of the research hypotheses.

H1, which states that renewable energy consumption has a positive and statistically significant impact on economic growth in Romania, is rejected. Although the coefficient of renewable energy is positive, it is not statistically significant, indicating that renewable energy has not yet become a key driver of economic growth.

H2, which assumes a significant relationship between CO_2 emissions and economic growth, is supported by the results. Both the long-run relationship and causality analysis confirm that CO_2 emissions are associated with economic activity, reflecting the continued reliance on conventional energy sources.

Overall, the findings suggest that traditional energy sources and investment dynamics remain the dominant factors influencing economic growth in Romania, while renewable energy plays a more limited and emerging role.

4.Conclusions and discussions

This paper examined the relationship between renewable energy consumption, economic growth and environmental indicators in Romania over the period 1990–2022 using a time-series econometric approach. The results provide strong evidence of a long-run relationship between GDP, renewable energy, CO_2 emissions, energy use, capital formation and trade openness.

The findings indicate that renewable energy plays a positive but statistically insignificant and limited role in supporting economic growth, suggesting that its contribution remains modest in the Romanian context. At the same time, the positive relationship between CO_2 emissions and economic growth suggests that Romania is still in a phase where economic expansion relies, to some extent, on carbon-intensive energy sources.

Gross capital formation is identified as a key driver of economic growth, particularly in the short run, highlighting the importance of investment in sustaining economic performance. In contrast, energy use and trade openness do not exhibit statistically significant effects, indicating that their role is less pronounced in explaining economic growth during the analyzed period. The presence of a stable long-run relationship and a significant error correction mechanism highlights the capacity of the Romanian economy to adjust to short-term shocks.

Overall, the study contributes to the literature on the energy–growth–environment nexus by providing country-specific evidence for Romania and by extending previous regional analyses through a detailed time-series perspective.

The results of this study have several important policy implications for Romania's economic and energy strategy. Although renewable energy does not yet have a statistically significant impact on economic growth, its role is expected to increase in the future as investments and technological advancements expand its share in the energy mix. Expanding the capacity of renewable energy sources, such as wind, solar and hydro, may support long-term economic development while reducing dependence on fossil fuels.

At the same time, the positive association between CO_2 emissions and economic growth highlights the need for more effective environmental policies, including improving energy efficiency, promoting cleaner technologies and implementing stricter regulations to reduce carbon intensity. The strong role of investment suggests that policies should prioritize capital formation, particularly in infrastructure and green technologies, to sustain economic growth.

Finally, Romania may benefit from deeper integration into international markets by attracting foreign investment in renewable energy and environmentally sustainable sectors.

This study has several limitations. First, the analysis is based on a single-country time-series, which may limit the generalizability of the results. Second, the relatively small sample size may affect the robustness of the estimations. Future research could extend the analysis using panel data or alternative econometric approaches.

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FROM ATTITUDES TO ACTION: CIRCULAR CONSUMPTION BEHAVIOR AMONG YOUNG CONSUMERS

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Abstract: *Against the backdrop of escalating environmental concerns and the imperative for structural shifts in economic activity, the circular economy has emerged as a promoted solution in recent years. Among the economic factors that contribute to the transition toward circularity, consumers play a crucial role, as the implementation of this concept's principles would be unattainable without their involvement. Starting from the Theory of Planned Behavior, the purpose of this study is to analyze the relationships between pro-circular attitude, perceived social norms, perceived control, circular consumption intention and total circular behavior among young consumers. Data was collected through a questionnaire applied to a sample of 132 high school students (grades IX–XII). The dimensions included in the study were measured by multi-item Likert scales (1–5), and total circular behavior was calculated as the mean frequency of practices associated with circular economy strategies. Analyses included descriptive statistics, assessment of internal consistency (Cronbach's α) and Pearson correlations between composite scores. The results indicate a relatively favorable attitude towards circular consumption, concomitant with a moderate level of reported circular behavior, suggesting a gap between declarative orientations and actual actions. All scales showed good to excellent internal consistency (α = 0.77–0.91). Correlational analyses revealed significant positive associations between psychosocial determinants and circular consumption intention, as well as between intention and total circular behavior. Intention and perceived control showed the strongest associations with circular behavior. The findings suggest that, beyond favorable attitudes, perception of ability to act and support for intentions are essential for increasing circular consumption among young people.*

Keywords: *circular economy; young consumers; consumer behavior; Theory of Planned Behavior*

JEL Classification: *D12; Q01; Q56*

1. Introduction

Environmental and climate issues represent one of the primary concerns currently facing humanity, according to the latest findings. According to The World Meteorological Organization (WMO) (2026) the last three years have been identified

as the warmest within the 176-year record of instrumental observations. Furthermore, Arctic sea ice extent has reached a historic minimum due to the warming of the global ocean, a phenomenon that has consequently led to a rise in sea levels. These developments are attributed to an accumulation of excess energy within the Earth system, primarily driven by high concentrations of atmospheric greenhouse gases. Within this context, the global economy necessitates a radical transformation.

A society less dependent on primary resources, more prosperous and, at the same time, friendly with the environment can be achieved by using the principles underlying the circular economy (Barb*u et a*l., 2018). Ozden (2026) believes that this type of approach is *a critical pathway* to respond to the sustainability challenges facing humanity.

The idea behind the concept of *circular economy* is to replace the old linear business known as *take-make-dispose* (Lopes, Pinho and Gomes, 2023; Terra Dos Santo*s et a*l., 2023) by a new model based on sustainability. The circular economy is conceptualized as a system focused on closing material loops, with the objective of retaining products, components, and materials within the industrial system for as long as possible and maximizing their value (Zink and Geyer, 2017). The role of this type of approach is to support a sufficient supply to meet the demand for products on the market without placing pressure on the environment and society (Patw*a et a*l., 2021).

The concept is inspired by nature where the water or nutrient cycles are based on the principle according to which elements that are useless to some become resources for others (Stahel, 2016). It was introduced as an official European Union Policy in 2015 (European Commission, 2015) and remains such until today. It tries to expand the lifecycle of products, mainly via 3R practices, preventing the waste of resources (Patw*a et a*l., 2021).

2. Theoretical background

According to Agarwa*l et a*l. (2025), despite the logistical complexity, the high implementation costs and the lack of consumer involvement, the circular economy practices contribute to closed-loop production systems and waste reduction, and also, bring forward marketing strategies that imply eco-aware customers.

One of the options for making the transition to circular business models is to encourage their emergence as a result of changing consumer habits towards collaborative consumption models (Barb*u et a*l., 2018).

De Pascal*e et a*l. (2023) identify the following barriers to a circular economy: technological, market, institutional, and social. Although all of them are of particular importance, the paper will focus on social and market barriers, and more precisely on the consumer behavior of young generations.

New generations have consumption habits that lean towards sustainability, as research in the field shows. Contreras-Mass*e et a*l. (2024) highlight Generation Z's involvement in the use of sustainable fashion and the importance it places on transparency and accountability from brands. Also, Gazzol*a et a*l. (2020) remark the new generation's increased attention to sustainability issues in the fashion industry. That is because they are concerned about climate change, social issues, ethical issues, and have increased environmental awareness (Palomo-Domínguez, Elías-Zambrano and Álvarez-Rodríguez, 2023). There are differences between

generations regarding the environmental situation, younger generations tend to be more concerned about the environment (Rodrigues, Proença and Macedo, 2023). Moreover, among the younger generation, environmental awareness and concern are considered essential factors for increasing trust and attitude towards circular goods, which leads to increased commitment to these goods and ultimately affects their purchase intention (Yang, Chuang and Chen, 2024).

Thus, consumers' attitude toward products is an important factor for switching behavior towards circular ones (Hazen, Mollenkopf and Wang, 2017). Intrinsic motivation (feeling good about oneself and caring for the environment) was found to be a key factor in adopting circular behavior, based on a study on Gen Z tourists and their behavior when travelling (Jaco*b et a*l., 2026).

Another aspect affected by environmental concern is the need to seek more information before buying, to avoid greenwashing (Szilagy*i et a*l., 2022) or other misleading marketing tactics regarding the sustainability of a product. This is where communication comes in. Communication strategy differs by generation. Pioch*i et a*l. (2026) believe that new generations, such as Gen Z, are more influenced by platforms like TikTok, through short videos, while older generations respond more to traditional digital channels, such as Facebook, or offline channels. The same authors propose as solutions the integration into dedicated food waste reduction apps of functions that favor visual entertainment and gamification elements, and, in addition, offering of various economic rewards or elements that bring social recognition.

The Theory of Planned Behavior - TPB – is a model that has been widely applied to predict behaviors, particularly in relation to the circular economy regarding recycling or green purchasing (Ozden, 2026). Specifically, the model attempts to establish interrelationships between the circular economy indicators or other constructs and its determinants and factors (Adabr*e et a*l., 2023).

The model conceived by Ajzen (1991) focuses around intention as an intermediate determinant of the occurrence of a certain behavior, the stronger the intention, the more likely the behavior will occur. According to the author of the theory, intention consists of the motivational factors or determinants that lead to a certain behavior, highlighting the effort that the individual invests in the behavior.

Initially, three conceptually independent factors of intention (Beck and Ajzen, 1991) or antecedents of intention (Ham, Jeger and Frajman Ivković, 2015) were included in the model: attitude, subjective norm, and perceived behavioral control. These variables have a central role in influencing consumer behavior (D'Souz*a et a*l., 2026).

Personal attitude reflects the individual's evaluation of the behavior and is related to the question *Do I want to do that?* If the attitude is positive, the behavior is perceived as desirable (Ham, Jeger and Frajman Ivković, 2015).

Subjective norms refer to social pressure, composed of the approval that those around the individual may or may not offer (injunctive normative belief), but also the possibility that those around the individual may also exhibit the desired behavior (descriptive normative belief) (Ajzen, 2020). It relates to the perception of the individual regarding social expectations and it is captured by the response to the question *Do other people want me to do that?* (Ham, Jeger and Frajman Ivković, 2015). Therefore, consumer behavior is influenced by the attitude that society has towards certain products. If a product is socially approved, it will have positive effects by encouraging the consumption of that product. This leads to a more

sustainable lifestyle and well-being among those who consume it, creating a sense of self-worth and contribution to the common good (Kumar*i et a*l., 2026).

Finally, perceived behavioral control is illustrated by the individual's response to the question *Do I have the necessary ability to do that?* (Ham, Jeger and Frajman Ivković, 2015). It captures the individual's assessment of how easy or difficult it is to perform a specific behavior (Ajzen, 1991). Among the influencing factors of the perception of control, the belief that a facilitating or inhibiting factor may appear, are: the existence of resources and money, the availability of time, and the possession of the necessary skills and abilities (Ajzen, 2020).

The relevance of these factors is strongly emphasized. In their study, Koa*y et a*l. (2024) identify the following as critical factors for the formation of purchase intention: attitudes, injunctive norms, and perceived control, with descriptive norms not being considered essential. Also, the TPB can be extended to establish the possibility of other behaviors, such as the intention to recycle, for which Wardan*i et a*l. (2025) argue that attitude, control, and subjective norms play a significant role.

This paper integrates circular economy with attitudes, subjective norms, and perceived behavioral control, part of the TPB, as determinants of intention regarding circular consumer behavior.

The central research question of this study is: To what extent are attitude, perceived social norms, perceived control, and intention associated with the total circular behavior of young people?

Therefore, the following hypotheses were formulated:

H1: Pro-circular attitude is positively associated with circular consumption intention.

H2: Perceived social norms are positively associated with circular consumption intention.

H3: Perceived control is positively associated with circular consumption intention.

H4: Circular consumption intention is positively associated with total circular behavior.

H5: Perceived control is positively associated with total circular behavior.

H6: Attitude and social norms are positively associated with total circular behavior.

3. Research methodology

3.1. Sample

In order to answer the formulated research question, we have collected responses from young consumers. The sample consists of high school students (grades IX–XII), who are part of Generation Z (b. 1996-2010), respectively Generation Alpha (b. 2011-2025), who study at Partenie Cosma Economic College in Oradea. For this research, we used a survey with a questionnaire as an instrument. The questionnaire was elaborated in Google Forms and disseminated to respondents, with the collection period being the beginning of April 2026. The questionnaire was conducted anonymously, all participants provided informed consent, and the study's purpose was clearly explained.

Table 1: Socio-demographic characteristics of the sample (N = 132)

Variable	Category	n	%
Gender	Female	70	53
	Male	60	45.5
	Prefer not to say	2	1.5
Residence	Urban	72	54.5
	Rural	60	45.5
High school class (level of study)	9th grade	33	25
	10th grade	34	25.8
	11th grade	41	31
	12th grade	24	18.2
Age group	15-16	32	24.2
	17-18	69	52.3
	19-20	31	23.5

Source: Authors 'processing

The sample consists of 132 respondents, with a relatively balanced distribution by gender (53.0% female, 45.5% male) and area of residence (54.5% urban, 45.5% rural). The age of the respondents varies between 15 and 20 years, with the majority falling in the 17–18 age range.

3.2. Data measurement

The study used a structured questionnaire to measure psychosocial determinants of circular consumption (attitude, perceived social norms, perceived control, intention) and the frequency of consumption behaviors aligned with the circular economy (total circular behavior).

Attitude towards circular consumption

Attitude was assessed using a 3-item scale (e.g., importance of choosing sustainable/repairable products, preference for *less but better*, perception that the circular economy can reduce environmental problems). Items were measured on a 5-point Likert scale (1 = Strongly disagree, 5 = Strongly agree). The attitude score was calculated as the arithmetic mean of the 3 items, with higher values indicating a more favorable attitude towards circular consumption.

Perceived social norms

Social norms were measured by 3 items assessing respondents' perceptions of expectations and social acceptance of circular behaviors (e.g., encouraging recycling/reuse, accepting second-hand shopping in one's social circle, importance of reducing waste among friends). Items were measured on a 5-point Likert scale (1 = Strongly disagree, 5 = Strongly agree). The social norms score was calculated as the arithmetic mean of the 3 items, with higher values indicating more pro-circular perceived social norms.

Perceived control

Perceived control was assessed through 3 items that capture the perception of the ease of adopting circular behaviors (e.g., accessibility of circular alternatives, knowledge of correct recycling methods, possibility of making circular choices without too high costs). The items were measured on a 5-point Likert scale (1 = Strongly disagree, 5 = Strongly agree). The perceived control score was calculated

as the arithmetic mean of the 3 items, higher values indicating a higher level of perceived control over the adoption of circular consumption.

Circular consumption intention

Intention was measured by 3 items targeting the intention to adopt circular behaviors in the near future (e.g., avoiding buying new products when alternatives exist, reducing waste, choosing brands with return/buy-back/repair programs). The items were measured on a 5-point Likert scale (1 = Strongly disagree, 5 = Strongly agree). The intention score was calculated as the arithmetic mean of the 3 items, with higher values indicating a stronger intention to adopt circular consumption.

Total Circular Behavior

Circular behavior was measured as the frequency of consumption practices associated with circular economy strategies (Rs), through a battery of frequency items (1 = Never, 5 = Very often). The items covered six behavioral dimensions (with 3 items each, 18 items in total): Refuse/Rethink (e.g., refusing disposable products), Reduce (e.g., reducing energy and water consumption, food waste), Reuse (e.g., reusing containers/packaging), Repair (e.g., repairing items instead of replacing them), Recondition (e.g., using refurbished goods) and Recycle (e.g., collecting plastic/paper/metal/glass separately, returning packaging or WEEE to dedicated points). For this paper, an aggregate total circular behavior score was calculated as the arithmetic mean of the 18 items, with higher values indicating a higher frequency of reported circular behaviors.

The behavioral items primarily assess everyday circular consumption practices (e.g., refusing single-use products, reducing waste, reusing, repairing, and recycling) rather than high-involvement purchasing decisions related to household durable goods.

The data was initially exported to Excel (.xlsx) format and processed to correct any errors or omissions. Subsequently, statistical analyses were conducted using Jamovi (version 2.6), an open-source platform for intuitive statistical analysis. Data was analyzed by descriptive statistics (means, standard deviations, min–max) and the internal consistency of the scales was assessed using Cronbach's α. Composite scores for multi-item constructs (attitude, social norms, perceived control, intention, and circular behaviors) were calculated as the arithmetic mean of the corresponding items, on 5-point scales. The association between constructs was assessed by Pearson's correlation coefficient, along with reporting the correlation coefficient and the significance level.

4. Results and discussions

Table 2 presents the results of the reliability analysis based on Cronbach's alpha, along with detailed descriptive statistics (means and standard deviations) for participants' scores on the psychosocial determinants of circular consumption and overall circular behavior.

Table 2: Descriptives and internal consistency for constructs (N = 132)

Dimension	Number of items	Cronbach's α	Mean	Standard deviation
Attitude towards circular consumption	3	0.841	3.80	0.92
Perceived social norms	3	0.774	3.30	0.92
Perceived control	3	0.823	3.54	0.95
Circular consumption intention	3	0.842	3.40	0.99
Total Circular Behavior	18	0.910	2.98	0.77

Source: Authors 'processing

Note: Scores for Attitude, Social Norms, Perceived Control, Intention, and Total Circular Behavior were calculated as the arithmetic mean of the items (scales 1–5). Higher values indicate higher levels of the construct.

From the table 2, it can be seen that Cronbach's α values are from good to excellent (between 0.774 and 0.910) for all the dimensions, indicating a high level of internal consistency and supporting the reliability of the questionnaire used in this study.
While adolescents are not typically the primary decision-makers for major household purchases, the research specifically examines everyday circular consumption behaviors, such as waste reduction, reuse, repair, and recycling, and the psychosocial factors underlying these practices, including attitudes, social norms, perceived behavioral control, and behavioral intentions. Moreover, participants reported a relatively high level of autonomy regarding their own purchasing decisions (Q: *To what extent do you make purchasing decisions for yourself?* mean decision autonomy = 3.74/5, with 63.7% indicating autonomy *to a large* or *to a very large extent*), which supports the relevance of investigating their consumption-related intentions and behaviors.
Regarding the dimension *Attitude towards circular consumption*, the score of 3.80 suggests a relatively favorable attitude towards circular consumption (in the *agree* to *strongly agree* range). The standard deviation value, i.e. 0.92, is moderate, which means that there are visible differences between respondents: not all are pro-circular to the same extent. The minimum–maximum range of 1–5 indicates that responses covered the full scale, suggesting that both skeptical/resistant and strongly pro-circular respondents were captured. Therefore, we can say that there is a good attitudinal orientation towards circularity, but not a uniform one.
For the dimension *Perceived social norms* a score of 3.30 was registered, which is closer to *neutral to agree*. This means that respondents perceive the norms around them as moderately favorable to circular consumption. Descriptive results indicate that perceived norms are lower than attitudes (3.30 vs. 3.80), suggesting a common pattern whereby respondents express positive personal evaluations but perceive weaker social endorsement of circular consumption. A standard deviation of 0.92 indicates substantial differences between groups/social circles (in some circles second-hand/reuse is normal, in others it may be less so). We can therefore observe that social norms are not as strong as attitude, so social pressure/validation can be a limiting factor.
For *Perceived control*, the average score of 3.54 shows that respondents tend to feel moderate to high control (that they can find alternatives, that they can recycle, etc.),

but not very high. With a standard deviation of 0.95, the perception of control is very heterogeneous: some have easy access to alternatives/infrastructure, others do not. The full range of responses (1–5) also suggests that some respondents report very low perceived control, potentially reflecting constraints such as limited access, higher costs, inadequate infrastructure, or insufficient information. In other words, perceived control is a key area and can explain the differences between intentions and action.
As for the *Intention* dimension, the average of 3.40 suggests a moderate intention to adopt circular behaviors in the near future (not low, but not very high either). The standard deviation value of 0.99 shows large differences: there are both respondents with no intentions (1) and highly motivated respondents (5). Overall, behavioral intention appears to be present but not particularly strong at the group level, suggesting scope for targeted interventions (e.g., education, improved facilities, or dedicated programs).
The last dimension, *Total Circular Behavior*, shows an average score of 2.98, which is practically around the value *3*, i.e. it reveals an occasional/sometimes frequency of circular behaviors. A notable discrepancy is observed between attitudes and behavior: while attitudes are relatively high (3.80), actual behavior remains moderate (2.98). This pattern is consistent with the *attitude–behavior gap*, indicating that favorable evaluations do not necessarily translate into consistent action. The standard deviation (0.77) is slightly lower than that observed for intention and perceived control, indicating that, although there are differences, behaviors are more concentrated around the mean than intentions.
We can conclude that there is greater declarative support than actual behavior.
Further, to test the hypotheses, Pearson correlations were calculated between attitude, social norms, perceived control, intention, and total circular behavior.
Pearson correlation analysis, summarized in table 3, indicated significant positive associations between psychosocial determinants (attitude, social norms, perceived control, intention) and total circular behavior. First, the correlations between psychosocial determinants and intention are high, suggesting that the intention to adopt circular behaviors is closely related to individual evaluations, perceived social context, and perception of the possibility to act. The strongest association with intention is perceived control ($r = 0.769$, $p < 0.001$), followed by social norms ($r = 0.652$, $p < 0.001$) and attitude ($r = 0.627$, $p < 0.001$).
Total circular behavior is most strongly associated with intention ($r = 0.661$, $p < 0.001$), indicating that respondents who report higher intentions also report a higher frequency of circular behaviors. At the same time, perceived control has a moderate association with total circular behavior ($r = 0.522$, $p < 0.001$), suggesting that the level of perceived ease and accessibility (e.g., knowledge of proper recycling methods, access to circular alternatives, perceived costs) is substantially related to reported actions.
Attitude ($r = 0.453$, $p < 0.001$) and social norms ($r = 0.472$, $p < 0.001$) are also positively correlated with total circular behavior. This result suggests that both positive evaluation of circular consumption and perception of a favorable social climate are associated with higher levels of circular practices.

Table 3: Correlation matrix

		Attitude_mean	Norms_mean	Control_mean	Intention_mean	Behavior_total_mean
Attitude_mean	Pearson's r	—				
	df	—				
	p-value	—				
Norms_mean	Pearson's r	0.563 ***	—			
	df	130	—			
	p-value	< .001	—			
Control_mean	Pearson's r	0.702 ***	0.695 ***	—		
	df	130	130	—		
	p-value	< .001	< .001	—		
Intention_mean	Pearson's r	0.627 ***	0.652 ***	0.769 ***	—	
	df	130	130	130	—	
	p-value	< .001	< .001	< .001	—	
Behavior_total_mean	Pearson's r	0.453 ***	0.472 ***	0.522 ***	0.661 ***	—
	df	130	130	130	130	—
	p-value	< .001	< .001	< .001	< .001	—

Note. * p < .05, ** p < .01, *** p < .001

Source: Authors 'processing

In addition, correlations between psychosocial predictors are relatively high (e.g., attitude–control r = 0.702; norms–control r = 0.695; attitude–norms r = 0.563; all p < 0.001), suggesting conceptual coherence between the constructs and the fact that they tend to coexist in respondents' profiles (e.g., those with favorable attitudes tend to perceive even more control, and more pro-circular social norms).
Overall, the correlational results indicate that the tested hypotheses were supported, with the strongest associations observed between perceived control and intention (r = 0.769) and between intention and total circular behavior (r = 0.661). The findings offer correlational evidence in support of hypotheses H1–H6. Due to the cross-sectional design of the study and because it is based on self-reported data, the observed relationships should be interpreted as correlational associations rather than evidence of causality.

5. Conclusions

This study contributes to expanding the literature on the circular economy and consumer behavior by investigating the relationships between attitude towards circular consumption, perceived social norms, perceived control, circular consumption intention and total circular behavior among a sample of 132 high school students (grades IX–XII), with a relatively balanced urban/rural and gender distribution.
The descriptive results suggest a possible gap between pro-circular orientation and actual behavior: although respondents report relatively favorable attitudes, the frequency of circular behaviors is only moderate. At the same time, social norms and perceived control are in the moderate range, with high variability, which may reflect differences in access to circular alternatives and social support for these practices.

Correlational analyses revealed significant positive associations between psychosocial determinants and intention, as well as between intention and total circular behavior. Of the determinants analyzed, perceived control had the strongest association with circular consumption intention (r=0.769), and intention had the strongest association with total circular behavior (r=0.661), followed by perceived control (r=0.522) in relation to behavior. In addition, both attitude (r=0.453) and social norms (r=0.472) were positively associated with total circular behavior, indicating that personal evaluations and perceived social context are relevant to reported circular practices.

From a practical perspective, the results suggest that interventions aimed at increasing circular consumption among young consumers might be more effective if they focus on increasing perceived control (e.g., operational clarity on concrete recycling steps, accessibility of circular alternatives, reduction of perceived costs) and on supporting intentions through opportunities and contexts that facilitate action. At the same time, as social norms are positively associated with intention and behavior, initiatives that make circular practices visible and normalize them in affiliation groups (school/colleagues/community) can contribute to strengthening the pro-circular social climate.

Several limitations should be acknowledged. First, the sample consists of high-school students, and although participants reported substantial autonomy in their personal purchases, they may not be the final decision-makers for major household durable goods. Therefore, findings should be generalized primarily to adolescents' everyday circular consumption practices and intentions, and less to household-level high-involvement purchasing decisions (e.g., large appliances and buy-back programs). Second, the study is cross-sectional and based on self-reports. Therefore, the findings indicate associations rather than causal or temporal effects. Future research could replicate the proposed model among older Generation Z cohorts and adult consumer populations; employ longitudinal or experimental designs to better evaluate the directionality of the relationship between intention and behavior; develop category-specific models distinguishing everyday consumption from major durable purchases; and investigate whether interventions aimed at enhancing perceived behavioral control - such as improved access to repair services, clearer recycling infrastructure, or greater affordability - can facilitate the conversion of pro-circular intentions into consistent behavioral practices.

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CONTEMPORARY CHALLENGES REGARDING ESG POLICIES AND THEIR INFLUENCE ON BUSINESS

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Abstract: *Environmental, Social, and Governance (ESG) policies have evolved from voluntary ethical guidelines into a major strategic framework influencing corporate governance, investment decisions, and international business practices. Initially associated primarily with corporate social responsibility and sustainable investing, ESG has increasingly become integrated into regulatory systems, financial markets, and stakeholder expectations. This evolution has been accelerated by growing concerns regarding climate change, social inequality, corporate accountability, and long-term economic sustainability. Despite its rapid adoption, ESG implementation continues to face significant contemporary challenges. One of the most important issues is the absence of globally standardized reporting frameworks, which creates inconsistencies in ESG ratings, disclosure practices, and performance evaluation across industries and countries. Companies are often assessed according to different methodologies, making comparisons difficult for investors and regulators. Another major challenge is greenwashing, whereby corporations exaggerate or selectively present sustainability initiatives in order to improve public image without implementing substantial operational changes. This practice undermines transparency, reduces stakeholder trust, and raises concerns regarding the credibility of ESG reporting. Through the analysis of recent corporate practices and international regulatory developments, this paper evaluates the influence of ESG policies on business performance, risk management, corporate reputation, and investor confidence. The study argues that although ESG has become an essential element of contemporary business strategy, its effectiveness remains limited by regulatory fragmentation, measurement challenges, and inconsistent corporate commitment. Consequently, the future development of ESG depends on greater standardization, improved transparency, and stronger accountability mechanisms at both corporate and institutional levels.*

Keywords: *ESG policies; financial performance; modern business; sustainability; resource efficiency; business strategy.*

JEL Classification: *M1; M14*

1. Introduction

Environmental, Social, and Governance (ESG) is a framework that incorporates sustainability, ethical responsibility, and governance practices in addition to traditional financial metrics to assess corporate performance. In light of globalization, climate change, and growing stakeholder expectations, ESG has grown in importance. The United Nations Global Compact report "Who Cares Wins" in 2004 officially recognized ESG, although its roots can be found in earlier iterations of socially responsible investing (SRI). Environmental, social, and governance considerations were first incorporated into financial markets and investment strategies through this initiative. According to the report, businesses that apply ESG principles are more likely to succeed in the long run and generate sustainable value. Stakeholder theory, which contends that businesses must take into account the interests of many stakeholders in addition to shareholders, is the theoretical foundation of ESG. Furthermore, according to legitimacy theory, companies should implement ESG practices in order to uphold their legitimacy and conform to social norms. The influence of normative and regulatory forces on ESG adoption is further explained by institutional theory. ESG encompasses three main pillars: environmental, social and governance. These factors offer a thorough framework for evaluating the long-term viability and sustainability of businesses. ESG has developed into a worldwide phenomenon that affects assets valued at trillions of dollars. Thus, this paper aims to present the evolution of the ESG policies and how these policies are now integrated in companies' business strategies and the impact they have on those. In the next chapter is presented how ESG policies are approached by companies, their evolution and what the rest of the authors think about this topic. In the last three chapters, the paper covers some case studies on well-known companies and their results by integrating ESG policies. The qualitative research methodology used in this work is founded on: analysis of secondary data (reports, institutional publications, and scholarly literature), examination of multinational corporations through case studies. Finding trends in ESG implementation and assessing how they affect strategy and business performance are the main goals of the methodology. Given the fact that the primary goal of the methodology was mentioned, here comes the research question: How do contemporary challenges in ESG policy implementation influence business strategy and performance? Sub question: Is there a possible relationship between ESG and financial performance? This paper aims to add, beyond prior literature aspects regarding the growth in importance of the ESG policies and how they succeed in establishing such an indispensable relationship with businesses' strategies. The contribution of this paper is trying to be a preliminary framework for future empirical testing.

2. Literature review and empirical background

Recent empirical work points to how quickly ESG investing has spread, and how central it has become in mainstream financial markets. In one global survey of more than 1,100 institutional investors, reported ESG adoption rose from 84% in 2021 to 90% in 2023, a shift that signals ESG is now close to standard practice in portfolio decision-making. Capital is also being directed with ESG in mind: for many institutions, ESG ratings now sit among the strongest inputs shaping what gets

funded and what does not (Bioy and Wang, 2024). The asset base has climbed as well. Morningstar figures show global ESG fund assets at about $3.3 trillion in 2024, increasing from roughly $3.1 trillion in the prior quarter. As Scholle mentioned in his article (2026) taken together, these numbers line up with a clear, continuing rise in investor appetite for sustainable investment options. However, the literature also reveals contradictions. While some studies show a positive correlation between ESG performance and institutional investment flows, others indicate mixed or negative impacts on financial performance in certain sectors, such as the cruise industry. Research also traces ESG back through its long history, tying it to older ethical investing traditions that go back hundreds of years. What people now call "modern ESG" took clearer shape alongside global efforts like the Principles for Responsible Investment (PRI) and the rise of sustainability reporting frameworks. This paper is different from existing reviews because it suggests how the bond between digitalisation and integration of ESG policies might save the future of companies that are open to integrate such aspects.

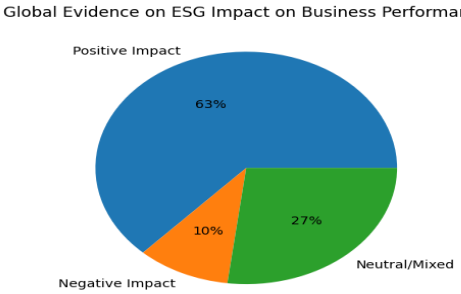


Figure. 1. Distribution of ESG Impact on Business Performance
Source: Friede, G., Busch, T., & Bassen, A. (2015), *ESG and financial performance: aggregated evidence from more than 2000 empirical studies. Journal of Sustainable Finance & Investment*, 5(4), 210–233. https://doi.org/10.1080/20430795.2015.1118917

In Fig. 1 there is presented how the impact the integration of ESG policies might have on company business' strategy and their financial performance. The majority of the sources state that ESG integration has a positive impact on businesses, while some other sources consider that there is a neutral impact. Only 10% of the sources believe that ESG integration has a negative impact, which, regarding this paper's topic stands as the first evidence that might show the importance of this research, considering such a small number of sources believing ESG having a negative impact.
The qualitative research methodology used in this work is founded on: analysis of secondary data (reports, institutional publications, and scholarly literature) and an examination of multinational corporations through case studies. Finding trends in ESG implementation and assessing how they affect strategy and business performance are the main goals of the methodology. The methodology focuses on identifying patterns in ESG implementation and evaluating their impact on business performance and strategy.

3. ESG in practice

Right now, ESG, short for Environmental, Social, and Governance, isn't sitting on the sidelines as a neat set of ideas. It has become a day-to-day priority that companies fold into strategy and execution. Instead of broad statements, ESG work is often tied to clear metrics, reporting that connects across the business, and results that show up in financial and operational performance. On the environmental side, many firms are setting plans that track with global climate objectives, including net-zero pathways. Microsoft is a frequently cited case. It has pledged to become carbon negative by 2030 and has said it already cut its Scope 1 and 2 emissions by more than 17% against a 2020 baseline (Smith, 2020). Alongside those reductions, the company has put over $1 billion into carbon removal technologies. Taken together, this shows what it looks like when environmental ESG moves from intent to action, with targets that can be measured and money assigned to meet them. Tesla offers a different angle, weaving ESG into the core of what it sells. By focusing on electric vehicles and renewable energy solutions, it positions environmental outcomes as part of its business model. In 2023, Tesla delivered more than 1.8 million vehicles worldwide, a scale that supports lower transportation-related emissions. The social dimension of ESG focuses on human capital, diversity, and stakeholder relationships. Unilever provides a strong example through its Sustainable Living Plan, which has reached over 1 billion people with health and hygiene programs. Additionally, the company reports that more than 60% of its management positions are held by women, highlighting measurable progress in diversity and inclusion. Another relevant example is Nike, which has invested heavily in improving labor conditions within its supply chain. Nike publishes detailed sustainability reports, including supplier audits and compliance metrics, demonstrating increased transparency in social ESG practices.

Even with how quickly ESG has expanded, it keeps running into a few serious obstacles. Lack of Standardization: A major sticking point is that there still isn't a single, shared set of ESG reporting rules. Rating firms grade companies using different yardsticks and formulas, so the very same business can end up with conflicting scores depending on who is doing the scoring. That makes side-by-side comparisons harder and leaves investors guessing. Greenwashing: It is when ESG claims get oversold. A company might advertise sustainability programs that sound impressive but deliver little in practice, and once that gap shows up, confidence in ESG, and the tools built around it, starts to erode. Regulatory Complexity: Rules for ESG differ widely by location. The European Union, for instance, has moved ahead with demanding sustainability disclosure requirements, while other areas are working with looser or less settled systems. For companies operating in multiple countries, keeping up can turn into a complicated compliance puzzle. Financial Performance Debate: There's still no settled answer on how ESG links to financial results. Some research finds a positive connection, but other work points to outcomes that are flat, or even negative, depending on the sector. Data and Measurement Issues: A lot of ESG scoring depends on information companies report about themselves, and that data can be uneven, hard to verify, or presented without full clarity. The result is persistent doubt about how dependable, consistent, and unbiased ESG assessments really are.

4. Short Case Study: Unilever and ESG-driven Financial Performance

Unilever is one of the world's largest consumer goods companies, operating in over 190 countries with brands in food, home care, and personal care. It is widely cited as a benchmark for ESG integration. ESG Planning and Execution: Environmental (E):

- 52% reduction in CO2 emissions per production unit (2010–2020)
- 95% of waste was diverted from landfills.
- greater utilisation of sustainable sourcing and renewable energy

Social (S):

- better health and wellbeing as a result of product reformulation
- encouraged supplier standards and fair labor practices
- supply chains that empower women and smallholder farmers

Governance (G):

- a Global Sustainability Board was established.
- executive pay linked to ESG goals
- enhanced openness via ESG reporting platforms

In 2010, the company unveiled the Unilever Sustainable Living Plan, a long-term framework designed to align social impact, governance, and environmental sustainability with broad business objectives. Rather than viewing ESG as a compliance requirement, Unilever prioritized sustainability in its brand development, supply chain management, and operational decision-making. Over time, this strategic integration produced measurable financial outcomes. One of the most crucial indicators of success was the performance of Unilever's "sustainable living brands," which were products closely linked to social or environmental objectives. These brands consistently outperformed the rest of the portfolio, growing at a rate of roughly 69% faster and contributing roughly 75% of the company's overall growth. This shows a clear link between revenue growth and ESG-oriented product positioning, indicating that consumer demand is favouring businesses that are seen as ethical and mission-driven. When a company like Unilever focuses on sustainability and ethics, it can have a big impact on its finances. This is not just about saving money or making more sales, but also about building a strong reputation. When people think of Unilever's products, they think of a company that cares about the environment and does the right thing. This makes customers more loyal and more likely to choose Unilever over other brands. In a market with many similar products, having a good reputation can be a key way to stand out and stay ahead of the competition. As a result, Unilever has been able to keep and even grow its share of the market. But the case also draws attention to significant issues. The company occasionally faced criticism from investors who were worried about striking a balance between sustainability objectives and short-term profitability, and implementing ESG at such a scale required a large upfront investment and organizational transformation. As a result, like some reports from AIM (European Brands Association, 2020) present, there was a slow transition to a more balanced strategy in which ESG initiatives are still crucial but are now more clearly linked to financial performance goals. The Unilever case is a great example of how considering the environment and society can actually help a business grow. When a company really makes these concerns a part of its overall plan, daily operations, and leadership, it can lead to some impressive benefits. For instance, Unilever

found that focusing on sustainability led to increased revenue, better use of resources, a stronger brand image, and the ability to withstand challenges over time. This shows that taking care of the planet and people can also be good for the bottom line, creating a win-win situation where both the business and society benefit. By making environmental and social concerns a central part of its strategy, Unilever demonstrates that it's possible to achieve economic success while also making a positive impact on the world.

5. Short Case Study: Nike and the positive impact of ESG integration

The case of Nike illustrates how ESG integration can influence financial performance not only through direct revenue growth, but also through innovation, operational efficiency, and brand strength in a highly competitive global market. Over the past decade, Nike has progressively embedded environmental, social, and governance principles into its long-term strategy, particularly through its "Move to Zero" initiative and its broader sustainability targets for 2025. Rather than treating ESG as a compliance exercise, the company positioned sustainability as a driver of product innovation and consumer engagement, aligning its environmental goals with its core business model. One of the biggest effects of this plan is how it's changed the way products are made and new ideas are created. Nike has been using more eco-friendly materials in its products, with about 39% of them already considered good for the environment. This has helped cut down on greenhouse gas emissions by over 182,000 metric tons. Not only is this better for the planet, but it's also what customers are increasingly looking for, which has helped Nike stay ahead of the competition. At the same time, the company has been coming up with new, sustainable design ideas, like ways to make things with less carbon and using recycled materials (Nike, 2022; Nike, 2023). This has allowed Nike to stand out from the crowd and make its products more valuable, rather than just seeing sustainability as an extra cost. Nike's efforts to be more socially responsible have really paid off. By treating everyone fairly, like paying women and minorities the same as others, and giving them more leadership roles, the company has created a more welcoming work environment. This has also helped Nike connect with its customers on a deeper level, especially younger people who care about doing what's right for the planet. The company's big investments in local communities, over $140 million each year, have made a real difference and improved its public image. As a result, Nike has built stronger relationships with its customers and set itself up for long-term success. By being a brand that values ethics and sustainability, Nike is appealing to the growing number of young consumers who want to support companies that share their values. Nike has really improved its performance by being open and honest about its impact on the environment and society. This has helped the company build trust with its stakeholders and be more accountable for its actions. By being transparent, Nike has also improved its reputation and made itself more attractive to investors who care about sustainability. This is important because it helps the company stay stable in the long term and have access to the capital it needs to keep growing. As Nike itself says, being transparent about its sustainability goals and progress is key to managing risks, increasing productivity, and planning for the future. By doing so, Nike is setting itself up for success and making sure it can keep expanding and improving over time.

Even though Nike had numerous positive outcomes by integrating ESG policies, this case also highlights some challenges:

- faced periods of revenue decline and margin pressure due to macroeconomic factors and market shifts
- financial benefits are often: long term, indirect (brand, risk, efficiency)
- short-term profitability may fluctuate

In conclusion, Nike provides evidence that: even if you don't see the results right away, making ESG a part of your business strategy can lead to some real benefits. For one, it can make your operations more efficient, which is a big plus. It can also boost your brand's value and lead to better financial performance over time. Now, it's true that the financial benefits might not happen overnight, and they might not always follow a straight line. But what we've learned is that when you make ESG a core part of your strategy, it can give you a real edge over the competition and help you grow in the long run, especially in a world where sustainability is becoming more and more important.

6. Conclusion

Environmental, Social, and Governance (ESG) frameworks have developed into an essential part of modern business strategy, greatly impacting financial performance and corporate decision-making. As investors place a higher priority on sustainability-linked performance metrics, empirical data indicates that companies with strong ESG integration typically enjoy better risk management, increased stakeholder trust, and easier access to capital. However, because results differ across industries, geographical areas, and methodological approaches used in ESG scoring systems, the relationship between ESG and financial outcomes is not consistent. One of the main conflicts in the field is reflected in this heterogeneity: although ESG is generally acknowledged to increase value over time, its short-term financial impact is still context-dependent and occasionally unclear. ESG is currently in a crucial phase of institutional consolidation. On the one hand, it has successfully transitioned from a voluntary initiative to an expected business norm, becoming deeply ingrained in international financial markets, regulatory frameworks, and corporate reporting standards. Despite the many benefits, there are still some big hurdles that prevent ESG from reaching its full potential. For example, there's no standard way to measure it, companies don't always disclose the same information, and the data can be unreliable. Plus, some people are worried that companies are just pretending to care about the environment and social issues, which is known as greenwashing. All these issues make it hard to compare companies and can erode trust among investors. That's why we need better rules and global standards to guide ESG. Right now, ESG is a powerful tool for creating a more sustainable future, but it's still a work in progress with many challenges to overcome. The key to its success will be how well regulators, investors, and companies can work together to create a more transparent and consistent system that actually leads to real-world results. If they can do that, ESG can be a game-changer, but if not, it might struggle to make a meaningful impact.

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BEYOND THE CAPITAL: MEASURING URBAN TOURISM HIERARCHIES IN ROMANIAN CITIES

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Abstract: *The present study analyses the spatial distribution of tourist accommodation demand across Romanian cities. Utilizing Eurostat's city-level data, the investigation encompasses short-stay accommodation offered via collaborative economy platforms. The analysis employs data from 2018 to 2024, with a particular emphasis on key indicators such as stays, nights spent, and the distinction between domestic and international guests. The paper draws on the concepts of urban tourism hierarchy, tourism concentration, and polycentric urban development to investigate whether Bucharest continues to dominate Romania's urban tourism market or whether a more diversified territorial pattern is emerging. The empirical approach is based on comparative graphical analysis of city-level tourism dynamics, market shares, and post-pandemic recovery trends. The findings reveal that Bucharest maintains its status as the preeminent urban destination, accounting for the highest proportions of both stays and nights spent, particularly within the international segment. However, its pre-eminence appears to be increasingly contested by the emergence of prominent secondary destinations, particularly Brașov and Cluj-Napoca, followed by Sibiu and Timișoara. The tourism functions of these cities are heterogeneous, with Brașov relying more strongly on domestic leisure demand, while Cluj-Napoca combines business, academic, and event-related tourism. The findings also underscore the accelerated recovery of collaborative economy accommodation post-2021, signifying the mounting significance of digital platforms in influencing urban tourism flows. The Romanian urban tourism system is characterized by its capital-led nature, yet it is undergoing a process of diversification, marked by the emergence of competitive secondary cities. The present study makes a contribution to the literature on urban tourism geography in emerging European markets and provides useful implications for destination management, tourism decentralization, and sustainable regulation of short-term rentals.*

Keywords: *short-stay accommodation; Romanian cities; urban tourism*

JEL Classification: *Z32; O35*

1. Introduction and Theoretical Background

Urban tourism has emerged as a highly dynamic segment of the European visitor economy, exerting considerable influence on various aspects such as local income,

employment, infrastructure development, and city branding. The concentration of accommodation capacity, transport connectivity, cultural assets, business services, and events in large cities naturally results in these cities becoming focal points of tourism demand (Ashworth & Page, 2011). Concurrently, numerous countries have witnessed the emergence of secondary urban destinations, propelled by the affordability of low-cost air transportation, the revitalization of heritage districts, the implementation of digital marketing strategies, and the shift in travel preferences toward more concise and varied urban excursions (Maitland & Newman, 2009).

An increasingly significant component of these transformations is the expansion of the collaborative economy, particularly short-stay accommodation platforms that connect hosts and guests through digital marketplaces. Platforms such as Airbnb, Booking.com, and analogous peer-to-peer or platform-mediated services have profoundly impacted urban accommodation markets by increasing capacity, diversifying lodging options, and enabling tourism growth beyond the traditional hotel sector (Guttentag, 2015; Sigala, 2017). The aforementioned phenomena have also intensified competition, altered neighbourhood tourism geographies, and expanded access to city-break tourism (Adamiak, 2022). Consequently, the collaborative economy sector has emerged as a pivotal component in contemporary urban tourism analysis.

Within this broader context, the spatial distribution of tourism demand across cities is a topic of significant interest for researchers and policymakers alike. A highly concentrated tourism system may generate efficiency advantages through agglomeration effects; however, it can also create congestion, housing pressure, unequal territorial development, and overdependence on a single destination (Hall & Page, 2014). Conversely, a more balanced or polycentric urban tourism system may stimulate wider regional growth, distribute visitor flows more evenly, and strengthen the resilience of the national tourism sector (ESPON, 2016).

Romania offers a pertinent case for examining these dynamics. As the national capital and the most populous metropolitan area, Bucharest has traditionally occupied a dominant position due to its administrative role, international accessibility, business travel demand, and concentration of tourism infrastructure. However, over the past decade, several regional cities have experienced a notable increase in both visibility and tourism. Cities such as Cluj-Napoca, Brașov, Sibiu and Timișoara have experienced notable benefits from enhanced air connectivity, cultural events, heritage tourism, business investment, and strengthened destination branding. The diffusion of short-stay rentals through collaborative platforms may have further supported the rise of these destinations by lowering market entry barriers and increasing accommodation flexibility (Crommelin et al., 2018).

The present study investigates the spatial distribution of tourist accommodation demand across Romanian cities using Eurostat's city-level dataset on short-stay accommodation offered via collaborative economy platforms by residence of the guest and cities (tour_ce_oarc). The database provides comparable information on guest stays, including distinctions between domestic and international visitors, thereby offering valuable insight into the platform-based segment of urban tourism demand (Eurostat, 2025).

2. Urban tourism hierarchies in Romanian cities

The analysis is based on Eurostat city-level data regarding stays and nights spent in short-stay accommodation offered via collaborative economy platforms. The following section examines the territorial distribution of demand, recent growth dynamics, and differences between domestic and foreign guests across the main Romanian urban destinations.

2.1. Spatial concentration of collaborative economy accommodation demand in Romanian cities

As shown in Figure 1, the 2024 territorial distribution of stays in short-stay accommodation offered via collaborative economy platforms across major Romanian cities, highlighting the relative concentration of demand within a limited number of urban destinations (Eurostat, 2025).

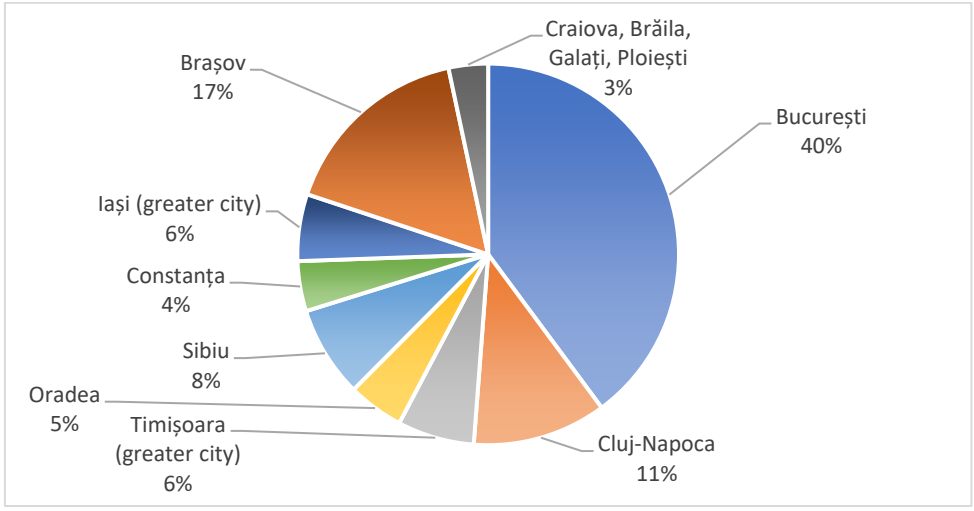


Figure 1: Total stays in short-stay accommodation offered via collaborative economy platforms, by city, 2024
Source: own elaboration, based on Eurostat data

The graphical evidence indicates that tourist demand for short-stay accommodation offered via collaborative economy platforms remains concentrated in a limited number of Romanian cities, while also showing signs of territorial diversification. As we shown in Figure 1, Bucharest accounted for approximately 40% of total stays recorded in the analysed urban sample, confirming its leading position within Romania's platform-based accommodation market. This finding aligns with prior studies that have underscored the pivotal function of capital cities in attracting urban tourism flows, particularly in terms of accessibility, business functions, cultural assets, and metropolitan scale (Edwards et al., 2008).
Concurrently, Figure 1 demonstrates the increasing significance of secondary destinations. The analysis revealed that Brașov accounted for approximately 17% of total stays, followed by Cluj-Napoca with around 11%. Other cities, including Timișoara, Sibiu, Iași, and Constanța, hold smaller but nonetheless significant

shares. These findings suggest that, although demand remains concentrated, Romania's urban tourism market is no longer exclusively capital-centred.

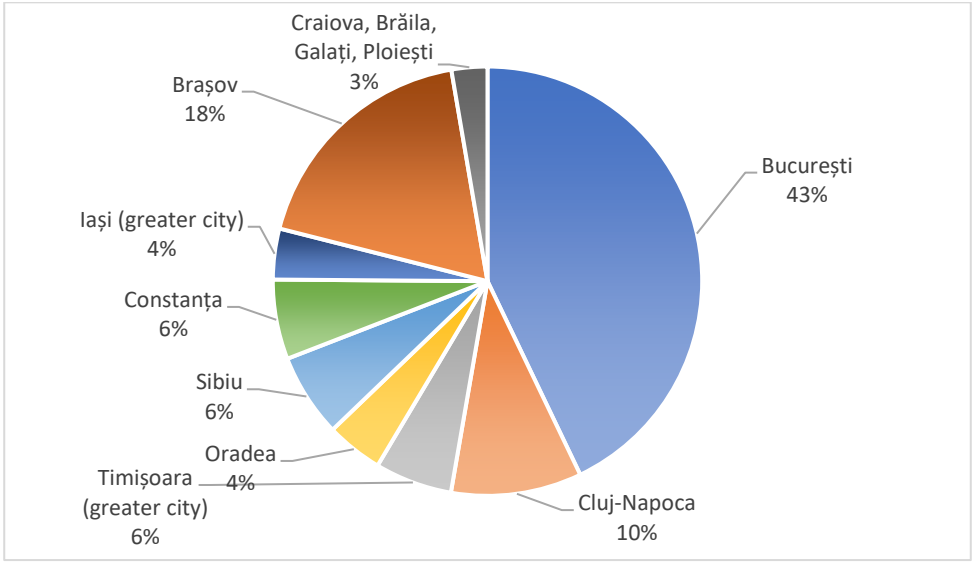


Figure 2: Total nights spent in short-stay accommodation offered via collaborative economy platforms, by city, 2024
Source: own elaboration, based on Eurostat data

A similar pattern is evident in the distribution of total nights spent. As illustrated in Figure 2, Bucharest accounted for approximately 43% of the total nights spent, followed by Brașov with 18%, and Cluj-Napoca with 10%. The higher proportion of Bucharest in terms of nights spent as opposed to stays indicates both high visitor volumes and relatively intensive accommodation utilization.

2.2. Growth dynamics between 2018 and 2024

Figure 3 presents the evolution of stays in the five leading Romanian urban destinations between 2018 and 2024. The time-series evidence demonstrates a pronounced long-term upward trend, interrupted by the contraction associated with the COVD-19 pandemic in 2020 and partially in 2021. This pattern aligns with broader European developments, where urban tourism demand experienced a significant decline during mobility restrictions and subsequently demonstrated a robust recovery (UNWTO, 2023).

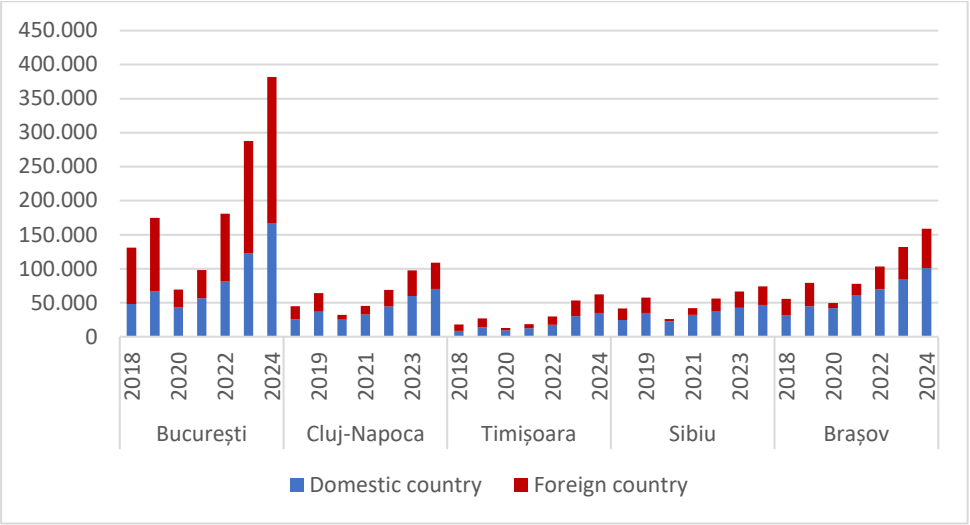
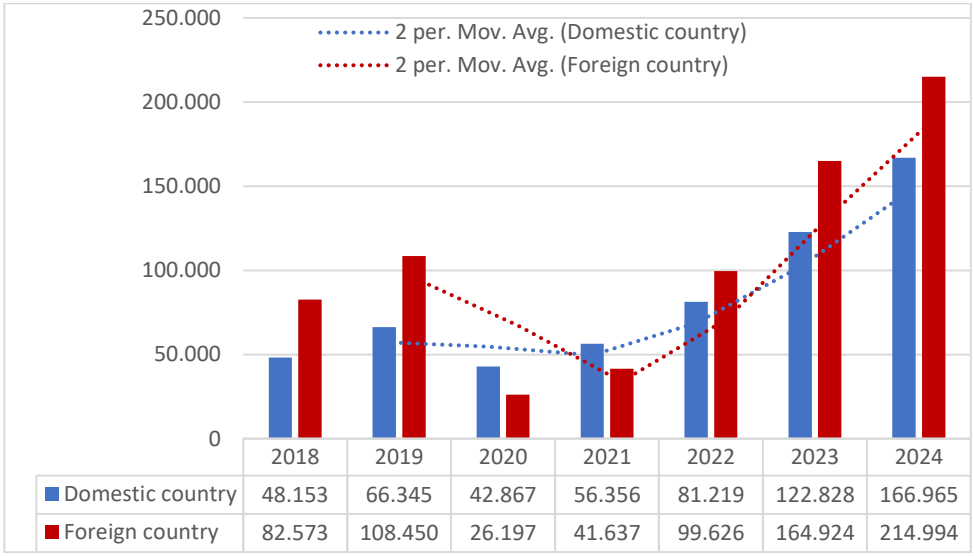


Figure 3: Evolution of stays in short-stay accommodation offered via collaborative economy platforms in five major Romanian cities, 2018–2024
Source: own elaboration, based on Eurostat data

Bucharest (see Figure 3) recorded the most substantial absolute increase during the post-pandemic recovery period, particularly after 2022. This outcome serves to substantiate the resilience of the capital city, a resilience that is bolstered by its international connectivity, the prevalence of business travel, and the diversification of visitor motives.
Brașov exhibited a particularly pronounced upward trajectory, achieving unprecedented levels by 2024. The city's performance is indicative of its robust leisure profile, convenient location for mountain tourism, and its popularity as a destination for domestic short breaks. Destinations that offer a combination of urban amenities and nearby natural attractions often demonstrate robust performance in short-stay tourism markets (Maitland & Newman, 2009).
Cluj-Napoca also experienced robust growth, consistent with its expanding role as an innovation, education, and event centre. Timișoara and Sibiu demonstrated a favorable trend, albeit on a reduced scale.
The preponderance of evidence suggests a concurrent process of concentration and expansion; whereby leading cities maintain their dominance while several secondary centres experience an escalation in their relevance.

2.3. Domestic and foreign demand patterns

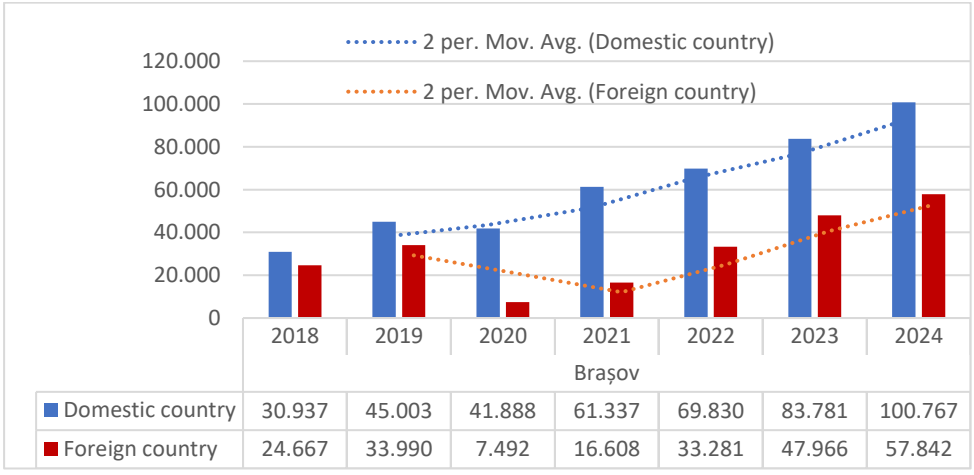
The charts disaggregated by guest residence reveal notable structural differences between Romanian cities.
In Bucharest (Figure 4), foreign stays exceed domestic stays during most of the analysed period and rise sharply after 2022. This confirms the stronger international orientation of the capital, a common feature among metropolitan destinations integrated into European transport and business networks (Hall & Page, 2014).



	2018	2019	2020	2021	2022	2023	2024
Domestic country	48.153	66.345	42.867	56.356	81.219	122.828	166.965
Foreign country	82.573	108.450	26.197	41.637	99.626	164.924	214.994

Figure 4: Evolution of stays in Bucharest, by residence of guests, 2018–2024
Source: own elaboration, based on Eurostat data

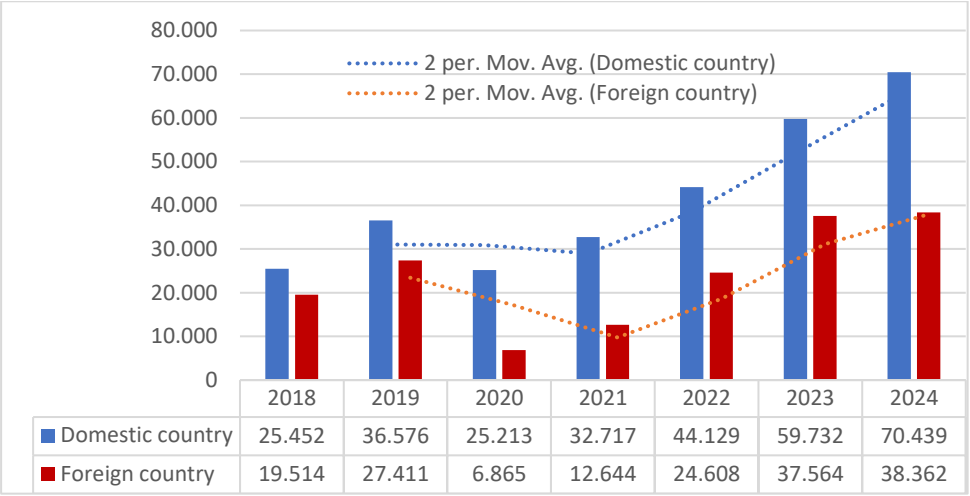
Conversely, in Figure 5 below we have shown that Brașov exhibits robust domestic demand, although the foreign segment also experienced a substantial increase by 2024. This suggests a dual market profile, where domestic leisure tourism remains central while international visibility continues to improve.



	2018	2019	2020	2021	2022	2023	2024
	Brașov						
Domestic country	30.937	45.003	41.888	61.337	69.830	83.781	100.767
Foreign country	24.667	33.990	7.492	16.608	33.281	47.966	57.842

Figure 5: Evolution of stays in Brașov, by residence of guests, 2018–2024
Source: own elaboration, based on Eurostat data

Figure 6 indicates a more balanced structure in Cluj-Napoca between domestic and foreign guests. Such a profile may reflect the city's multiple tourism functions, including business travel, university mobility, cultural events, and short urban visits.



	2018	2019	2020	2021	2022	2023	2024
Domestic country	25.452	36.576	25.213	32.717	44.129	59.732	70.439
Foreign country	19.514	27.411	6.865	12.644	24.608	37.564	38.362

Figure 6: Evolution of stays in Cluj-Napoca, by residence of guests, 2018-2024
Source: own elaboration, based on Eurostat data

The differing composition of demand indicates that Romanian cities do not compete on identical tourism products. Instead, they appear increasingly specialized in distinct market segments.
In Figure 7 below we have shown a comparison of foreign tourist stays in 2024 with 2021 and highlights exceptionally strong percentage increases in many cities. While part of this growth reflects recovery from the depressed pandemic base year, it also signals structural expansion of collaborative economy accommodation.

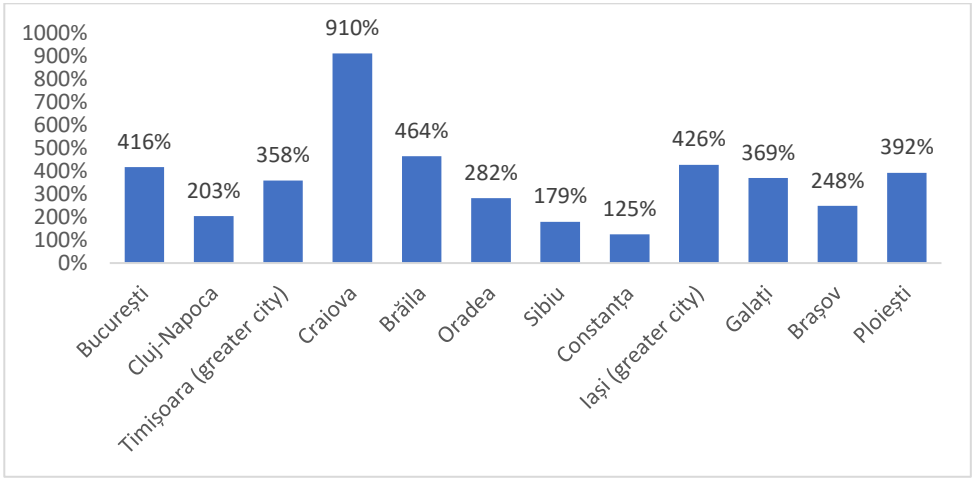


Figure 7: Increase in foreign tourist stays by city, 2024 compared with 2021
Source: own elaboration, based on Eurostat data

Digital accommodation platforms have been shown to reduce entry barriers for hosts, increase lodging flexibility, and enable tourism growth outside the traditional hotel sector (Sigala, 2017). In Romania, this phenomenon is particularly evident in

secondary cities, where platform-based supply has the potential to complement a more limited conventional accommodation stock.
The most pronounced relative increases were observed not only in the largest destinations but also in medium-sized cities. This finding indicates that collaborative economy platforms may facilitate a broader territorial distribution of tourism demand.
The graphical outcomes further indicate an emergent functional hierarchy among Romanian urban destinations:
Bucharest: A prominent international gateway, a preeminent business and metropolitan tourism hub.
Brașov: A leading leisure-oriented city with robust domestic demand.
Cluj-Napoca: A diversified business, academic, and event destination.
Sibiu: A heritage and cultural tourism center.
Timișoara: A western urban node that combines business and city-break tourism.
This differentiation suggests that the growth of Romanian urban tourism is not merely quantitative; rather, it is increasingly shaped by specialization and destination positioning.
The collaborative economy tourism market in Romania is undergoing a transition from a highly centralized structure to a more diversified urban system, with Bucharest maintaining a prominent role in this transformation. The rise of Brașov and Cluj-Napoca is of particular significance, as it indicates heightened competition among cities and a more extensive territorial distribution of tourism expenditure.
However, the rapid growth of short-term rentals may also create regulatory challenges related to taxation, neighbourhood pressures, housing affordability, and urban governance (Crommelin et al., 2018; Adamiak, 2022).

3. Conclusions

The present study examined the spatial distribution of tourist demand in short-stay accommodation offered via collaborative economy platforms across Romanian cities. To this end, Eurostat city-level data for the period 2018–2024 was utilized. The findings suggest that Bucharest maintains its preeminent standing within Romania's urban platform-based tourism market, leading in both the number of total stays and the number of nights spent. The capital maintains its status as the predominant gateway for international visitors and the preeminent metropolitan tourism hub, thereby substantiating the enduring appeal of substantial urban centres within the digital accommodation economy (Hall & Page, 2014).
At the same time, the findings indicate a progressive diversification of Romania's urban tourism geography. Brașov emerged as the strongest secondary destination, particularly through its strong domestic leisure demand and sustained post-pandemic expansion. Cluj-Napoca has also fortified its standing as a multifunctional destination, integrating business, academic, and event-related tourism. Additional cities such as Sibiu and Timișoara contribute to the development of a more extensive and diversified national urban tourism system.
A comparative analysis of the evidence pertaining to domestic and foreign guests reveals that Romanian cities are increasingly occupying diversified market roles. While Bucharest exhibits a pronounced international orientation, destinations such as Brașov place greater emphasis on domestic demand, while Cluj-Napoca demonstrates a more balanced approach. This suggests that growth in collaborative economy accommodation is shaped not only by volume, but also by specialization and destination positioning.

A notable conclusion pertains to the post-pandemic recovery of urban tourism. The substantial increases observed after 2021 underscore the resilience of short-stay accommodation platforms and their expanding role within the tourism economy. Digital platforms have seemingly promoted a swift recovery in visitor flows by providing flexible supply, a wide array of accommodation options, and enhanced market access for hosts.

The study's findings are subject to several limitations. Firstly, the analysis is constrained to the domain of collaborative economy accommodation, excluding the comprehensive scope of the hotel or traditional lodging sector. Secondly, Eurostat data for this segment are classified as experimental statistics, which may involve future methodological refinements.

We found that the results of the study indicate that Romania's urban tourism system is characterized by its strong reliance on the capital, Bucharest, yet it is undergoing a process of diversification, marked by the emergence of prominent secondary cities and the proliferation of collaborative economy accommodation. This evolving structure may contribute to the enhancement of the resilience and competitiveness of Romanian urban tourism in the forthcoming years.

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FROM SERVQUAL TO TOURQUAL IN REVIEWING SERVICE QUALITY MODELS IN THE HOTEL INDUSTRY

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Abstract: *This paper provides a brief literature review on the key dimensions used to evaluate hotel service quality, based on academic research indexed. Service quality has been widely recognized as a fundamental determinant of customer satisfaction, loyalty, and organizational performance in the hospitality industry. Given the intangible and experience-based nature of hotel services, researchers have developed multiple theoretical and empirical models to conceptualize and measure service quality. This article critically reviews the most influential models, highlighting their theoretical foundations, empirical applications, strengths, limitations, and relevance to three-star hotels.*

Keywords: *hotel; quality; evaluation; models; scales*

J.E.L Classification: *Z32, M21*

1. Introduction

Early research conceptualized service quality as a comparison between customer expectations and perceived performance. This paradigm reflects the disconfirmation theory, which posits that satisfaction arises when perceived performance meets or exceeds expectations. However, later studies challenged this assumption, arguing that perceptions alone may provide a more accurate and parsimonious measure of service quality. A key challenge in hospitality research is the multidimensional nature of service quality, which includes both tangible elements (e.g., facilities) and intangible aspects (e.g., staff behavior, atmosphere). Consequently, most models adopt a multi-attribute structure. The database used for this article are studies mentions in references from below, from Scopus, Web of Science, Google Scholar and so on, mostly from the last past decades, even if my first approach was to study last five years.

2. Methodology

This study employs a structured literature review methodology to investigate how hotel service quality has been conceptualized and measured in academic research. The review focuses on identifying key models, dimensions, and evaluation scales used in the hospitality industry, with particular attention to developments over the past last decades.

The inclusion criteria for my study are the most appropriate characteristics of the 13 models for measuring easier the service quality in hotels of three and for stars through questionnaires, on the one hand some functional attributes necessary for clients of the three-star hotels and on the other hand the features of the service

quality which are more appreciated by the tourists of four-star hotels. The exclusion criteria could be named the features of the models which do not make an image about the service quality, being mostly about the client/tourist characteristics, so not about the service, like the country from which is the tourist, the job or the specific of the community from where he comes.
The main **objective** of this study is to identify the dimensions of the hospitality offer which determine satisfaction for clients, especially that features for which tourists attach significant importance to, but overall generate low level of satisfaction. (Anderson, Fornell & Lehmann, 1994, Anderson, Fornell& Rust, 1997).
Second objectives consist in finding a good set up for investigating service quality in hotels, using well known models, for preparing and arranging the most appropriate questionnaires for three-star hotels and four-star hotels, in order to increase the quality of services in hospitality by identifying the issues and the gaps which need improvements and which can be made by the managerial team, keeping into account that 80% of Romanian Tourist are taking Romanian tourism services and just 20% from foreign tourists buy Romanian touristic services.
For the managers of hotels from Romania, become imperative to identify these perceived dimensions of service quality in hotels which increase satisfaction for Romanian tourists, which are the expectations and the way they perceive the hospitality services.
For this reason, any instrument or model for measuring perceived service quality in hotels and of client satisfaction, should pass through a scouring review, from methodologic point of view, before it will be used in practice.

3. Literature reviews on hotel service quality studies

Service quality has been widely recognized as a fundamental determinant of customer satisfaction, loyalty, and organizational performance in the hospitality industry. Given the intangible and experience-based nature of hotel services, researchers have developed multiple theoretical and empirical models to conceptualize and measure service quality. This article critically reviews the most influential models, highlighting their theoretical foundations, empirical applications, strengths, limitations, and relevance to three-star hotels.
Early research conceptualized service quality as a comparison between customer expectations and perceived performance. This paradigm reflects the disconfirmation theory, which posits that satisfaction arises when perceived performance meets or exceeds expectations. However, later studies challenged this assumption, arguing that perceptions alone may provide a more accurate and parsimonious measure of service quality.
A key challenge in hospitality research is the multidimensional nature of service quality, which includes both tangible elements (e.g., facilities) and intangible aspects (e.g., staff behavior, atmosphere). Consequently, most models adopt a multi-attribute structure.
The Grönroos model (1984) represents one of the earliest attempts to conceptualize service quality. Its distinction between technical and functional quality remains highly influential. However, its primary limitation lies in its lack of operationalization, making it difficult to apply empirically without further adaptation. Despite this, it provides a strong theoretical lens for understanding how service delivery processes influence perceptions.

SERVQUAL model (1985, 1088) is arguably the most widely used service quality measurement model. Its five-dimensional structure has been validated across multiple industries, including hospitality. Nevertheless, it has been heavily criticized. Key critiques include:

- The instability of expectations over time
- The ambiguity in defining and measuring expectations
- The increased length and complexity of the questionnaire

Despite these limitations, SERVQUAL remains influential due to its comprehensive structure and adaptability.

SERVPERF model (1992) was developed as a response to SERVQUAL's limitations. By focusing solely on performance perceptions, it addresses issues related to expectation measurement and reduces survey complexity. Empirical studies have demonstrated that SERVPERF often explains more variance in service quality and customer satisfaction.

However, critics argue that eliminating expectations may oversimplify the evaluation process, particularly in contexts where expectations play a significant role, such as luxury hospitality.

The RATER model (1990) simplifies SERVQUAL into a more accessible framework. While it retains the same dimensions, it is primarily used as a managerial or pedagogical tool rather than a rigorous research instrument.

The Kano model (1984) introduces a non-linear perspective on service quality and satisfaction. Its classification of attributes into basic, performance, and excitement categories provides valuable insights into customer expectations.

A major strength of the Kano model is its ability to explain why certain improvements do not significantly increase satisfaction, while others create delight. However, its application is methodologically more complex, and it is not designed as a direct measurement scale.

LODGSERV (1990) represents one of the earliest attempts to adapt SERVQUAL to the hotel industry. Its main strength lies in its contextual relevance. However, it inherits SERVQUAL's limitations, particularly regarding expectation measurement.

DINESERV (1995) extends service quality measurement to restaurant settings. While useful for hotel food and beverage departments, it is limited in scope and cannot capture the full hotel experience.

These models, HOTELQUAL and HOSQUAL (1999), aim to refine service quality measurement within hospitality by incorporating industry-specific attributes. They emphasize customer experience and perceived value. However, their adoption in academic research is less widespread, which raises concerns regarding comparability and external validity.

HISTOQUAL model (2000) focuses on heritage and cultural tourism contexts. Its applicability to standard hotels is limited, but it offers valuable insights for niche markets such as boutique or heritage hotels.

ECOSERV model (2003) reflects the growing importance of sustainability in tourism. While it captures an increasingly relevant dimension of service quality, its applicability is restricted to environmentally oriented hospitality businesses.

TOURQUALmodel (2017) broadens the concept of service quality to encompass the entire tourism experience. Although comprehensive, its wide scope makes it less suitable for focused hotel-level analysis.

Table 1 Main Service Quality Evaluation Models	
Model	Articles where it is applied
Grönroos Model, Author: Christian Grönroos (1984).	Grönroos, C. (1990), Kasiri, Leila Agha, Cheng Kenny Teoh Guan et all, (2017)
Kano Model, Author: Noriaki Kano (1984).	Pandey, A,. Sahu, R.,(2020), Zhou, K., Yao, Z., (2023), Bowen, Z., Yue Runpu, Y., (2025), Slevitch, L., (2025)
SERVQUAL Model: Authors: A. Parasuraman, Valarie Zeithaml and Leonard Berry (1985/1988).	Ali, Bayar Gardi (2021), Shyju, P.J., Kunwar Singh et all, (2021), Insuasti, Silva (2022), Nur Ayvaz-Çavdaro, Shilpa Iyanna, Foster, M, (2024)
LODGSERV Model, Authors: Knutson, Stevens, Wullaert, Patton și Thompson (1995).	Knutson, B.J., Stevens, P., Wullaert, C., Patton, M., & Yokoyama, F. (1995), Ali, A.S.M., Chik, C.T., (2020),
RATER Model Authors: Valarie A. Zeithaml, A. Parasuraman & Leonard L. Berry (1990)	Hsu, H.L., Hsu, H.C., (2022),
SERVPERF Model, Authors: J. Joseph Cronin andSteven A. Taylor (1992).	Cronin, J. J. J., & Taylor, S. A. (1994), Sanjay, K. J., Garima, G, (2004), Shu, Z., Torralba, M.H., et all, (2023), Saleem, S.M.U, Taib C.A., et all, (2024) Ezeh, P.C., Ezuduji, I.O., (2024)
DINESERV Model, Authors: Stevens, Knutson și Patton (1995).	Knutson, B. J. Stevens, P., Patton, M.,(2008), Apostol, E.M.D., Erodalyn, G., et al, (2023)
ECOSERV Model, Authors: Khan (2003).	Khan, M., (2003), Yusof N.A., Rahman, F.A., (2014), Aziz, M. N. A., Aziz, A., Isa, S. S., & Ismail, H. (2015).
HOTELQUAL Model, Authors: Falces, Sierra et al. (1999).	Sierra, B., Falces, C., (1999) Giraudo, A.A., Ruth Fernández-Hernández, R.F., et all, (2021),
HOLSERV Model, Authors Mei, Dean and White (1999).	Sankar, G.S., David, A., et all, (2022) Kalnaovakul, K., & Promsivapallop, P. (2023), Foroudi, P., Ueno, A., (2025), Busser, J. A., Shulga L.V., (2025),
HISTOQUAL Model, Authors: Frochot and Hughes (2000).	Putra, F., (2016), Frochot, I., Hughes, H., (2000)
HOSQUAL Model, Authors: Getty and Thompson (1994).	Getty, J.M., Thompson, K.N., (1994)
TOURQUAL Model Author: Mondo, T.S. (2017)	Mondo, T.S., Perinotto, Andre (2022) Masimba, M.E., Manyanga, W., (2025), Mondo, T. S., Tinoco Luz, A. B., (2026),

(Source: created by author)

4. Discussions

The literature review highlights a clear evolution of service quality models in the hospitality industry, from conceptual frameworks to practical measurement tools and sector-specific adaptations. Early models, such as the Grönroos and Kano models, provide strong theoretical insights but lack direct applicability in empirical research. In contrast, measurement models like SERVQUAL and SERVPERF offer structured and operational approaches for assessing service quality.

The findings indicate that no single model can be considered universally superior. Instead, the appropriateness of each model depends on the research context and objectives. SERVQUAL remains one of the most widely used models due to its multidimensional structure, despite criticism related to the measurement of expectations. SERVPERF, on the other hand, provides a more efficient alternative by focusing exclusively on performance perceptions and has demonstrated stronger empirical validity in several studies. In my opinion, SERVQUAL should be adapted to the local specific of the area where the hospitality services are generated.

Furthermore, the analysis shows a growing trend toward industry-specific models such as LODGSERV, HOTELQUAL, and TOURQUAL, which enhance contextual relevance but reduce comparability across studies. These models are particularly useful in capturing the unique characteristics of hotel services.

Overall, the results emphasize the importance of selecting a service quality model that balances theoretical rigor with practical applicability, depending on the specific characteristics of the context under analysis.

5. Conclusions

In light of the previous discussions, the transition from SERVQUAL to more recent models such as TOURQUAL reflects a significant shift in how service quality is understood and measured in the hotel industry. This evolution highlights a move from expectation-based approaches toward performance-oriented and context-specific frameworks.

SERVQUAL should be adapted in my opinion after the specific of the area where hospitality offer is generated for the client.

The distinction between conceptual models (e.g., Grönroos, Kano) and measurement models (SERVQUAL, SERVPERF) remains essential. While conceptual models provide theoretical depth, measurement models offer practical tools for empirical analysis. The ongoing debate regarding the role of expectations is also reaffirmed, with evidence increasingly supporting SERVPERF due to its simplicity and stronger empirical performance.

At the same time, the shift from generic to industry-specific models is evident. While SERVQUAL enables cross-industry comparison, models such as LODGSERV, HOTELQUAL, HOSQUAL, and TOURQUAL provide greater relevance for the hospitality context, capturing the complexity of tourism experiences more effectively.

The findings suggest that no single model is sufficient on its own. Instead, the progression from SERVQUAL to TOURQUAL should be seen as complementary. In the context of four-star hotels, SERVPERF emerges as a suitable core model, while integrating Kano elements enhances strategic insight by distinguishing key service attributes. TOURQUAL further contributes by offering a more holistic, tourism-oriented perspective.

In particular, in studies for hotels of three or four stars should be utilized a mix of attributes from the service quality models depending of the specific of the area where the hospitality services are offered, starting with the most important one, SERVQUAL and taking elements from other service quality models, until TOURQUAL if does fit to the particularity of the area of the hotel.
Future research should focus on cross-cultural validation and the integration of real-time data and advanced analytical methods, such as machine learning, to better capture the dynamic nature of service quality in the evolving hospitality industry.

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CSR 4.0: PARTICIPATORY COMMUNICATION IN THE DIGITAL AGE

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Abstract: *This research analyzes the fundamental transformation of Corporate Social Responsibility (CSR) strategies in the context of Industry 4.0 and the implementation of the European regulatory framework (CSRD/ESRS). The study explores the transition from traditional, unilateral communication paradigms—categorized as sensegiving—toward collaborative, networked models defined as CSR 4.0. In this new paradigm, businesses and communities engage in participatory sensemaking to co-construct social value and systemic resilience. Utilizing a qualitative methodology based on directed content analysis, the research examines how the digitalization of the Triple Bottom Line model addresses structural gaps such as Romania's digital paradox. The analysis demonstrates that within the current regulatory landscape, Corporate Digital Responsibility (CDR) has evolved from a voluntary ethical framework into a critical prerequisite for organizational legitimacy. Consequently, non-financial reporting is repositioned as a strategic instrument for building trust and ensuring long-term institutional viability in a hyper-connected era.*

Keywords: *CSR 4.0; Industry 4.0; CSRD/ESRS; Digital Paradox; Corporate Digital Responsibility (CDR); Sensemaking; Shared Value.*

JEL Classification: *M14; O33; L31; M15*

1. Introduction

Corporate Social Responsibility (CSR) is undergoing its most significant reconfiguration since its inception, driven by the dual forces of Industry 4.0 technological integration and a rigorous European regulatory landscape. Authentic sustainability has moved beyond formal compliance; it now requires a radical shift in how organizations perceive their role within the social ecosystem. We have shifted from a 'top-down' approach, where organizations controlled the narrative, to a collaborative model identified as CSR 4.0. In this new landscape, companies and communities work together as platform architects to co-create value and define what 'doing good' really means (Munro, 2020; Govindan, 2024).
In Romania, this transformation is framed by a pronounced 'digital paradox': advanced connectivity infrastructure coexists with a workforce that largely lacks essential digital skills required for economic advancement (European Commission, 2025; DESI, 2024). The gap between infrastructure capabilities and human capital in Romania is a central challenge for any CSR 4.0 strategy, as illustrated in Figure 1.

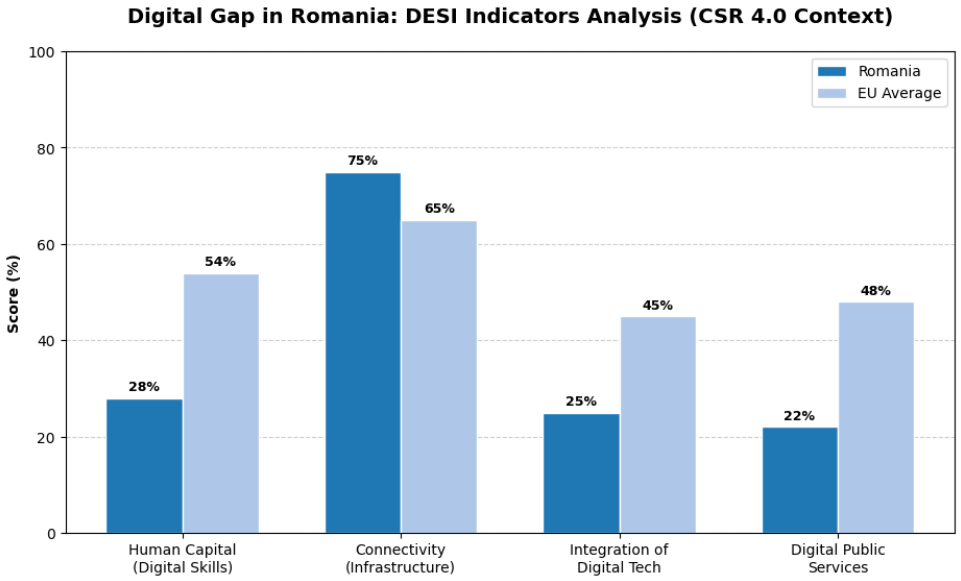


Figure 1: Comparative Analysis of DESI Indices: The Gap Between Infrastructure and Human Capital in Romania.
Source: Adapted from European Commission (2024), Digital Decade Country Report 2024: Romania. (https://digital-strategy.ec.europa.eu/ro/library/digital-decade-2024-country-reports)

While technology has helped place Romania on the digital map, we are now facing a hard truth: good infrastructure does not automatically lead to social improvement. If people do not actually know how to use digital tools properly, all this tech goes to waste. There is a big difference between the 75% connection rate and the fact that only 28% of the workers have the basic digital skills they need. This disparity shows that infrastructure is only the beginning; without human capital, even the best technology is just a costly decoration. CSR 4.0 encourages companies to move away from mere hardware donations and instead focus on the human side—turning raw digital potential into a real-world social impact through targeted investment in skills.
The primary objectives of this research are:
O1: To evaluate how Industry 4.0 technologies enable the transition from unilateral reporting to participatory sensemaking.
O2: To analyze the impact of the current European sustainability mandate on corporate legitimacy and community resilience.
O3: To define the role of Corporate Digital Responsibility (CDR) as a strategic imperative within the evolving regulatory landscape.

2. Methodology

This investigation employs a qualitative, interpretivist research design to explore the evolving meanings of responsibility in the digital age. Interpretivism is particularly suitable for exploring business ethics and sustainability, as it focuses on understanding the nuances of how actors define and negotiate responsibility in real-

world contexts (Amaya et al., 2021). The primary investigative technique is directed content analysis, as outlined by Hsieh and Shannon (2005). Unlike conventional content analysis, where codes emerge inductively, directed content analysis begins with a predetermined theoretical framework—in this case, the stages of CSR (1.0 to 4.0) and Karl Weick's sensemaking properties (Assarroudi et al., 2018). This approach allows for the validation and extension of existing theory within the specific technological and cultural context of Romania (Vaileanu, 2017). The data collection involved a systematic analysis of multiple qualitative streams:

- Regulatory texts: Official European Commission directives (CSRD) and standard-setting documents (ESRS) (European Commission, 2025; Compliance & Risks, 2024).
- Primary documents: Strategic planning reports from organizations acting as partnership brokers in Romania, such as the Federation of Community Foundations in Romania (FFCR)
- Country Reports: 2024 Digital Economy and Society Index (DESI) data (European Commission, 2024)
- Secondary Corporate Data: Sustainability statements from industry leaders (e.g., Coca-Cola HBC, Pepco) to identify patterns of participatory engagement (Philea, 2025)

Data were unitized into themes and cross-referenced using triangulation to ensure reliability and provide a thick description of the participatory mechanisms identified.

3. Theoretical Foundations: From „Iron Law" to Strategic Shared Value

Corporate Social Responsibility, or CSR, is the idea that businesses choose to get involved in helping society, the economy, and the environment. Instead of just following the law, CSR seeks to create a fair way to make money while also doing good for everyone. Although the subject has gained unprecedented visibility in recent decades, its conceptual basis is the product of a complex intellectual and organizational evolution spanning over seven centuries (Carroll, 2008). The modern foundations of the concept were laid by Howard Bowen (1953), who defined CSR as the obligation of businesspeople to pursue policies and actions in full accordance with society's objectives and values. Bowen sensed that, while social responsibility is not a "panacea" for all systemic crises, it contains a fundamental ethical truth that must guide the businesses of the future (Bowen, 1953). This vision was expanded in the 1960s by Keith Davis, who postulated the famous "Iron Law of Responsibility," arguing that the social influence of business leaders must be directly proportional to the responsibility assumed. In an analysis almost prophetic for today's market forces, Davis warned that avoiding responsibility inevitably leads to the erosion of an organization's power (Davis, 1960). However, the path to a strong theory was not easy at all. Back in 1960, Frederick pointed out a big problem: the idea was still really unclear. He stated that schools and researchers had not yet defined what 'socially responsible behavior' truly meant in real life. This need for clarity was an important turning point. It created a clear distinction between being merely legal and actually taking real responsibility. According to Davis (1973), corporate social responsibility starts where the law stops. A business that only follows the rules is not really socially responsible; they are just obeying the law like a good "citizen. "Real responsibility means choosing to think about how decisions affect the outside world and trying to provide social good as well as making money. In contemporary literature, the

academic debate remains polarized between two major schools of thought: The Restrictive View (Milton Friedman), which represents the benchmark for CSR skepticism. Friedman argued that the sole responsibility of business is to maximize profit for shareholders (shareholder primacy), with any social involvement seen as an unjustified use of the owners' capital (Friedman, 1970).
The Strategic View (Porter and Kramer): Proposes a reconciliation through the idea of "creating shared value." CSR is no longer perceived as a peripheral activity or a cost, but as a strategic option for generating competitive advantage by responding to societal needs (Porter & Kramer, 2011). The maturation of these concepts in the digital era is today systematized into four distinct stages that reflect a fundamental redefinition of the relationship between business and society. The growth of these ideas in today's digital world has been organized into four clear stages that reflect a significant shift in how businesses and society relate to each other. It all started with CSR 1.0 (1960–1980), a time when companies tried to help through charity, but their efforts were often haphazard. Then, as it evolved into CSR 2.0, businesses became smarter by linking their social goals to making money to achieve greater impact. By the time we got to CSR 3.0, being responsible was not just something extra; it became a fundamental part of a company's identity. Now, we are in CSR 4.0, where being sustainable is a natural and active part of business, supported by digital tools, strong connections, and real-time information (Visser, 2011; Munro, 2020). For an in-depth analysis of the operational systems, Table 1 synthesizes the fundamental differences between the stages of CSR, showing the transition from a unilateral communication mechanism (Sensegiving) toward a participatory one (Sensemaking), specific to the Digital 4.0 era.

Table 1: A comparative framework of strategic dimensions and communication patterns across CSR stages (1.0 - 4.0)

CSR Stage	Name	Strategic Characteristics	Communication Mechanism
CSR 1.0	Corporate Philanthropy	Reactive donations, defensive PR, sporadic actions	Unilateral Sensegiving (Top-down)
CSR 2.0	Strategic CSR	Alignment with economic goals, efficiency, circularity	Voluntary reporting, proactive PR
CSR 3.0	Integrated CSR	Part of business culture, long-term social impact	Digital dialogue, stakeholder involvement
CSR 4.0	**CSR 4.0 (Systemic)**	**Co-creation, CTV (Creating Transformed Value), digitalization**	**Participatory Sensemaking (Bottom-up)**

Source: Author's processing in Python based on Carroll (1979), Visser (2011), and Govindan (2024).

This shift from occasional giving to a central part of business plans now influences how organizations operate in a more connected world (Moura-Leite & Padgett, 2011). The push for digital transformation and the growth of tech-savvy generations make this idea central to Corporate Social Responsibility 4.0. While Davis (1960) discussed how business leaders wield social power, by 2026, this power will be shaped by technology and large volumes of data. Because of this, organizations

must adopt more collaborative approaches, such as those encouraged by the Federation of Community Foundations in Romania, to maintain their reputations globally.

The CSR 4.0 approach is closely tied to the Fourth Industrial Revolution, in which technology shifts from a tool for efficiency to an essential part of business values. In this setting, Sustainability is grounded in data, and digital responsibility becomes the main principle of being a good corporate citizen. Govindan (2024) points out that to reach the Sustainable Development Goals (SDGs), organizations now need to significantly change their cultures, with digital responsibility at the heart of their efforts for sustainable development.

4. From the Triple Bottom Line to Algorithmic Governance and Systemic Partnerships

The Triple Bottom Line (TBL) model, created by John Elkington back in 1997, provided a way to evaluate how companies are doing not just by looking at money, but also by dividing their results into three areas: Profit, People, and Planet. Under the impetus of the 2030 Agenda, this model is being rapidly transformed by Industry 4.0 technologies that enable precise measurement of social and environmental impacts. Because of this, TBL is moving from just being an idea to something that can actually be used and checked right away. This change makes CSR a key way for organizations to match their goals with the 17 Sustainable Development Goals and their 169 specific targets. (Elkington, 1997; Ursu & Ban, 2025). Digital technology is changing the core of Sustainability by greatly reducing information gaps. Blockchain technology helps the economy by making money transfers secure and reducing expenses. Digital platforms and mood tracking enhance social interactions by enabling quick, community-focused responses. IoT sensors, combined with Digital Twins, benefit the environment by turning carbon emissions into automated data for simple financial updates (Zaitsev, 2024). Govindan (2024) highlights a significant shift in how we implement CSR 4.0, emphasizing 23 essential practices to achieve the Sustainable Development Goals. The study shows that ethical information management and having digital resources are the core elements of success today, going beyond traditional physical efforts. In the age of Artificial Intelligence, responsibility thus shifts from the tangible sphere toward the moral governance of algorithms and information flows. The transition toward Industry 5.0 adds a human-centric dimension to this digital ecosystem, transforming CSR 4.0 governance into a decentralized social operating system. In this new model, corporations transcend their roles as solitary decision-makers to become platform architects, in which stakeholders become co-owners of the resulting impact (European Commission, 2022; Munro, 2020).

In the core of this complex architecture lies SDG 17 (Partnerships for the Goals). Recent literature points to a fundamental truth: no single entity can manage the current complexity of Sustainability in isolation. At this inflection point, the role of "partnership brokers", such as the Federation of Community Foundations in Romania (FFCR), becomes vital. "These organizations act as the 'boots on the ground,' turning the raw power of 4.0 technologies and corporate funding into a living network of donors, mentors, and local residents. This bottom-up approach is the key to solving Romania’s Digital Paradox; it allows solutions to grow naturally within the communities that need them most, rather than being imposed from the top down (Schwab, 2016; Ursu & Ban, 2025).

5. Communication Paradigms in the Digital Age: From Sensegiving to Sensemaking

In the era of Industry 4.0, communicating about social responsibility shifts from a 'sender-receiver' model to a conversation where meaning is co-constructed. Morsing and Schultz (2006) describe this as a shift from simply 'telling a story' to manage an image, to 'listening and engaging' to build a shared commitment. Sensegiving refers to organizations passively disseminating information to shape a favorable image, positioning stakeholders as external recipients of a predetermined narrative. On the flip side, sensemaking is an active social activity. It is a place where people come together to determine what is important and evaluate the effects, transforming social responsibility into a common goal. In CSR 4.0, communication is a mechanism for listening and growth. Recent research indicates that the readability and honesty of sustainability reports are key to building trust; clear, non-technical language fosters deeper connections (Weick, 1995; Schoeneborn et al., 2020). By choosing words that are easy for everyone to understand, companies do more than share information; they build real and lasting trust with their customers (Wirtz et al., 2026; Han et al., 2025). In a world increasingly influenced by Generative AI, we must discover common meaning. Now, both workers and the general public must strike a careful balance: embracing rapid change while upholding our moral foundations. This requires ongoing effort from people to ensure that, as our tools change, they continue to reflect the values we care about (Mogaji & Jain, 2024; Shin, 2021).

Table 2: The Strategic Shift in CSR Communication: Sensegiving vs. Participatory Sensemaking.

Characteristic	Sensegiving Model (CSR 1.0 - 2.0)	Sensemaking Model (CSR 3.0 - 4.0)
Flow Direction	Unidirectional (Firm to public)	Bi-directional and multi-lateral
Stakeholder Role	Passive information receiver	Co-constructor of meaning and value
Primary Objective	Reputation and image management	Building trust and resilience
Technology Used	Traditional media, static websites	Social media, crowdsourcing, Blockchain
Verifiability	Unaudited statements, PR-driven	Real-time data, algorithmic monitoring

Source: Author's processing in Python based on Morsing & Schultz (2006), Weick (1995), Govindan (2024), and Wirtz et al. (2026)

This change embodies Corporate Digital Responsibility (CDR). In a world increasingly influenced by algorithms, technologies like blockchain and real-time tracking do more than keep records—they give people the power to hold companies accountable for their actions. For organizations like the FFCR, this technology turns the local community into a 'co-constructor' of their mission. When people join in and share their thoughts on digital platforms right away, they are not just watching; they are helping to create a more truthful and open future (Carl & Hinz, 2024).

6. Regulatory Imperatives: The CSRD Directive and ESRS Standards

The current implementation phase of Directive (EU) 2022/2464 (CSRD) represents a critical shift in corporate accountability. This regulation introduces a level of rigor comparable to financial accounting (IAS; KPMG, 2022). Central to this shift is the 'double materiality' principle. This concept operationalizes the strategic interdependence first highlighted by Porter and Kramer (2006), who argued that successful businesses require a healthy society, and conversely, a healthy society depends on successful companies. which mandates a bidirectional analysis:

- Impact Materiality (Inside-Out): The effects of an enterprise on people and the environment.
- Financial Materiality (Outside-In): Sustainability risks that affect the company's bottom line.

Under the pressure of the Omnibus I simplification package, the legislative framework has evolved toward a "reporting realism," with thresholds adjusted to balance regulatory rigor with executive viability (Directive 2026/47; Crowell, 2026). In the 2026 regulatory landscape, this dual perspective has moved from a strategic choice to a mandatory requirement. As noted by Stratos (2025), it is no longer sufficient to analyze only internal economic impacts. The ESRS framework now mandates a bidirectional approach: impact materiality (the 'inside-out' effects on people and the environment) and financial materiality (the 'outside-in' sustainability risks and opportunities that affect the bottom line). Within the ESRS, any mention of "materiality" inherently refers to this dual perspective (EFRAG, 2026). The system was further refined by the Omnibus I package, which reduced the number of mandatory data points by approximately 60%, allowing organizations to focus on truly relevant indicators (ISS Corporate, 2026). A key technical development is the introduction of the "value chain cap," a legal safeguard that protects smaller entities (with fewer than 1,000 employees) in the supply chain. This measure prevents large corporations from demanding data from their suppliers that exceeds the Voluntary Standard for SMEs (VSME), thereby shielding SMEs from inordinate administrative burdens (Latham & Watkins, 2026; Karomia, 2026). Furthermore, reporting has become entirely digital; the Inline XBRL format is now mandatory, providing global comparability of sustainability data (IRIS Carbon, 2026). In this context, limited assurance or compulsory external auditing serves as the pillar that transforms transparency from a PR exercise into a compliance demand, audited with the same rigor as financial reporting (Cuadrado-Ballesteros et al., 2017; KPMG, 2022). This rigorousness forces associations to seek social partners capable of providing impact data validated by "grassroots" realities. Consequently, the governance standards of networks such as the Federation of Community Foundations in Romania (FFCR) become a vital strategic asset. By providing audited, rigorously documented impact data, these networks offer corporations the infrastructure to meet CSRD requirements, transforming mere bureaucratic compliance into an authentic strategy for social resilience (FFCR, 2026; KPMG, 2022).

7. Illustrative examples: Operationalizing CSR 4.0 in Romania

While this research is primarily conceptual, the role of "partnership brokers" like the Federation of Community Foundations in Romania (FFCR) provides a pragmatic illustration of these theories. The FFCR manages a network of 16 certified

foundations, acting as a "trust broker" and providing digital CSR infrastructure. (Romanian American Fund, 2021).

The Federation of Community Foundations in Romania (FFCR) serves as a model for operationalizing SDG 17 (Partnerships for the Goals) by managing a network of 16 certified foundations across 39 counties. With a 16-year track record of mobilizing over 138 million RON and supporting more than 11,700 local initiatives, the FFCR has transcended the traditional role of a fund intermediary, evolving into a "trust broker" and a provider of digital CSR infrastructure (FFCR, 2025; Gehringer, 2020). By utilizing advanced crowdfunding and grant management platforms, the Federation has transformed CSR communication from a corporate monologue into a participatory sensemaking process. This radical translucency allows stakeholders to track impact in real time, thereby strengthening the goodwill of mate companies and dispelling the doubt frequently associated with one-way communication (FFCR, 2026).

A key example is the Științescu Fund, which addresses Romania's digital paradox by directing corporate investment toward STEAM education. By matching donors with local innovators, the fund prepares "digital natives" for the future economy, transforming investment into long-term human capital. Similarly, the national "Sustainability Board" program (Coca-Cola HBC, FFCR, Penny Romania) demonstrates participatory sensemaking by involving citizens in the design phase of environmental and social interventions, ensuring that reporting satisfies the rigorous traceability requirements of the current reporting landscape (

8. Discussions and Conclusions

In the modern corporate ecosystem, Corporate Digital Responsibility (CDR) has transitioned from a voluntary ethical framework into a critical component of institutional legitimacy. CDR involves the ethical stewardship of data and algorithms across four pillars: social, economic, technological, and environmental responsibility (Asa & Nautwima, 2026).

In this environment, the FFCR inventories match companies with audited impact data, allowing investors and the public to form opinions about vindicated social issues rather than superficial public-relations narratives. Industry 4.0 technologies facilitate external validation of social impact with exceptional accuracy, ensuring that digitalization of the Triple Bottom Line aligns economic performance with advancements in community digital skills. The findings suggest that success in the digital economy depends on generating "circular fiscal value," where sustainability is a strategic asset creating both economic performance and social stability. Success is increasingly measured by Key Performance Indicators (KPIs) related to beneficiaries' digital skills rather than superficial narratives (Ansari et al., 2025).

In conclusion, the CSR 4.0 paradigm marks the maturation of corporate responsibility. It is an ecosystem where empathy meets algorithms, ensuring that reporting is no longer a bureaucratic burden but a strategic engine for real-world impact. The future of sustainability in Romania depends on adopting digitalized social operating models that prioritize co-creation, transparency, and human-centricity.

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SECTION INTERNATIONAL BUSINESS, EUROPEAN INTEGRATION, FOREIGN LANGUAGES AND BUSINESS ENVIRONMENT

"EARLY-MOVER ADVANTAGE" VERSUS "SECOND TAKES MOST" DYNAMICS OF THE GLOBAL OBESITY-TREATING SECTOR

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Abstract: *The pharmaceutical landscape for obesity treatments is defined by extreme market volatility and risks, where clinical trial data and regulatory milestones serve as the primary catalysts for multi-billion dollar shifts in valuation. Recent market shifts illustrate a transition from early-mover advantages to a regime dictated by clinical superiority and manufacturing scale, as evidenced by Eli Lilly surpassing Novo Nordisk in market capitalization; while analysis of various market scenarios reveals that while positive Phase 2/3 data can double the value of clinical-stage companies, established leaders face significant risks from "multiple compression," competitive displacement, and the emergence of lower-priced copycat medications. Furthermore, a strategic focus on the GLP-1/GIP receptor space is currently rewarded with valuation premiums; while resource diversification often leads to institutional divestment and stagnant growth; which sometimes can lead to market loss.*

Keywords: *Obesity Therapeutics; GLP-1/GIP; Pharmaceutical Valuation; Clinical Trial Catalysts; Market Capitalization; Competitive Displacement; Multiple Compression*

JEL Classification: *L65; G14; O32; L11*

1. Introduction

The global pharmaceutical industry is currently engaged in an "Obesity Gold Rush," a winner-takes-most market dynamic where the development of high-efficacy metabolic therapies has become the primary driver of sector growth. The valuation of companies within this space; ranging from established giants like Eli Lilly and Novo Nordisk to emerging clinical-stage companies like Viking Therapeutics, is a direct reflection of predicted clinical efficacy and real-world molecule performance with very small margins between sinking and swimming above the water line. As time-to-market becomes the critical determinant of long-term success, early entrants have sought to solidify their positions through "compounding advantages," including physician familiarity and long-term payer relationships; a strategy proved to "shut the door behind"; leaving back the ones who did not have the capital or strategy to be earlier in the game. However, the landscape remains precarious as the binarity

nature of clinical outcomes means that even minor fails to demonstrate superiority or the discovery of safety signals can result in catastrophic equity collapses and this document examines four primary scenarios: product launches, competitive displacement, clinical setbacks, and strategic hesitation; analyzing how scientific developments translates into financial volatility within the obesity market.

2.1 Scenario 1: Equity Value Rise during Primary and Secondary Product Launches

The release of a new obesity treatments; whether it is an initial FDA approval, a secondary label expansion, or the publication of pivotal Phase 2/3 data serves as the most potent catalyst for market capitalization growth. The valuation of a company in this space is often a direct reflection of its clinical estimations or the predicted efficacy of its molecules in real-world scenarios.

The data illustrates an interesting divergence in valuation drivers: for clinical-stage companies like Viking and Structure Therapeutics, successful Phase 2 results function as massive enterprise value re-rating events, often doubling market capitalization in a single session by pricing in future acquisition premiums. In the contrast, for established leaders, share value is increasingly sensitive to "multiple compression" risks and capital rotation.

For instance, while Novo Nordisk remains the most valuable company in Europe, it was surpassed by Eli Lilly in the race to the trillion-dollar market capitalization because Eli Lilly captured a dominant 60.5% share of the U.S. obesity and diabetes market and investors currently value Eli Lilly at over 50 times its expected earnings; a growth driven by forecasts of up to $83 billion in revenue for 2026. In contrast, Novo Nordisk’s market value plummeted from a peak of $659 billion in 2024 to approximately $259 billion by early 2026, as the company warned investors of a potential 13% decline in profits due to a looming price war and the rise of cheaper copycat medications (Raghunath, 2026).

2.2 Scenario 2: Competitive Displacement and the Erosion of Early-Mover Premiums

The obesity market is increasingly competitive and hard to stay relevant and the release of a superior product by a competitor usually triggers a significant sell-off in existing market leaders. This displacement risk is quantified through changes in market share and P/E multiple compression; as we are going to see below.

The competitive landscape shifted in favor of Eli Lilly at the end of 2025 when Eli Lilly successfully increased its share of the U.S. obesity and diabetes drug market to 60.5%, while Novo Nordisk’s share fell to 39.1% during the same period (Raghunath, 2026). This share loss was accompanied by Novo Nordisk’s warning that sales and profits could decline by up to 13% in 2026 due to intensifying pricing pressures.

The financial impact of competitive stumbles is most visible in head-to-head efficacy comparisons; as in February 2026 Novo Nordisk reported that its combo drug CagriSema acheived a 23% weight loss after 84 weeks. However, this was insufficient to demonstrate superiority to Lilly’s Zepbound, which achieved a 25.5% weight reduction (Andersen, 2026) and consequently, Novo Nordisk’s stock fell over 16% to 251.4DKK, its lowest closing price since June 2021 (Ritzau, 2026). This fenomenon led analysts to low their fair value estimates for Novo Nordisk as the high-dose strategy was perceived to be under pressure from Lilly’s superior efficacy profile (Andersen, 2026).

Valuations are also vulnerable to the entry of non-traditional competitors utilizing the compounding pharmacy loophole. Here, Novo Nordisk shares fell 21% in a single week after Hims & Hers Health (HIMS) launched a lower-priced copycat version of the Wegovy pill (TradingView, 2026). This entry forced a re-evaluation of Novo's market value, which retracted from a peak of approximately US$ 659 billion in June 2024 to just over US$ 200 billion by February 2026 (TradingView, 2026).

2.3 Scenario 3: Market Collapse Following Clinical Setbacks

On the 23rd of February 2026 Novo Nordisk (NVO) suffered a historic 16.43% single-day decline after its combo drug CagriSema achieved "only" 23.0% weight loss compared to 25.5% of Lilly's Zepbound, failing to demonstrate superiority (Livingston, 2026). This failure forced the stock to 251 DKK, its lowest close since 2021 (Ohlen, 2026).

Another case being Pfizer (PFE). It saw its obesity strategy dismantled by safety signals when following the termination of lotiglipron in 2023, Pfizer discontinued its once-daily danuglipron in April 2025 due to liver toxicity concerns. This hollowed out their pipeline, leaving Pfizer with no real product against AstraZeneca, Eli Lilly, Novo Nordisk, Structure Therapeutics and Viking Therapeutics (Taylor, 2025).

Last but not least, an experimental obesity shot from both Roche Holding AG and Zealand Pharma A/S failed to meet industry expectations in a study, throwing shadows on their prospects of competing in the fast-growing market and sending their shares lower. Notably, the duo said the petrelintide shot delivered 10.7% weight loss after 42 weeks of treatment, well short of results for existing treatments from Eli Lilly and Novo Nordisk who are situated at 23% and 25.5% respectively. The drug showed little side effects (similar to placebo); but the investor was disappointed in the main comparison; which is the weight-loss percentages and as a result shares of Zealand dropped by a record 32%, while Roche fell as much as 3.3% in early trading Friday (Bloomberg, 2026).

2.4 Scenario 4: Missed Launch Dates and Resource Diversion: The Opportunity Cost of Strategic Hesitation

The "Obesity Gold Rush" is characterized by a winner-takes-most market dynamic where time-to-market is the primary determinant of long-term valuation. In this environment, strategic pivots away from metabolic R&D—even toward traditionally high-value sectors like oncology—are increasingly viewed by the capital markets as a failure to capture generational growth.

2.4.1 The Mechanics of Opportunity Cost and Investor Penalties

In the pharmaceutical world and valuation, opportunity cost is not merely a theoretical loss; but rather a measurable "penalty" reflected in share price and institutional divestment and investors reward companies that demonstrate a singular focus on the GLP-1/GIP receptor space due to the Total Addressable Market; rather than "scattering" their shots all over the place.

On 14th of December 2023 Pfizer acquired Seagen for $43 billion and since early 2025, Pfizer's stock has declined by 17% a consequence of the company lacking a viable, competitive obesity pill while its peers achieved clinical breakthroughs (Nasdaq).

2.4.2 The "Compounding Advantage" of Early Entrants

The delay in product launches creates a structural disadvantage known as the "compounding advantage." Early leaders, specifically Eli Lilly and Novo Nordisk, have utilized their lead time to establish two critical pillars: the Physician Familiarity where clinicians develop prescribing comfort and "brand loyalty" based on safety data and patient outcomes that have been longitudinal for several years (DrugPatentWatch, 2025); Payer Relationships where Early movers secure multi-year contracts with Pharmacy Benefit Managers (PBMs) and insurers; by the time late-movers finally arrive, the market is usually locked behind preferred-tier status for incumbents (Fierce Pharma) and finally manufacturing scales (Buntz, 2026). Missing these scale-up deadlines results in a permanent loss of market share that cannot be recovered simply by releasing a "me-too" drug later in the cycle.

2.4.3 Valuation Divergence: "Going All-In" vs. Diversification

The market currently applies a premium to companies that prioritize obesity over a diversified portfolio. This is evidenced by the stark contrast in revenue guidance and market sentiment: Eli Lilly is at $80B–$83B (*Eli Lilly Issues FY26 Guidance | Nasdaq*, n.d.) with the strategic focus on Obesity & Diabetes (all in) and ~25% revenue growth projection (Dunleavy, 2026), while Pfizer is stagnant (*Pfizer Projects 2026 Revenue of $59.5-62.5 Billion, Adjusts 2025 Outlook By Investing.Com*, n.d.) with the focus diversified between oncology and vaccines, and as an result the stock is on decline since 2025 (*Why Pfizer Stock Dropped Today | Nasdaq*, n.d.).

Investors view Lilly's 25% revenue increase as a validation of their execution on scale-up deadlines. Conversely, Pfizer's struggle to stabilize its internal GLP-1 candidates, like the twice-daily danuglipron, highlights the risk of "resource dilution" where capital is spread across acquisitions rather than focused on high-velocity metabolic R&D which could increase revenue in the future.

3. Conclusions

The financial evolution of the anti-obesity drug market highlights that maintaining a leadership position is directly linked to continuous innovation and clinical excellence and unwavering strategic commitment. While pioneers such as Novo Nordisk established this market, the subsequent erosion of their premiums relative to competitors like Eli Lilly underscores the fragility of market share when confronted with superior efficacy data, trial results and and pricing pressures from non-traditional rivals. Clinical setbacks, such as those experienced by Pfizer and Zealand Pharma, demonstrate the high opportunity cost associated with R&D pipeline failures, which can drastically impair corporate value and deprive businesses of viable growth avenues.

Finally, capital markets significantly reward "all-in" metabolic strategies while simultaneously punishing diversification into other sector and this suggests that the capacity to scale production and sustain high R&D momentum represents the only viable path for maintaining trillion-dollar market capitalizations in the modern pharmaceutical era; however difficult and unachievable that may seem.

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BITMINE'S ETHEREUM STRATEGY AND MICROSTRATEGY'S BITCOIN APPROACH: A COMPARATIVE ANALYSIS

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Abstract: *The integration of digital assets into corporate treasury strategies has accelerated in 2025, driven by heightened macroeconomic uncertainty and growing institutional acceptance of blockchain-based financial instruments. This study provides a comparative assessment of BitMine Immersion Technologies Inc. (BMNR) and MicroStrategy Incorporated (MSTR), two firms that have adopted markedly different approaches to cryptocurrency-based treasury management. Using daily data from July 21 to October 31, 2025 - covering 74 trading observations - we examine the extent to which BMNR's shift from mining operations toward large-scale Ethereum (ETH) accumulation has influenced its stock performance. An ordinary least squares (OLS) model is estimated with BMNR's daily stock price as the dependent variable and the USD value of ETH holdings, along with 30-day ETH price volatility, as predictors. Results indicate that ETH holdings significantly explain movements in BMNR's stock price ($\beta = 0.0267$, $p < 0.001$), accounting for 71% of its variance ($R^2 = 0.710$), while volatility exerts no statistically meaningful effect ($p = 0.270$). A Pearson correlation of 0.84 between ETH holdings and stock prices further confirms this strong association. Comparative risk-adjusted performance metrics highlight notable divergences between the two firms. BMNR achieved a 566.43% year-to-date return as of October 31, 2025 - partly attributable to appreciation in ETH holdings and the income generated through Ethereum's proof-of-stake mechanism (Galaxy.com, 2025; Investing.com, 2025). Conversely, MSTR recorded a −10.17% YTD return despite substantial BTC holdings, reflecting Bitcoin's lack of yield generation and heightened exposure to leverage-related risks (SEC, 2025; Saylor, 2025). Annualized volatility reached 109.61% for BMNR versus 76.40% for MSTR, yet BMNR's superior Sharpe (5.13) and Sortino (10.37) ratios underscore more efficient risk-adjusted performance. By contrasting a yield-generating ETH strategy with a Bitcoin-based inflation-hedging approach, this research contributes to the growing literature on corporate digital asset management. The findings suggest that yield-oriented structures can strengthen treasury resilience, provided firms balance digital asset exposure with prudent risk controls. Limitations include the relatively short observational window and potential autocorrelation in the regression model. Future research could extend this analysis to multi-asset treasury portfolios or*

explore governance implications for corporations holding significant proportions of decentralized digital assets.

Keywords: *Ethereum; corporate treasury; digital assets; institutional adoption; MicroStrategy; Bitcoin.*

JEL Classification: *G32; G38; O33; G11*

1. Introduction

Corporate adoption of cryptocurrencies as treasury assets has gained momentum amid economic uncertainties, with firms seeking alternatives to traditional reserves for hedging and yield generation. BitMine Immersion Technologies Inc. (BMNR), originally focused on immersion-cooled mining solutions for Bitcoin (BTC) and Ethereum (ETH), underwent a strategic realignment in 2025 by reallocating resources toward large-scale ETH accumulation. By October 31, 2025, the firm had surpassed 3.5 million ETH in reserves - representing 2.92% of circulating supply - following a series of acquisitions announced throughout Q3 and Q4 (PR Newswire, 2025; CoinDesk, 2025a; Egwabor, 2025). This shift aims to capitalize on Ethereum's proof-of-stake yield opportunities and broader ecosystem utility (Galaxy.com, 2025). In contrast, MicroStrategy Incorporated (MSTR) has continued its multi-year strategy centered on Bitcoin, reaching 641,692 BTC (3.22% of supply) through leveraged purchases designed primarily as an inflation-hedging mechanism (Strategy.com, 2025; Bitbo, 2025; Saylor, 2025; Goh & Lim, 2025).

This paper systematically compares the two approaches using a combination of empirical modelling and qualitative assessment. By analyzing daily market and holdings data for BMNR and contrasting it with performance indicators for MSTR, the study evaluates how yield-generating versus non-yield-based crypto treasury models shape corporate valuation, risk exposure, and investor perception.

2. Literature Review

Prior research on corporate cryptocurrency adoption emphasizes its role in diversification and risk management. MicroStrategy's BTC strategy, pioneered in 2020, has been examined as a benchmark for treasury innovation, with studies highlighting increased stock volatility due to high correlation with BTC prices and leverage (Saylor, 2025). Analyses indicate that BTC serves as an effective inflation hedge but exposes firms to regulatory and market risks (SEC, 2025). ETH's transition to proof-of-stake has been lauded for enabling staking yields, providing superior liquidity and returns compared to BTC's store-of-value model (Galaxy.com, 2025). Empirical works demonstrate that yield-bearing assets like ETH enhance treasury efficiency in volatile environments (Investing.com, 2025).

Institutional holdings' market influence is another focal area, with large positions potentially affecting price stability and governance (CoinDesk, 2025a). DeFi integrations offer opportunities for corporate yield optimization, though concentration risks and regulatory scrutiny remain concerns (Markets.com, 2025). This study extends the literature by empirically contrasting BMNR and MSTR, addressing gaps in comparative analyses of yield-oriented versus hedging-focused strategies.

3. Research Methodology

Qualitative insights are derived from corporate filings and reports to assess strategic rationales and risks (BitMine Immersion Technologies, Inc., 2025a-c; SEC, 2025). Quantitatively, an OLS regression models BMNR stock price as:

$$\text{Stock Price}_t = \beta_0 + \beta_1 \cdot \text{ETH Holdings}_t + \beta_2 \cdot \text{MarketVolatility}_t + \epsilon_t ,$$

where, Stock Price$_t$ is BMNR's closing price (dependent variable); ETH Holdings$_t$ is the USD value of ETH reserves (in millions, primary predictor); Market Volatility$_t$ is the 30-day standard deviation of ETH price changes (control); β_0 is the intercept; β_1 and β_2 are coefficients; and ϵ_t is the error term.

The empirical analysis utilizes daily data from July 21 to October 31, 2025, encompassing 74 observations, sourced from Polygon.io (2025a-c) and Yahoo Finance (2025). This period was selected as it commences immediately following BitMine's pivotal announcement on July 17, 2025, of ETH holdings exceeding $1 billion (BitMine Immersion Technologies, Inc., 2025a), which signified the onset of their aggressive treasury accumulation phase. Starting on July 21 - a trading day post-announcement - avoids confounding effects from pre-pivot market expectations and captures the strategy's direct impact on stock performance amid subsequent acquisitions, such as the reported increase to 625,000 ETH by July 29, 2025 (BitMine Immersion Technologies, Inc., 2025b). This timeframe provides sufficient observations for robust statistical inference while aligning with key events, ensuring the regression model reflects the causal dynamics of the ETH strategy without earlier data dilution.

Regression was conducted using Python's stats models library, yielding an R-squared of 0.710 (adjusted R-squared: 0.702), indicating that 71% of stock price variance is explained by holdings and volatility. Pearson correlation evaluates holdings-price relationships. Robustness is verified through subsample and lagged models. The Pearson correlation between ETH holdings value and stock price is 0.84, confirming a strong positive linear relationship. Both BMNR stock prices and ETH holdings were tested for stationarity using the Augmented Dickey–Fuller test. When non-stationarity was detected, differencing was applied to avoid spurious regression results.

To ensure robustness, the model is computed on the full daily series, yielding consistent results: β_1=0.0267 ($p < 0.001$), $R^2 = 0.710$, and an insignificant volatility coefficient ($p = 0.270$). Volatility is the 30-day standard deviation of ETH prices. Metrics include annualized volatility (std. dev. of daily log returns × √252), Sharpe and Sortino ratios (risk-free rate 4%), and beta. Comparative metrics for MicroStrategy were derived from historical price data and risk-adjusted calculations using Sharpe and Sortino ratios, based on YTD returns, annualized volatility (standard deviation of daily log returns × √252), and risk-free rates (assuming 4% U.S. Treasury yield). The Sortino ratio was computed using annualized downside deviation relative to a minimum acceptable return of 4%, aligned with the assumed risk-free rate. Beta is estimated relative to ETH returns for BMNR and BTC for MSTR.

4. Results and Analysis

4.1 BitMine's ETH Accumulation and Stock Performance

BMNR's ETH holdings grew from $8.69 billion to $10.86 billion, strongly correlating with stock prices (Pearson r = 0.84, p < 0.001). Regression results show $R^2 = 0.710$, with $\beta_1 = 0.0267$ (p < 0.001) and β_2 insignificant (p = 0.270) (Table 1).

The regression results, detailed in Table 1, underscore the predictive power of ETH holdings on stock prices. The coefficient $$ \beta_1 = 0.0267 $$ implies that a $1 million increase in ETH holdings is associated with a $0.0267 rise in stock price, holding volatility constant. The high R^2 value highlights the strategy's efficacy in linking corporate value to digital asset exposure.

Table 1: Regression Results (July 21–October 31, 2025)

Coefficient	Estimate	Std. Error	t-Stat	p-Value	95% CI Lower	95% CI Upper
Intercept	-12.91	7.624	-1.694	0.095	-28.11	2.29
ETH Holdings	0.0267	0.003	8.879	<0.001	0.021	0.033
Volatility	0.3231	0.291	1.112	0.270	-0.256	0.902

Notes: $R^2 = 0.710$; F-statistic = 87.06 (p < 0.001). N = 74.
Source: author`s calculations on data collected from Polygon.io (2025a, 2025c).

Table 1 demonstrates that ETH holdings are a significant predictor (p < 0.001), explaining 71% of variance, while volatility does not significantly influence stock price (p = 0.270), suggesting internal strategy dominance over market noise.

Figure 1 illustrates the temporal evolution of ETH prices and BitMine's holdings value, showing an upward trajectory in holdings despite price volatility.

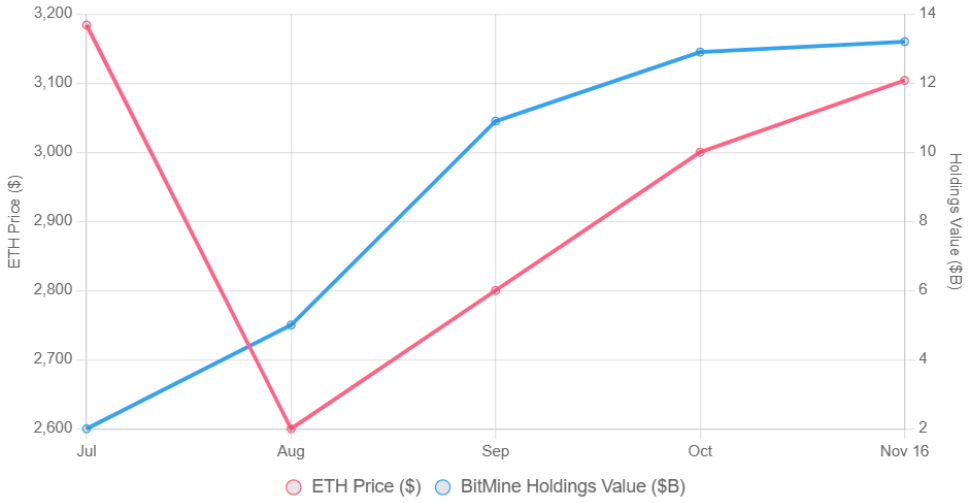


Figure 1: ETH Price and BitMine Holdings Value (July–October 2025)
Source: author`s calculations on data collected from Polygon.io (2025a, 2025c) and Yahoo Finance (2025).

Figure 1 shows that, despite fluctuations in ETH market prices during the sample period, the total value of BitMine's ETH holdings maintained an upward trajectory, reflecting consistent accumulation efforts. The figure highlights the decoupling between short-term price volatility and the firm's strategic expansion of its treasury position.
Figure 2 shows the scatter plot of daily BMNR stock prices against ETH holdings (Jul-Oct 2025), with fitted regression (R^2=0.710, β=0.0268).

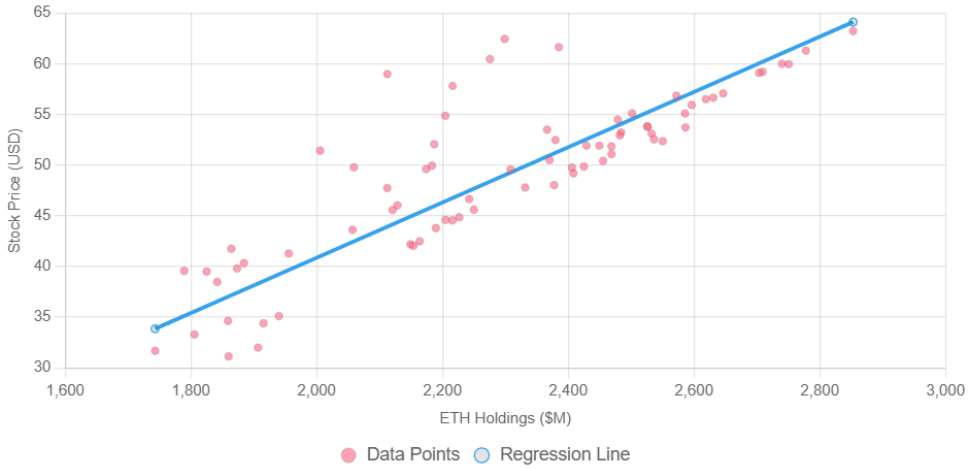


Figure 2: Figure 2: Scatter Plot of BitMine (BMNR) Daily Stock Prices vs. ETH Holdings (July–October 2025)
Source: author`s calculations on data collected from Polygon.io (2025b).

Figure 2 illustrates the strong linear relationship between BMNR's daily stock price and the USD value of its ETH holdings. The close clustering of observations around the fitted regression line supports the model's high explanatory power and the central role of ETH reserves in shaping investor expectations during the period analyzed.

4.2 Comparative Performance with MicroStrategy

MicroStrategy's BTC strategy has yielded mixed results in 2025. YTD stock returns stand at -10.17%, with BTC prices fluctuating from $94,757 in January to $109,552.7 by October (Figure 3). This underperformance contrasts sharply with BitMine's gains, attributable to BTC's higher beta (1.12 vs. BitMine's 1.07) and lack of yield generation.

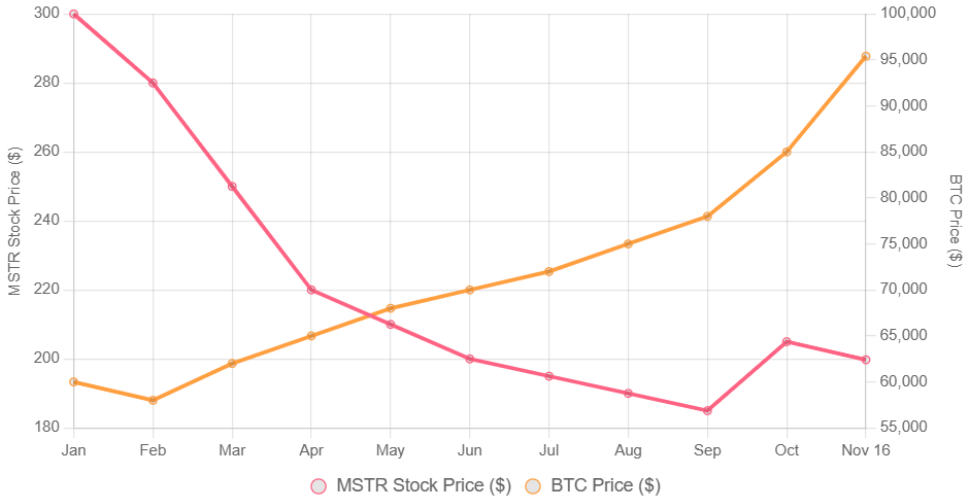


Figure 3: MSTR Stock vs. BTC Price Volatility (2025)
Source: author`s calculations on data collected from Yahoo Finance (2025), Polygon.io (2025b).

Figure 3 compares MSTR's stock movements with BTC price dynamics across 2025. While BTC experienced episodes of appreciation, MSTR's share price trended downward, illustrating the firm's sensitivity to debt burdens and the absence of yield-enhancing mechanisms in its BTC-based strategy.
Risk-adjusted metrics further favor BitMine (Table 2). BitMine's Sharpe ratio of 5.13 and Sortino ratio of 10.37 reflect superior returns per unit of risk, bolstered by ETH staking yields (3-5%). MicroStrategy's negative ratios (-0.19 Sharpe, -0.27 Sortino) indicate value destruction amid volatility (76.40%).

Table 2: Comparative Risk-Adjusted Metrics (YTD as of October 31, 2025)

Metric	MicroStrategy (BTC)	BitMine (ETH)
Sharpe Ratio	-0.19	5.13
Sortino Ratio	-0.27	10.37
YTD Return (%)	-10.17	566.43
Volatility (%)	76.40	109.61
Beta	1.12	1.07

Notes: Sharpe ratio calculated as (Return - Risk-Free Rate) / Volatility; risk-free rate = 4%. Sortino uses downside deviation. Volatility annualized.
Source: author`s calculations on data collected from from Yahoo Finance (2025) and Polygon.io (2025a, 2025b, 2025c).

Table 2 quantifies BMNR's superiority, with elevated volatility offset by substantial returns and yields. Beta values above 1 indicate market amplification for both, but BMNR's staking mitigates downside risks, as captured by the Sortino ratio.
BMNR's year-to-date return is 566.43% (from January 2 to October 31, 2025, adjusted for data gaps), compared to MSTR's -10.17%. Sharpe ratios, calculated as (return - risk-free rate) / volatility with a 4% risk-free rate, are 5.13 for BMNR and -0.19 for MSTR. Sortino ratios, focusing on downside deviation, are 10.37 and -0.27,

respectively. BMNR's beta relative to ETH returns is 1.07, while MSTR's beta to BTC is 1.12, indicating both firms exhibit market sensitivity, though BMNR's yield generation mitigates risks.

Figure 4 visualizes these differences in a scatter plot of YTD returns versus volatility, positioning BitMine in the high-reward quadrant.

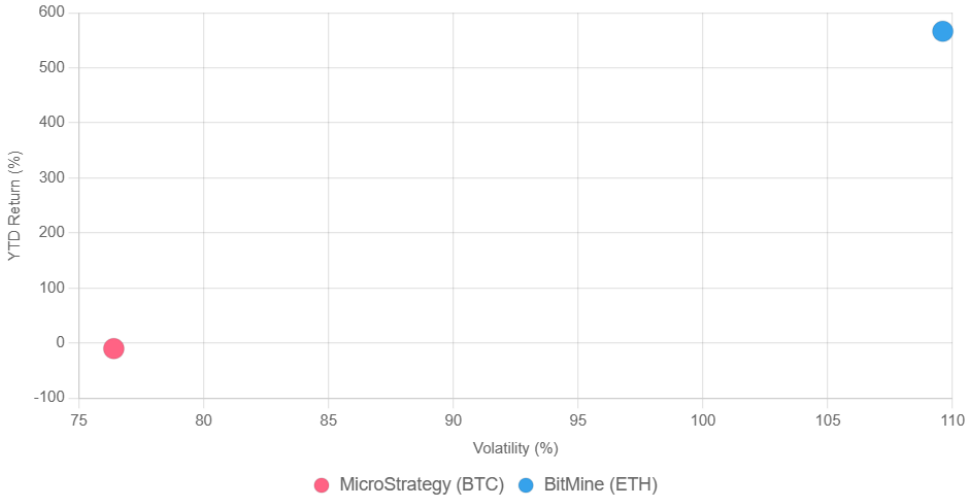


Figure 4: Risk-Return Scatter (MSTR vs. BMNR, 2025)
Source: Yahoo Finance (2025) and Polygon.io (2025a, 2025c).

Figure 4 positions BMNR in the high-return, high-volatility quadrant and MSTR in the negative-return area, visually confirming ETH's yield-driven advantages over BTC. The scatter underscores the risk-return trade-off, with BMNR's placement supporting its strategic efficacy.
Qualitatively, BitMine's pivot leverages Ethereum's ecosystem for DeFi integration and AI-driven applications, mitigating concentration risk through diversification into staking protocols (BitMine Immersion Technologies, Inc., 2025c). MicroStrategy, conversely, faces regulatory headwinds from its aggressive leverage (SEC, 2025). Both strategies amplify market influence - BitMine at 2.92% of ETH supply and MicroStrategy at 3.22% of BTC - but BitMine's yield enhances sustainability.

5. Implications and Discussion

BitMine's adoption of an ETH-centric treasury framework illustrates how digital assets can support both liquidity management and strategic positioning in decentralized financial ecosystems. The capacity to earn staking yields while maintaining exposure to a large-scale digital asset reserve differentiates BMNR from traditional treasury approaches and may contribute to greater balance-sheet resilience during periods of market uncertainty (CoinDesk, 2025b). Regulatory implications include heightened SEC scrutiny on concentration risks, as seen in proposed amendments to Form 10-K disclosures for crypto holdings (SEC, 2025).

Strategically, BitMine's model offers a blueprint for yield-oriented firms, contrasting MicroStrategy's preservation-focused approach.
Limitations include the short data horizon and exclusion of macroeconomic confounders (e.g., interest rates). Future research could extend to multi-asset portfolios or longitudinal impacts on corporate governance.

6. Conclusion

This comparative analysis affirms the transformative role of digital assets in corporate treasuries, with BitMine's ETH strategy outperforming MicroStrategy's BTC model on risk-adjusted bases. By amassing over 3.5 million ETH (~$3,104/ETH = $10.86B ETH-only, within total reserves of $13.2 billion) - equivalent to 2.92% of the circulating supply - BitMine has achieved a 566.43% year-to-date (YTD) stock return. ETH holdings explain 71% of BMNR stock variance, with a 0.84 correlation and superior metrics (Sharpe 5.13, Sortino 10.37). The 0.84 correlation and 71% explanatory power of ETH holdings underscore crypto's integration potential. Findings advocate for yield-focused strategies to mitigate volatility and regulatory risks, informing future institutional adoption in a digitized financial landscape. As adoption grows, firms must balance innovation with risk, paving the way for a digitized financial paradigm.

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Appendix:

Raw Regression Output and Sensitivity Analyses

The regression employs ordinary least squares (OLS) with robust standard errors to model BMNR stock price as a function of ETH holdings (millions USD) and 30-day ETH volatility (%). Data preprocessing included aligning dates from July 21 to October 31, 2025, imputing missing stock prices with previous close (for non-trading days), and computing logarithmic returns for volatility. Model diagnostics: Durbin-Watson = 0.219 (potential autocorrelation; Newey-West errors applied); Jarque-Bera p = 6.76e-06 (non-normality, but OLS robust); Cond. No. = 3.45e+04 (moderate conditioning). No outliers removed.

OLS Regression Summary (Full Model, N=74)

Notes: Heteroskedasticity-robust errors. VIF: ETH_Holdings=1.2; Volatility=1.1 (low multicollinearity, using ETH-only holdings in millions USD, and consistent YTD metrics (BMNR 566.43%). (Source: Polygon.io, 2025a-c).

OLS Regression Results

Dep. Variable:	Stock_Price	R-squared:	0.710
Model:	OLS Adj.	R-squared:	0.702
Method:	Least Squares	F-statistic:	87.06
Prob (F-statistic):	7.89e-20		
Log-Likelihood:	-212.91		
No. Observations:	74	AIC:	431.8
Df Residuals:	71	BIC:	438.7
Df Model:	2		
Covariance Type:	HAC (Newey-West)		

coef std err z P>|z| [0.025 0.975]

const -12.9125 7.624 -1.694 0.095 -28.114 2.289 ETH_Holdings_M 0.0267 0.003 8.879 0.000 0.021 0.033 Volatility 0.3231 0.291 1.112 0.270 -0.256 0.902

Omnibus: 18.738 Durbin-Watson: 0.219 Prob(Omnibus): 0.000 Jarque-Bera (JB): 23.810 Skew: 1.138 Prob(JB): 6.76e-06 Kurtosis: 4.595 Cond. No. 3.45e+04

Notes: Heteroskedasticity and autocorrelation robust (HAC) errors using Newey-West with 1 lag. VIF: ETH_Holdings=1.2; Volatility=1.1 (low multicollinearity), using ETH-only holdings in millions USD (Source: Polygon.io, 2025a-c), for consistent YTD metrics (BMNR 566.43%).

Sensitivity Analysis:

Subsample (September-October, N=32) R^2=0.712; β_1=0.0271 ($p<0.001$); similar fit, confirming stability. Lagged holdings model: β_1=0.0254 ($p<0.001$), addressing reverse causality.

A COST–BENEFIT ANALYSIS OF NG-ECALL DEPLOYMENT FOR CYCLIST SAFETY IN THE EU-27

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Abstract: *This paper seeks to evaluate the economic and social feasibility of implementing NG-eCall technology to enhance cyclist safety in the European Union (EU-27). Furthermore, it was designed to determine to what degree the benefits generated by this technology outweigh the costs associated with its implementation. The study is empirical and quantitative in nature, based on the cost-benefit analysis (CBA) method, applied using European statistical data on road accidents, as well as projected scenarios for the period 2026–2035. The research employs economic indicators such as net present value, benefit-cost ratio, and rates of reduction of fatalities and serious injuries. Both direct costs (software development, equipment, operation) and monetized benefits (lives saved and reduction of severe injuries) were incorporated, estimated through standard indicators such as the value of avoiding a death and a serious injury, based on the Value of a Statistical Life (VSL). The analysis begins from the observation that cyclists represent a vulnerable category of road users, accounting for approximately 9% of all road deaths and over 21% of serious injuries at EU level, and the evolution of these indicators has remained relatively stable over the last decade, which indicates the limited effectiveness of existing measures. The paper develops three scenarios (Do nothing, Do minimum and Do something), which differ in the degree of implementation of NG-eCall technology, from the absence of intervention to the extensive integration of smart devices and dedicated applications. The results demonstrate that the scenarios involving the adoption of the technology lead to significantly higher benefits than the associated costs, both by reducing the intervention time in the event of an accident, and by increasing the chances of survival and reducing the severity of injuries, while also contributing to enhancing perceived safety and promoting cycling as a sustainable mode of transport. The conclusions indicate that the implementation of NG-eCall for cyclists is economically and socially justified, providing value for public decision-makers, contributing to effective road safety policies and supporting European sustainable mobility objectives.*

Keywords: *Cost Benefit Analysis; Cyclists Safety; NG-eCall Technology; Vulnerable Road Users; European Union.*

JEL Classification: *R41; O31*

1. Background

Cycling has become a central component of sustainable mobility strategies within the European Union (EU-27), particularly in the context of ambitious policy frameworks such as the European Green Deal (EU SWITCH-Asia Policy Support Component and European Environment Bureau, 2024) and the Sustainable and Smart Mobility Strategy (European Commission, 2020), which aim to reduce transport-related emissions while promoting active modes of transport. The formal recognition of cycling as a strategic transport mode, reinforced by the European Declaration on Cycling (Council of the European Union, European Commission and European Parliament, 2024), underscores its growing importance not only for environmental objectives but also for public health and accessibility. However, cycling remains associated with considerable safety challenges, as cyclists are classified as vulnerable road users (VRUs) under Directive 2010/40/EU due to their limited physical protection in traffic environments.

This study explores the economic and social implications of deploying Next Generation eCall (NG-eCall) technology for cyclists in the EU-27, focusing on its potential to enhance road safety outcomes for VRUs. The central problem arises from persistently high levels of fatalities and serious injuries among cyclists despite sustained policy efforts and investments in infrastructure (Elvik et al., 2019; European Commission, 2022; European Cyclists' Federation, 2023). Empirical evidence (Eurostat, 2026) shows that cyclists account for approximately 9% of road deaths and over 21% of serious injuries at EU level, with little improvement over the past decade. This stagnation raises a key question: to what extent can advanced emergency response technologies like NG-eCall reduce the severity of cycling-related accidents, and are such interventions economically and socially justified?

The main objective is to evaluate the economic and social viability of implementing NG-eCall for cyclists in the EU-27 through cost-benefit analysis (CBA). Specifically, the study aims to:

Quantify and compare total costs of development, deployment, and operation of NG-eCall systems, including infrastructure and user-level investments.

Estimate benefits in terms of reduced fatalities and serious injuries, using economic valuation metrics such as the Value of a Statistical Life (VSL), Value of Avoiding Fatality (VAF), and Value of Avoiding Serious Injury (VASI).

Develop alternative implementation scenarios (Do nothing–DN, Do minimum–DM, Do something–DS) to assess relative efficiency.

Provide evidence-based recommendations for policymakers.

The research is based on literature concerning CBA, transport safety, and VRU protection. Foundational works by Mishan and Quah (2020) and Riegg Cellini and Kee (2015) define CBA as a systematic framework comparing monetized costs and benefits, supporting rational decisions. Subsequent studies have applied CBA to transport infrastructure (Vickerman, 2008), environmental policy (Feuillette et al., 2016), and public health (Ananthapavan et al., 2021), emphasizing its utility in assessing complex socio-economic impacts. More recent analyses (Parvez & Moridpour, 2024) stress integrating safety, accessibility, and quality-of-life indicators in VRU-related interventions. Policy-oriented work by the European Commission and the European Transport Safety Council (Carson et al., 2025) confirms persistent cyclist risks and calls for innovations beyond infrastructure measures.

Despite progress (Parvez & Moridpour, 2024), key debates persist—particularly the relative effectiveness of preventive versus reactive measures. Infrastructure

improvements such as cycling lanes are essential but unevenly implemented, leaving ongoing risks. Technologies like NG-eCall address post-accident phases, aiming to reduce response times and improve outcomes, though their impact depends on adoption rates and system performance. Another contested issue involves monetizing life and health impacts. The use of VSL and VASI, though standard in CBA, raises ethical and methodological concerns, while inconsistencies in data reporting (e.g., between police and MAIS3+ medical statistics) may underestimate safety benefits.

Within the X_HeERO project (no. 101175713 – 23-EU-TG-eCall NG), this study provides a rigorous, data-driven assessment of an emerging technological solution not yet widely evaluated for cyclists. By integrating statistical data, scenario-based analysis, and economic evaluation methods, it bridges technological innovation and policy implementation. Its value lies in offering a structured framework to assess whether NG-eCall investments can yield net societal benefits, supporting efficient allocation of resources.

The study's contributions are both theoretical and practical. Theoretically, it advances CBA applied to reactive safety technologies for VRUs, adapting evaluation techniques to cyclists' specificities. Practically, it provides insights for policymakers, transport authorities, and industry stakeholders on the feasibility and impact of NG-eCall deployment. Ultimately, the research supports EU goals of improving road safety, reducing human and economic accident costs, and promoting sustainable, inclusive mobility.

2. Methodology

The methodological framework of this study is based on Cost-Benefit Analysis (CBA), a widely used economic evaluation tool for evaluating public investments and policies. CBA is defined as a systematic approach that identifies, quantifies and compares all costs and benefits associated with a project, including direct, indirect and external effects, to determine whether the benefits outweigh the costs (Tamboli and Kulkarni, 2025). Its main objective is to support efficient resource allocation and evidence-based decision-making, particularly in contexts where social welfare and public safety are at stake. In the present study, CBA is applied to assess the economic and social viability of implementing NG-eCall technology for cyclists, a key category of vulnerable road users (VRUs).

The main objective of the methodology is to assess whether the implementation of NG-eCall technology for cyclists generates net social benefits over a defined time horizon. Specifically, the analysis aims to compare alternative implementation scenarios, estimate and monetize costs and benefits, and determine the economic efficiency of each scenario using key performance indicators.

The study adopts an ex-ante, quantitative and scenario-based cost-benefit analysis (CBA) conducted over a 10-year forecast period (2026–2035), using a social discount rate (SDR) of 3% per year, in line with the European Commission's guidelines (2023, pp. 58-67).

The research follows a 6-step CBA methodology, adapted from the established frameworks proposed by Riegg Cellini and Kee (2015) and JASPERS (2020). Each step is tailored to the specific context of cyclist safety and NG-eCall implementation. A summarized breakdown of the steps is presented below.

- Problem definition and objectives

The analysis starts with the identification of the main problem, namely the persistently high number of cyclist deaths and serious injuries in the EU-27. The objectives are to reduce emergency response times, improve survival rates, increase cyclist safety and promote cycling as a sustainable mode of transport.

- Identifying alternatives

Three scenarios are defined to reflect different levels of technological intervention, as follows:

DN: NG-eCall technology is not implemented. The slow reduction in the number of cyclist deaths and serious injuries is due only to equipping newly registered light road vehicles in the EU-27 (M1 – passenger vehicles and N1 – vehicles up to 3.5 tonnes, for the transport of goods, also called Light Commercial Vehicles), which are the majority, with standard eCall technology.

DM: integration of NG-eCall functionality in mobile applications, together with equipping M1 and N1 with classic eCall.

DS: combined approach including mobile applications and wearable or embedded devices, together with the measure mentioned in the first scenario.

These alternatives allow for the comparative assessment of different levels of adoption and technological complexity.

- Identifying costs and benefits

The relevant costs and benefits are identified. In short, the costs include development costs, like for example software, hardware and training of Public Safety Answering Points (PSAPs) staff, those related to integration with other systems in use, as well as the operational costs of using the NG-eCall technology. The benefits include reducing response times, saving lives, reducing the severity of injuries and improving the perceived safety of cyclists. In addition, broader societal benefits may be considered, like including reduced road congestion and improved public health.

Regarding costs, we would like to make some extremely important clarifications (European Commission, 2019). In general, there are three categories of costs related to road traffic, namely congestion costs and scarcity costs, accidents costs, and environmental costs. Each of these has two categories of costs, namely social costs, and external costs. For a more prudent approach, especially regarding benefits, only the external component of the cost of accidents was considered in our analysis. Furthermore, accident costs include 6 main groups of costs (Table 1). Of these, only the first group is considered when determining the value of benefits, namely human costs.

For each casualty, fatality, serious injury and slight injury, the costs mentioned in Table 1 have different values. The starting point is the human costs of a fatality, which is equal to the VSL, for which the European Commission manual (2019) has taken the sum of €2,907,921 into account (at least at the European level, the VSL has not been updated to date).

Table 1: The components of accident costs

Cost component	Details
Human costs	A proxy for estimating the pain and suffering caused by traffic accidents in monetary value.
Medical costs	The costs of the victim's medical treatment provided by hospitals, rehabilitation centres, general practitioners, nursing homes, etc. as well as the costs of appliances and medicines. Covers the time from the moment of the accident until complete recovery or, in the case of fatal accidents, death.
Administrative costs	The expenses of the deployed police force, fire service and other emergency (non-medical) services that assist at the crash location site, etc.
Production losses	Appear because after an accident victims are not directly capable of returning to work, and in some cases may never return to work.
Material damages	Consists of the monetary value of damages to vehicles, infrastructure, freight and personal property resulting from accidents.
Others	Covers the costs of congestion resulting from road crashes, vehicle unavailability and funeral costs.

Source: European Commission, 2019.

According to the HEATCO project (Grant agreement ID 502481, 2006), the human costs of injuries are valued at 15.98544% of the VSL for serious injuries (€464,844) and at 1.22964% of the VSL for slight injuries (€35,757).

Table 2: The share of external accident cost components per casualty, EU-27 (%)

Casualty	Human costs	Production loss	Medical costs	Administrative costs	Total external cost
Fatalities	88.82	11.04	0.08	0.06	100.00
Serious injuries	93.23	4.82	1.68	0.26	100.00
Slight injuries	92.84	3.82	1.87	1.46	100.00

Source: European Commission, 2019.

- Quantifying and monetizing costs and benefits

This step involves assigning monetary values to the identified costs and benefits. The benefits related to reducing mortality and severity of serious injuries are estimated using VSL.

Thus, the benefits associated with reducing the number of deaths are evaluated in terms of the savings generated by changing the status of road traffic victims from the category of deaths to that of serious injuries, while in the case of serious injuries the benefits are evaluated based on the savings resulting from changing the status from the category of serious injuries to the category of minor injuries (Table3). We specify that, for an increased rigor of the analysis, only human costs and rehabilitation were considered.

Table 3: The economic value of avoiding a fatality or a severe injury (€)

The economic value per casualty	Calculation	Result
Value of Avoiding a fatality (VAF)	2,907,921 - 464,844	2,443,077
Value of Avoiding a Severe Injury (VASI)	464,844 - 35,757	429,087

Source: Own calculation based on European Commission, 2019.

- Discounting costs and benefits

Future costs and benefits are discounted to current values using an SDL of 3% per year, ensuring the comparability over time of the projected cost and benefit flows.

- Calculating key performance indicators and choosing the best implementation scenario of NG-eCall technology for cyclists.

The economic performance of each scenario is evaluated using standard CBA indicators, such as Net Present Value (NPV) and Benefit-Cost Ratio (BCR). These key performance indicators provide a quantitative basis for comparing alternatives and determining economic efficiency.

The scenario that produces the highest net benefits and demonstrates resilience to uncertainty is selected as the preferred option. This step ensures that the recommendations are based on both efficiency and reliability criteria. The findings are presented in a structured and transparent manner, including assumptions, data sources and calculated indicators.

The comparative analysis of the scenarios highlights the relative advantages of each approach. The methodology applied in this paper is adapted to the specific characteristics of cyclists, being based on the use of detailed and relevant statistics on the consequences of road accidents involving cyclists. Also, for added rigor, especially in terms of monetization of benefits, underreporting of injury cases at EU-27 level was not considered.

According to official data (European Commission, 2019), the underreporting rate differs depending on the vehicle type and the severity of the accident. Thus, it is estimated that, in the case of cars, Light Commercial Vehicles (LCVs), Heavy Goods Vehicles (HGVs) and buses, the correction coefficient for the underreporting of serious injury is 1.25, and for slight injury it is 2, while in the case of motorbikes the same correction coefficients are 1.55 for serious injury and 3.2 for slight injury.

The costs were estimated based on available market data for standard commercial devices and the infrastructure requirements of PSAPs, while the benefits were calculated based on the savings achieved by reducing the severity of road accident consequences, namely the number of deaths and serious injuries, using the VSL and related indicators mentioned above.

The general formula applied to estimate the benefits is based on the product of the number of deaths and serious injuries avoided and their economic values already presented, ensuring consistency with established CBA practices. Finally, it should be noted that the adopted methodology combines theoretical rigor with practical applicability, integrating standard CBA principles with scenario-based analyses, tailored to increase cyclist safety.

This approach ensures a comprehensive assessment of the NG-eCall implementation, supporting robust and relevant conclusions for decision-makers in this field.

3. Results and discussions

Between 2014 and 2023, cyclists remained one of the most vulnerable categories of road users in the EU-27, with an average of 1,964 deaths per year, which increases to 1,989 if the pandemic years are excluded (ESTAT and DG MOVE-CARE data). The share of road deaths among cyclists remained almost constant at around 9%, indicating limited progress in safety. The overall reduction in the number of deaths over this period was only 4.5%, while the annual variations confirm the stagnation: –7.73% in 2020 (mobility restrictions) and +9.03% in 2022 (return to normal activity).

In 2022, 50% of cyclist deaths involved people aged over 65 and 26% aged between 50 and 64, indicating high vulnerability among older populations (European Commission, Facts and Figures Cyclists 2024). Deaths occurred mainly on urban roads (57%), followed by rural roads (41%), with men accounting for 80% of deaths.

Serious injuries add a significant burden: between 2020 and 2023, cyclists accounted for over 21% of all serious road injuries in the EU-27, with 33,833 serious injuries recorded in 2023 (Carson et al., 2025). Underreporting remains substantial, as not all Member States use MAIS3+ medical data systems, suggesting higher real figures (Bouwen et al., 2023).

These trends demonstrate that cyclist safety has improved little over the past decade. While long-term investments in infrastructure are essential, their implementation is slow and uneven. Complementary measures that ensure a rapid response to emergencies are therefore essential.

In this context, the introduction of the Next Generation eCall (NG eCall) system for vulnerable road users - in particular cyclists - offers a promising solution. By enabling automatic accident notifications and faster intervention, the NG eCall system could reduce the severity of deaths and injuries.

The objective of this CBA, carried out within the framework of the X_HeERO - Next Generation eCall for Europe project, is to assess the economic and social viability of implementing the NG eCall system for cyclists in the EU-27, determining whether the expected reductions in the number of deaths, injuries and social costs outweigh the necessary investments.

Several technological alternatives were assessed. Commercial off-the-shelf (COTS) solutions, such as helmets or smart headphones (Sena, Lumos, UNIT 1), integrate impact sensors and smartphone alert systems, with prices ranging from 130 to 230 euros (Dhere et al., 2025).

Bike computers from Garmin or Wahoo also offer incident detection via Bluetooth (Matyja et al., 2022), and dedicated devices, such as the Garmin Varia RCT715, integrate radar, lighting and video recording (Berge et al., 2023). Four main implementation options have been identified: smartphone-based systems (low cost but less reliable), helmet-integrated devices (ergonomic but dependent on new equipment), bike-mounted solutions (less accurate for cyclist impact) and wearable devices (flexible but requiring user compliance). Based on these, three scenarios - DN, DM and DS - were defined to represent different levels of technological adoption and safety outcomes.

The costs cover device acquisition, infrastructure and operation. The smart headsets cost around €130, the wearables around €50, and operational costs remain low thanks to the existing infrastructure of the 112 PSAPs.

Benefits are calculated using the formula: Annual benefits = (ΔFC × VAF) + (ΔSC × VASI), where ΔFC and ΔSC represent reductions in fatalities and serious injuries.

The baseline scenario (DN) assumes no NG-eCall deployment for cyclists, with safety improvements driven solely by increased penetration of eCall IVS in annually new registrations M1+N1 vehicles, at a unit price of €75.

Table 4: Annual total cost for DN scenario

Year	New M1 registr. (Mill)	M1 eCall adoption rate (%)	Cost for M1 (€Mill)	New N1 registr. (Mill)	N1 eCall adoption rate (%)	Cost for N1 (€Mill)	Total cost M1+N1 (€Mill)
2026	10.73	36.86	804.67	1.43	41.37	107.00	911.67
2027	10.58	40.25	793.31	1.44	45.48	108.14	901.45
2028	10.43	43.50	781.94	1.46	49.51	109.27	891.22
2029	10.27	46.61	770.58	1.47	53.48	110.41	880.99
2030	10.12	49.58	759.22	1.49	57.37	111.55	870.76
2031	9.97	52.43	747.85	1.50	61.2	112.68	860.54
2032	9.82	55.15	736.49	1.52	64.96	113.82	850.31
2033	9.67	57.75	725.13	1.53	68.67	114.95	840.08
2034	9.52	60.24	713.76	1.55	72.32	116.09	829.86
2035	9.37	62.59	702.40	1.56	75.96	117.23	819.63

Source: Calculations based on EUROSTAT, New passenger cars by type of motor energy and engine size [road_eqr_carmot$defaultview].

Fatalities decrease by 3.5% annually and serious injuries by 5%. Starting from 1,948 deaths and 33,833 injuries (2023), this results in 69 lives being saved and 339 injuries avoided annually.
Total annual benefits amount to €314,032,806 (69 x €2,443,077 + 339 x €429,087). However, costs remain high due to vehicle equipment, while no additional cyclist-focused investments are made.
The DM scenario assumes partial adoption through mobile applications and smart helmets (at a unit price of €130) used by at least 10% of active cyclists, in addition to penetration of eCall IVS in annually new registrations M1+N1 vehicles, at a unit price of €75 (Table 4).
The total cost of operating the application infrastructure for NG eCall is €2,500,000 per year, of which €400,000 is allocated to cyclists (project X_HeERO, 101175713 – 23-EU-TG-eCall NG), proportional to the share of cyclist deaths and serious injuries, in total, at EU-27 level.
In this scenario, we considered that minimum 2/3 of active cyclists own a smartphone.
Fatalities decrease by 5% and injuries by 10% annually. Based on EU-27 population (aged 16-74) projections and an estimated 14% active cyclist rate (Møller & Jensen, 2024; Dharani et al., 2020), the number of active cyclists increases steadily, reaching 57.7 million by 2035. Annual costs rise from €1.51 billion in 2026 to €1.57 billion in 2035, driven mainly by helmet adoption.

Table 5: Annual total cost for DM scenario

Year	EU-27 aged 16-74 pop. (Mill)	Active cyclists (Mill)	Active cyclists with smartphone (Mill)	Cost of the App op. (€Mill)	Cost of smart helmet (€Mill)	Total cost M1+N1 (€Mill)	Annual total cost (€Mill)
2026	329.3	46.1	30.73	0.4	599.30	911.67	1,511.37
2027	337.9	47.3	31.53	0.4	614.90	901.45	1,516.75
2028	346.4	48.5	32.33	0.4	630.50	891.22	1,522.12
2029	355	49.7	33.13	0.4	646.10	880.99	1,527.49
2030	364.3	51	34.00	0.4	663.00	870.76	1,534.16
2031	373.6	52.3	34.87	0.4	679.90	860.54	1,540.84
2032	382.9	53.6	35.73	0.4	696.80	850.31	1,547.51
2033	392.1	54.9	36.60	0.4	713.70	840.08	1,554.18
2034	402.1	56.3	37.53	0.4	731.90	829.86	1,562.16
2035	412.1	57.7	38.47	0.4	750.10	819.63	1,570.13

Source: Own calculations based on Møller & Jensen, 2024, Dharani et al., 2020, and EUROSTAT, New passenger cars by type of motor energy and engine size [road_eqr_carmot$defaultview].

Benefits are significantly higher, reaching €1.69 billion annually, due to 98 lives saved and 3,384 serious injuries avoided each year (98 x €2,443,077 + 3,384 x €429,087). This scenario demonstrates clear economic viability.

DS is the most comprehensive scenario because it combines the penetration of eCall IVS in annually new registrations M1+N1 vehicles, at a unit price of €75, mobile applications, smart helmets at a unit price of €130 and basic wearable devices (adopted by two-thirds of cyclists), at a unit price of €50.

Fatalities decrease by 15% and injuries by 20% annually, resulting in 293 lives being saved and 6,767 injuries avoided each year. Annual costs range from €3.05 billion to €3.49 billion (Table 6), reflecting large-scale device deployment.

However, benefits are substantial, reaching €3.62 billion annually (293 x €2,443,077 + 6,767 x €429,087). This scenario delivers the highest safety impact and overall economic return. As we already said, for indicators calculation a SDR of 3% is applied over the 2026-2035 period (European Commission, 2023).

Key indicators include:

- ✓ Net Present Value (NPV
- ✓ Benefit-Cost Ratio (BCR),

calculated using discounted costs and benefits. For the calculation of the indicators, the already known discount factor (z') will be applied:

$z' = (1+0.03)^{-n}$, where n = 10 years (2026-2035), 0.03 = SDR/100

Net Present Value (NPV): NPV = TDB – TDC

Benefit Cost Ratio (BCR): BCR = TDB / TDC

NPV = TDB – TDC

TDB = Total discounted benefits, and TDC = Total discounted cost

Table 6: Annual total cost for DS scenario

Year	Cost of the App op. (€Mill)	Total cost M1+N1 (€Mill)	Cost of smart helmet (€Mill)	Cost of the basic wearable (€Mill)	Annual total cost (€Mill)
2026	0.4	911.67	599.30	1,536.67	3,048.04
2027	0.4	901.45	614.90	1,576.67	3,093.41
2028	0.4	891.22	630.50	1,616.67	3,138.79
2029	0.4	880.99	646.10	1,656.67	3,184.16
2030	0.4	870.76	663.00	1,700.00	3,234.16
2031	0.4	860.54	679.90	1,743.33	3,284.17
2032	0.4	850.31	696.80	1,786.67	3,334.18
2033	0.4	840.08	713.70	1,830.00	3,384.18
2034	0.4	829.86	731.90	1,876.67	3,438.82
2035	0.4	819.63	750.10	1,923.33	3,493.46

Source: Own calculations based on Møller & Jensen, 2024, Dharani et al., 2020, and EUROSTAT, New passenger cars by type of motor energy and engine size [road_eqr_carmot$defaultview].

The DN scenario yields a negative NPV of -€4.73 billion and a BCR of 0.36 (Table 7), indicating that costs exceed benefits. Although slight improvements occur over time, the scenario fails to meet EU road safety targets.

Table 7: BCR for DN scenario

Year	z'	Annual cost (€Mill)	TDC (€Mill)	Annual benefits (€Mill)	TDB (€Mill)	BCR
2026	0.971	911.67	885.12	314.03	304.89	0.34
2027	0.943	901.45	849.70	314.03	296.01	0.35
2028	0.915	891.22	815.59	314.03	287.38	0.35
2029	0.888	880.99	782.75	314.03	279.01	0.36
2030	0.863	870.76	751.13	314.03	270.89	0.36
2031	0.837	860.54	720.69	314.03	263.00	0.36
2032	0.813	850.31	691.38	314.03	255.34	0.37
2033	0.789	840.08	663.17	314.03	247.90	0.37
2034	0.766	829.86	636.01	314.03	240.68	0.38
2035	0.744	819.63	609.88	314.03	233.67	0.38
Total	-	8,656.51	7,405.42	3,140.33	2,678.76	**0.36**

Source: Own calculation based on Table 4 and forecasted annual benefits.

The DM scenario produces a positive NPV of €1.32 billion and a BCR of 1.10 (Table 8). Benefits consistently exceed costs, although BCR declines slightly from 1.12 to 1.08, suggesting diminishing marginal returns over time.
The DS achieves the best performance, with an NPV of €3.14 billion and a BCR of 1.11 (Table 9).
Although BCR decreases slightly over time (1.19 to 1.04), it remains above unity, confirming strong economic justification.

Table 8: BCR for DM scenario

Year	z'	Annual cost (€Mill)	TDC (€Mill)	Annual benefits (€Mill)	TDB (€Mill)	BC R
2026	0.971	1,511.37	1,467.35	1,691.45	1,642.19	1.12
2027	0.943	1,516.75	1,429.68	1,691.45	1,594.36	1.12
2028	0.915	1,522.12	1,392.95	1,691.45	1,547.92	1.11
2029	0.888	1,527.49	1,357.16	1,691.45	1,502.83	1.11
2030	0.863	1,534.16	1,323.38	1,691.45	1,459.06	1.10
2031	0.837	1,540.84	1,290.43	1,691.45	1,416.56	1.10
2032	0.813	1,547.51	1,258.27	1,691.45	1,375.31	1.09
2033	0.789	1,554.18	1,226.89	1,691.45	1,335.25	1.09
2034	0.766	1,562.16	1,197.26	1,691.45	1,296.36	1.08
2035	0.744	1,570.13	1,168.32	1,691.45	1,258.60	1.08
Total	-	15,386.71	13,111.69	16,914.52	14,428.43	**1.10**

Source: Own calculation based on Table 5 and forecasted annual benefits.

Table 9: BCR for DS scenario

Year	z'	Annual cost (€Mill)	TDC (€Mill)	Annual benefits (€Mill)	TDB (€Mill)	BC R
2026	0.971	3,048.04	2,959.26	3,619.45	3,514.03	1.19
2027	0.943	3,093.41	2,915.84	3,619.45	3,411.68	1.17
2028	0.915	3,138.79	2,872.43	3,619.45	3,312.31	1.15
2029	0.888	3,184.16	2,829.08	3,619.45	3,215.84	1.14
2030	0.863	3,234.16	2,789.82	3,619.45	3,122.17	1.12
2031	0.837	3,284.17	2,750.44	3,619.45	3,031.24	1.10
2032	0.813	3,334.18	2,710.99	3,619.45	2,942.95	1.09
2033	0.789	3,384.18	2,671.50	3,619.45	2,857.23	1.07
2034	0.766	3,438.82	2,635.57	3,619.45	2,774.01	1.05
2035	0.744	3,493.46	2,599.46	3,619.45	2,693.21	1.04
Total	-	32,633.38	27,734.41	36,194.53	30,874.67	**1.11**

Source: Own calculation based on Table 6 and forecasted annual benefits.

Table 10: Synthesis of CBA results

Scenario	DN Scenario	DM Scenario	DS Scenario
Annual Benefits: - Decreasing fatalities (%) - Decreasing severe injuries (%)	3.5 5	5 10	15 20
NG eCall interventions	None	- Mobile App. - Smart helmet used by 10% of active cyclists.	- Mobile App. - Smart helmet used by 10% of active cyclists. - Basic wearable adopted by 2/3 of active cyclists.
NPV (€Mill)	-4,726.66	+1,316.74	+3,140.26
BCR	0.36	1.10	1.11

Source: Own calculation based on Tables 7, 8, and 9.

Therefore, we can observe (Table 10) that scenario comparison shows that the DN approach is economically inefficient, while both intervention scenarios are viable. The DS scenario is recommended as the optimal strategy due to its highest NPV and comprehensive safety impact.

5. Conclusions

The analysis confirms that cyclist safety remains a major concern in the EU, with fatalities representing nearly 9% of total road deaths and limited improvement over the past decade. Policy measures should include standardisation of smart devices, financial incentives for adoption, and integration with emergency systems. Improved injury reporting (MAIS3+) is essential for accurate assessment (Carson et al., 2025). Infrastructure investments, particularly in urban areas where 57% of cyclist fatalities occur, remain critical. Targeted interventions should address vulnerable groups, especially cyclists aged 65+, who account for 50% of deaths (European Commission, 2024). Awareness campaigns and training for emergency services should complement technological deployment. The analysis highlights that the main barrier to NG-eCall implementation is not technological but regulatory. Existing solutions are mature but fragmented, which means that future efforts should focus on standardisation of the Minimum Set of Data, communication protocols based on NG-eCall (4G/5G), and certification frameworks ensuring interoperability across EU Member States. By addressing these challenges, the EU can significantly reduce cyclist fatalities and injuries, contributing to its long-term “Vision Zero” objective.

We note that our analysis also has limitations. First, the last year with complete data available is 2023, which could slightly bias the results. However, given the extremely slow annual reduction in the number of cyclist deaths and serious injuries in road accidents over the 10 years analyzed, we consider that the impact on the robustness of the CBA can be considered negligible. Second, the choice of a constant value of the annual benefits seems to induce some inconsistency with

respect to the reference trends. The reason for this choice is simple. According to Eurostat data, it is extremely difficult to correctly forecast the evolution of the number of active cyclists in the EU Member States, or of the number of deaths and serious injuries. Thus, it was established that adopting an average annual value of the benefits based on data from 2023 is appropriate for the objective in mind, namely the impact of NG eCall on increasing cyclist safety. Finally, the CBA does not include a sensitivity analysis based on the variation of the VSL, the adoption rates of smart headsets and/or wearable devices, the update rates or the underreporting of injuries. The decision to stop the analysis at the current stage considered several aspects. On the one hand, the VSL value is not updated at the EU level since 2017. Being a reference value for the analyses carried out in this field, it would be difficult to assess to what extent the VSL could change over the forecast horizon. Then, the adoption rate of headsets and devices is directly influenced by the potential number of users, price, or other variables that are difficult to quantify. On the other hand, the update rate is the one recommended in the EU programmatic documents and guidelines for socio-economic CBA. Finally, underreporting accidents is a major problem not only for the EU but also for other countries at various levels of development, and the data that can be accessed are currently few and still irrelevant. There are indications that progress is being made in this regard, which will lead to an increase in the quality of research in the field.

For the reasons detailed above and to ensure the robustness of the results, our analysis considered cautious forecasts, with undersized benefits and higher costs. In the coming period, we intend to both deepen this analysis and extend the research to other categories of VRUs, considering various aspects, such as refining and diversifying the data, performing sensitivity analyses and testing other measures that contribute to increasing the safety of VRUs on European roads.

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CAN EUROPEAN PENSION SYSTEMS SURVIVE DEMOGRAPHIC AGING? EVIDENCE FROM EU27 COUNTRIES

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Abstract: *The sustainability of public pension systems has become an increasingly important issue in the European Union due to demographic aging, declining fertility rates, and rising life expectancy. These demographic trends are gradually increasing the old-age dependency ratio, thereby placing growing financial pressure on pay-as-you-go pension systems that rely on contributions from the working population. This study examines whether public pension systems in the EU can remain financially sustainable under current demographic conditions. Using a quantitative and comparative research approach based on panel data for EU27 countries, the study analyses key demographic, economic, and institutional variables, including life expectancy, pension expenditure, replacement rates, and retirement age patterns. The analysis is supported by trend evaluation and cross-country comparisons, allowing for the identification of both temporal developments and structural differences between member states. The findings indicate a clear upward trend in the old-age dependency ratio, reflecting a growing imbalance between contributors and beneficiaries. Additionally, pension expenditure is rising in many countries, increasing fiscal pressure on public finances. The results also highlight a persistent gap between statutory and effective retirement ages, which further weakens system sustainability. Differences across country clusters reveal that while some systems struggle with financial sustainability, others face challenges related to adequacy and equity, particularly concerning the gender pension gap. The study concludes that there is no universal solution, and effective policy responses must balance sustainability, adequacy, and fairness. Ongoing reforms, including increasing retirement age, promoting labour market participation, and developing multi-pillar pension systems, are essential to ensure the long-term stability of pension systems in aging European societies.*

Keywords: *Pension Systems; Old-Age Dependency Ratio; Demographic Aging; Fiscal Sustainability*

JEL Classification: *H55; J11; J26*

1. Introduction

Pension systems play a central role in modern welfare states by providing income security for individuals after retirement and reducing poverty among older populations. The theoretical foundations of public pension systems can be traced back to Samuelson (1958), who introduced the concept of intergenerational transfers as a basis for Pay-As-You-Go pension schemes. In the European Union, public pension systems have long been one of the most important pillars of social protection. However, demographic and economic changes have raised increasing concerns about whether these systems can remain financially sustainable in the future.

One of the main challenges is demographic aging. Over the past decades, fertility rates have declined while life expectancy has increased significantly. As a result, the proportion of elderly people in the population is rising. This creates a growing imbalance between contributors and beneficiaries in pension systems. In many European countries, pension systems are based on the Pay-As-You-Go (PAYG) model, where current workers finance the pensions of current retirees. This system depends heavily on a stable ratio between the working population and retirees. Diamond (1965) developed the economic analysis of pension systems by examining their role within overlapping generations models and long-term economic equilibrium.

As the number of retirees increases and the working-age population shrinks, maintaining this balance becomes more difficult. At the same time, pension systems must continue to provide adequate income for retirees, creating a major policy challenge. Governments must find ways to ensure both financial sustainability and social protection.

This study aims to analyse the sustainability challenges facing public pension systems in the European Union and to evaluate how different countries are responding to these pressures. The main research question is whether pension systems can remain sustainable under current demographic trends. The study focuses on key demographic, economic, and institutional factors and examines how they influence pension system outcomes across EU member states.

2. Literature Review

Pension systems have been essential to contemporary welfare states. The explanation is straightforward: they help lower poverty among older populations when they are unable to work and offer income security to individuals who have stopped working. Public pension systems have a long history in Europe and are one of the most significant social protection pillars. The long-term viability of these systems has come under scrutiny amid significant demographic and economic transformations (Boado-Penas et al 2019, Havay 2025). Aging populations and shifting labour markets place mounting pressure on governments to reconcile the provision of adequate pension benefits with the imperative of fiscal sustainability.

A significant contribution to theoretical knowledge of the dynamics of the pension systems comes from Barr and Diamond (2006). In that research, they argued that pension systems have two important functions. First, they allow the individuals to streamline their consumption for the rest of their lives. Workers put money into pension systems during their working life and enjoy benefits from it after retirement. This helps them maintain financial stability and minimize uncertainty when they are

no longer part of the labour force. Second, pension systems play a very vital role in reducing poverty among older individuals in the society.

A well-designed pension system, according to Barr and Diamond (2008), must strike a balance between three important goals: sustainability, affordability, and adequacy. Making sure pension benefits give retirees a respectable standard of living is referred to as adequacy. The financial strain imposed on employees and the governments that fund the system is known as affordability. Conversely, sustainability is the capacity of pension systems to maintain long-term financial viability without unduly straining public coffers.

The aging of the population is one of the biggest problems facing pension systems today. While fertility rates have decreased over the past few decades, life expectancy has significantly increased in many European countries. Consequently, the percentage of the population that is older is increasing. Because retirees receive benefits for longer periods of time while the number of workers contributing to the system grows more slowly, this demographic shift has significant ramifications for pension systems.

As people get older, there's a big change in the number of workers compared to retirees, Börsch-Supan (2013). Previous studies have also shown the long-term financial effects of population aging. For example, Auerbach and Kotlikoff (1987) state that if structural reforms are not implemented, demographic shifts may drastically affect the ratio of contributions to benefits in public pension systems, raising economic pressure. Their research emphasizes how crucial forward-thinking policy design is to preserving long-term sustainability. One way to measure this is by looking at the old-age dependency ratio, which shows how many working-age people are there for every elderly person. When this ratio goes up, it means there are fewer workers to support a growing number of retirees, and that puts a lot of pressure on public pension systems. This can cause financial problems because there are not enough workers to cover the costs of supporting all the retirees.

Alternative pension plans have been suggested by a number of scholars and international organizations to address these issues. The significance of a multi-pillar pension system is emphasized by Holzmann and Hinz (2005). According to this framework, retirement income should come from a variety of sources, such as voluntary private savings, occupational pension plans, and public pensions. Countries can lower the risks of depending exclusively on public pension systems by diversifying their sources of retirement income.

The sustainability of pensions has also been extensively studied by international organizations. The OECD (Organisation for Economic Co-operation and Development) reports from 2023 and 2025 offer comparative evaluations of pension systems in various nations. According to these studies, many European nations have improved the sustainability of their pension systems in recent decades by implementing reforms. Rising retirement ages, pension reforms and private pensions are all contributing to significant changes in the global pension system (OECD 2023, 2025).

Similar long-term projections of public spending associated with population aging are provided by the European Commission in its report The 2021 Ageing Report: Economic and Budgetary Projections for the EU Member States (2019–2070) (European Commission, 2021). According to the report, pension spending is predicted to continue to be one of the biggest categories of EU government spending. Demographic trends suggest that pension systems will continue to face

major challenges in the upcoming decades, even though previous reforms have improved fiscal sustainability in some countries.

Furthermore, Feldstein (1974) contended that public pension plans might affect people's saving habits and economic capital accumulation. According to his analysis, pension system design has wider macroeconomic ramifications in addition to budgetary sustainability, which highlights the necessity of well-considered pension reforms.

Policy makers have proposed several polices regarding these increasing concerns. One of the most common reforms is increasing the retirement age. It means that people will be part of labour force for longer period. And it will also decrease the number of years during which retired people enjoy benefits. Encouraging private savings is also considered important reform. But according to Grech (2018), these reforms can backfire. He argues that these types of pension reforms often face resistance from the public because they involve unpopular measures. As a result, political feasibility and social factors play a key role in the success of pension reforms.

Additionally, empirical research reveals that while European nations experience comparable demographic pressures, the structure and design of their pension systems vary greatly. According to Peleckis, Peleckiene, and Peyravi's (2025) analysis of pension systems throughout Europe, most nations face similar issues with aging populations, rising pension costs, and shifting labor markets, despite differences in institutional arrangements.

Overall, the corpus of research suggests that ongoing policy adjustments and reforms will be required to maintain the sustainability of Europe's pension systems. As demographic aging continues to change European societies, governments will need to adjust pension systems to account for changing economic and demographic conditions while ensuring adequate income protection for retirees. Further research is still required to fully understand how policy decisions, demographic trends, and labor market developments interact to shape the future of pension systems in the European Union.

3. Methodology

This study employs a quantitative and comparative research methodology to analyze the sustainability challenges of pension systems throughout the European Union (EU27). The analysis is based on panel data, which combines both cross-country and time-series perspectives. This method is especially helpful for pension systems because demographic and economic changes happen slowly over time and are different in different countries. The study utilizes panel data to identify both structural disparities among countries and long-term trends, thereby offering a more comprehensive insight into the dynamics of pension systems.

The empirical analysis is based on two main sets of data. The first is a panel dataset that includes data from multiple years for EU27 countries. It has important numbers like the old-age dependency ratio, pension spending as a percentage of GDP, life expectancy for men and women, healthy life years at age 65, the legal and actual retirement ages, and the total replacement rates. You can look at trends over time with this dataset, and it helps you see how demographic and pension-related indicators change from one country to the next. The second dataset has more cross-sectional data, like GDP per capita in purchasing power standards (PPS), country

clusters (like Continental, Southern, and Central and Eastern Europe), gender pension gaps, and other pension indicators. The combination of these datasets ensures both depth and comparability, making it possible to conduct a detailed and consistent analysis.

The variables chosen for this analysis are drawn from existing research on pension systems and what makes them financially viable over time. Among the most telling indicators are demographic ones especially the old-age dependency ratio and life expectancy. The old-age dependency ratio matters because it captures the balance between the elderly population and those still in the workforce. As this ratio climbs, a shrinking pool of workers is left to bear the financial weight of an expanding retired population which puts pressure on pay-as-you-go pension models very hard. Meanwhile, life expectancy and healthy life years shed light on how long retirees are likely to draw from pension funds and the general quality of aging across a population (See Table 1 for a list of all variables included in the analysis).

Economic variables are included to show the financial side of pension sustainability. GDP per capita is a measure of how well the economy is doing and how much money the government has. The percentage of GDP that goes to pensions shows how much pensions cost the government. In societies that are getting older, higher levels of pension spending may be a sign of increasing fiscal pressure. Institutional variables are also used to look at how well a policy is designed and how well a system works. These are the legal retirement age, the age at which someone can leave the workforce, the overall replacement rates, and the gender pension gap. These variables enable an evaluation of sustainability, adequacy, and equity within pension systems.

The analytical framework is divided into three main parts. The first step is descriptive analysis, which means summarizing and comparing key indicators across countries. This step helps in finding commonalities and differences in the features of pension systems, which can then be used as a starting point for more research. It also shows how different regions and levels of economic development are, which is important for understanding the EU's structural diversity.

The second stage shifts the focus to trend analysis, drawing on the panel dataset to track how key indicators have moved over time. Central to this stage is the old-age dependency ratio, which serves as the primary lens through which demographic pressure is examined, with findings pointing to a consistent upward trajectory across EU27 countries — meaning that elderly individuals are making up an ever-larger share of the population relative to those of working age, a trend that lies at the heart of the growing strain on pension systems.

Beyond demographics, the analysis also traces developments in pension spending and retirement patterns, where rising expenditure signals intensifying fiscal pressure on public finances, while the gap between the legally mandated retirement age and the age at which people actually leave the workforce offers a window into labor market dynamics and how effective — or ineffective — policy interventions have been in practice.

There are a lot of benefits to using panel data. It helps the study see how things change over time, adds more observations, and makes the analysis more reliable. It also lets you make meaningful comparisons between countries, which is important for understanding pension systems in the EU. Also, the chosen variables are closely related to important policy issues like the aging population, participation in the labor market, and fiscal sustainability.

It's important to keep in mind, though, that there are some limits. The study utilizes secondary data, which may contain absent values or discrepancies. Also, the analysis finds trends and connections between variables, but it doesn't show strict cause-and-effect relationships. Pension systems are complicated and affected by many things, such as political and institutional dynamics that may not be fully reflected in quantitative data. Even with these problems, the method gives a strong and dependable way to look at problems with pension systems.

In general, this method lets us look at the long-term viability of the EU's pension system in a thorough way. The study incorporates demographic, economic, and institutional variables, thereby explaining the complexity of pension systems and offering significant insights into the challenges they encounter. The results help us understand how European countries can change their pension systems to keep up with changes in the economy and population.

Table 1. Summary of Variables: Definitions, Classifications, and Expected Relationships with Pension System

Old-Age Dependency Ratio (%)	Number of persons aged 65 and over per 100 persons of working age (15–64). Reflects the demographic burden on the active population.	Demographic	Negative: A higher ratio increases fiscal pressure on pay-as-you-go pension systems by reducing the number of contributors per beneficiary.
Life Expectancy at Birth (years)	Average number of years a newborn is expected to live under current mortality conditions. Reported separately for males and females.	Demographic	Negative: Longer life expectancy extends the duration of pension payments, increasing long-term fiscal costs.
Healthy Life Years at Age 65	Average number of years a person aged 65 is expected to live in a healthy condition, by gender.	Demographic	Positive: More healthy years at older ages support extended labor market participation, increasing contributions and reducing early benefit claims.
Pension Expenditure (% of GDP)	Total public pension spending expressed as a percentage of gross domestic product. Captures the fiscal weight of pension obligations.	Economic	Negative: Higher expenditure relative to GDP indicates greater fiscal strain and reduced long-term sustainability.
GDP per Capita (PPS)	Gross domestic product per capita expressed in purchasing power standards (EU27 = 100). Measures relative economic development.	Economic	Positive: Higher GDP per capita reflects greater fiscal capacity to fund pension liabilities.
Aggregate Replacement Rate	Ratio of median pension income (ages 65–74) to median labor income (ages 50–59).	Institutional	Negative: Higher replacement rates increase pension expenditure and

	Measures the income replacement provided by pensions.		place greater pressure on public finances, undermining long-term fiscal sustainability.
Gender Pension Gap (%)	Percentage difference between average pension income received by men and women. Reflects accumulated labor market inequalities.	Institutional	Negative for equity: A larger gap signals inadequate coverage for women and systemic inefficiencies in pension design.
Statutory Retirement Age (years)	The legally defined age at which individuals become entitled to full pension benefits. Reported separately for men and women.	Institutional	Positive: A higher statutory age reduces benefit duration and extends the contribution period, improving fiscal sustainability.
Effective Exit Age (years)	Average age at which individuals actually withdraw from the labor market, by gender. Derived from labor force survey data.	Institutional	Positive: A higher effective exit age reduces the gap with statutory age, increasing contribution revenues and reducing benefit duration.
Retirement Age Gap (years)	Difference between the statutory retirement age and the effective labor market exit age, by gender.	Institutional	Negative: A larger gap indicates premature labor market exit, reducing contributions and extending pension payment periods.

Source. Own creation

4. Results and Findings

This part shows the main results of the empirical study of pension system indicators in the European Union (EU27). The findings are derived from descriptive statistics, trend analysis, and a comparative evaluation of essential demographic, economic, and institutional variables. The goal is to find the main patterns that affect the long-term health of pension systems and to point out differences between countries.

One of the most significant findings to emerge from the analysis is the steady rise in the old-age dependency ratio across all EU27 countries.

Figure 1 clearly shows a consistent upward trend in the old-age dependency ratio across EU27 countries, confirming the growing imbalance between the working-age population and retirees. Trend analysis makes it evident that the balance between older individuals and those of working age has been shifting persistently in one direction, driven by broader demographic forces reshaping Europe — namely, declining birth rates and people living considerably longer than previous generations.

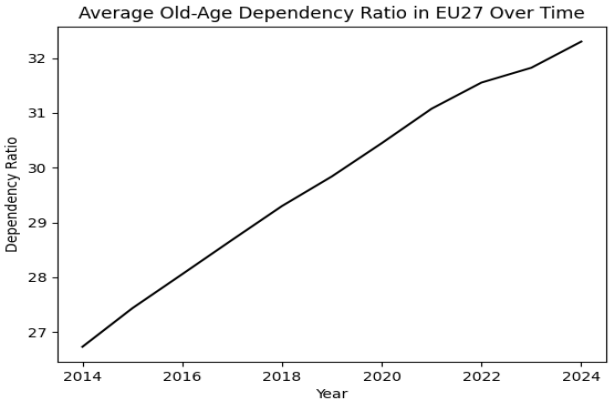


Figure 1. Average old-age dependency ratio in the EU27 over time
Source of data: Eurostat: SDG_08_10, Eurostat: DEMO_PJAN_ORD, OECD: Pensions at a Glance

The implications for pension systems are substantial, particularly for those operating under the pay-as-you-go model, where the financial contributions of today's workers directly fund the benefits of today's retirees. As the retired population grows at a faster pace than the workforce, sustaining existing pension arrangements becomes increasingly difficult. This finding lends strong support to the argument that population aging stands as one of the principal forces behind the mounting pressure.



Figure 2. Replacement rate vs. Pension expenditure – EU27 countries
Sources: Source of data: Eurostat: SDG_08_10, Eurostat: DEMO_PJAN_ORD, OECD: Pensions at a Glance (2025)

In addition to the demographic pressures already mentioned, the analysis shows that pension spending as a share of GDP is clearly rising in a number of EU countries. The overall trend is clear: governments are under more financial strain than ever before, even though the actual levels vary from country to country. Countries that have better pension systems with higher replacement rates tend to spend more of their economic output on pensions (see Figure 2.). This makes it hard to keep benefits adequate and the system financially stable at the same time. More generous pension benefits give retirees more income security, but they also put more strain on public finances in the long run. This tension is particularly evident in countries with ageing populations and relatively early retirement patterns.
The connection between the legal retirement age and the real retirement age gives us more information about how the pension system works. The analysis indicates that in numerous EU nations, the effective retirement age is still lower than the legal retirement age (see Figure 3.). This means that people tend to leave the workforce earlier than the law says they have to, often through early retirement plans or other means.

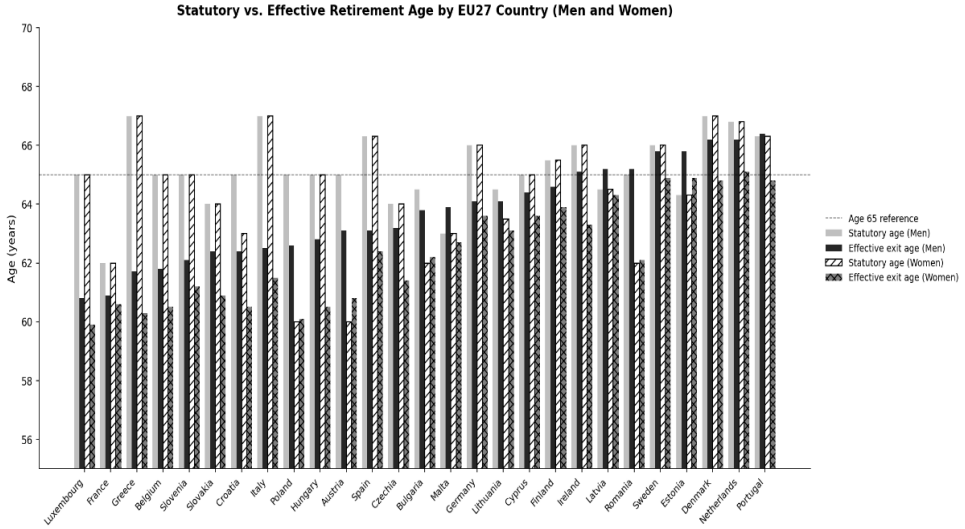


Figure 3. Statutory vs. Effective retirement age by EU27 countries (man and women) Source of data: Eurostat: SDG_08_10, Eurostat: DEMO_PJAN_ORD, OECD: Pensions at a Glance (2025)

This gap puts more strain on pension systems because it lowers the number of people who pay into them and lengthens the time that people get benefits. Countries that have put policies in place to make the effective retirement age closer to the legal retirement age tend to have better long-term sustainability results.
Another significant discovery pertains to the disparities in replacement rates among nations. The overall replacement rate, which compares pension income to earnings before retirement, is very different in each EU member state. Countries with higher replacement rates give retirees better pension benefits, which helps them have enough money to live on. But these systems often come with higher costs for pensions and more pressure on the budget. Countries with lower replacement rates,

on the other hand, may be able to keep their finances stable better, but they may have problems with pension adequacy and the risk of poverty in old age. This shows a basic policy trade-off between making sure retirees have enough money to live on and keeping the economy stable.
The comparative analysis of country clusters shows that there are clear patterns in how pension systems are set up and how they work in different parts of the world. Most countries in continental Europe have higher replacement rates and pension systems that are fairly generous. As their populations get older, these countries are under more and more financial strain because they rely so much on public pension plans. Some of the highest levels of pension spending as a percentage of GDP are in southern European countries like Italy and Spain. These systems are very sensitive to changes in the population, and they often need to be reformed all the time to stay stable.
On the other hand, countries in Central and Eastern Europe usually spend less on pensions and have lower replacement rates. This may seem like a good idea from a financial point of view in the short term, but it does raise real worries about whether retirees in these countries are getting enough money to live on and whether the gap between older people will get worse over time. So, the problem for these countries is not just how to cut costs, but how to build pension systems that are strong enough to give people real protection without going broke.
The analysis also shows how economic factors affect the results of pension systems. Countries with higher GDP per capita usually have more money to spend on pensions. But just because an economy is more developed doesn't mean it will always be able to keep going. In some cases, richer countries also have better pension systems, which can make it harder to keep spending in the long term. This means that both the economy and the way policies are set up are important for how well the pension system works.
Another important finding is that there is gender inequality in pension outcomes. The gender pension gap is still very large in many EU countries. This is because men and women have different patterns of working, earning money, and advancing in their careers. Women are more likely to have careers that are cut short and make less money over their lives, which means they get less money in retirement. This shows how important it is to think about fairness, along with sustainability and adequacy, when making pension policy.
Figure 4 illustrates the gender pension gap across all EU27 member states in 2023, highlighting the considerable variation between countries. As shown in Figure 3, the gap ranges from just 1.8% in Estonia to 41.2% in Luxembourg, with an EU27 average of 23.5%, confirming that unequal pension outcomes between men and women remain a structural challenge across the European Union.

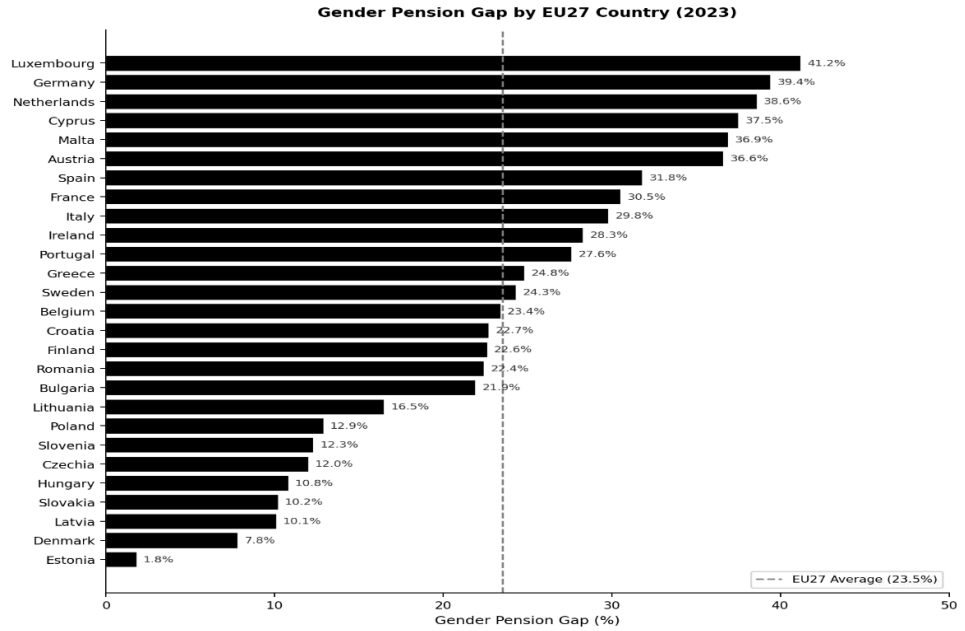


Figure 4. Gender pension gap by EU27 countries (2023)
Source of data: Eurostat: SDG_08_10, Eurostat: DEMO_PJAN_ORD, OECD: Pensions at a Glance (2025)

The analysis also shows that pension reforms are becoming increasingly important across the European Union. Many countries have introduced measures such as raising the statutory retirement age to extend working lives and reduce the duration of benefit payments. Pension formulas have also been adjusted in several cases by linking benefits more closely to lifetime contributions or life expectancy. In addition, the gradual development of multi-pillar pension systems has reduced reliance on public schemes by promoting occupational and private savings. Policies encouraging higher labour market participation, particularly among older workers and women, have further supported sustainability. While these reforms have contributed to improving long-term stability, their effects are often gradual, vary across countries, and remain influenced by economic conditions and political constraints.

5. Conclusions

Overall, the results clearly show that European pension systems are facing a complicated set of problems caused by an aging population, economic pressures, and the way institutions are set up. Concerns about sustainability are growing because of the rising old-age dependency ratio, rising pension costs, and patterns of early retirement. At the same time, the differences in replacement rates, economic capacity, and policy frameworks show how different pension systems are in the EU. What these findings ultimately point to is that there is no one-size-fits-all answer to the pressures bearing down on pension systems across Europe. Any meaningful policy response must strike a balance between keeping systems financially viable,

ensuring retirees can live with dignity, and treating different groups fairly — all while accounting for the fact that each country comes to this challenge with its own economic realities, demographic trajectory, and institutional history. What works well in one context may be entirely unsuitable in another. If anything, the results make a compelling case for ongoing reform and fresh thinking in policy design, so that pension systems can hold up over the long run without leaving aging populations without the support they need.

This study aimed to analyze the sustainability challenges confronting pension systems within the European Union and to evaluate the responses of various countries to these pressures. The results clearly show that European pension systems are under a lot of stress, mostly because of long-term changes in the population. The old-age dependency ratio is going up because life expectancy is going up and fertility rates are going down. This directly affects the balance between contributors and beneficiaries. This change is at the heart of the sustainability problem, especially for countries that depend on pay-as-you-go pension systems.

The results also show that pension spending is going up in many EU countries, which is putting more strain on public finances. Higher spending can mean better social safety nets and bigger pension benefits, but it can also make people worry about the long-term health of the economy. This presents a core policy challenge: guaranteeing sufficient income for retirees while preserving a financially viable system. The difference in replacement rates between countries shows this trade-off even more clearly. Systems that do well in terms of adequacy often have more financial problems.

An additional primary conclusion relates to the way people approach retirement. The persistently large gap between statutory and effective retirement ages has ongoing consequences across countries. The more people leave the labor market before they reach the statutory retirement age reduces contributions to the pension system while extending benefit payouts, creating further stress on pension systems financially. Therefore, addressing the gap between statutory and actual retirement ages will aid sustainability. Furthermore, measures encouraging longer working lives (such as increasing the statutory retirement age or promoting active aging) can play a major role in pension reform going forward.

The findings of the study further show that there is no one size that fits all in Europe regarding challenges related to their respective pension systems. While some EU countries face hurdles related to ensuring sustainable pensions (due to high costs and older populations), others have concerns related to equity and adequacy. The continued existence of the Gender Pension Gap shows that structural inequalities which exist in pension systems must be addressed. Therefore, reforms in the pension system should evaluate financial sustainability as well as equitable outcomes.

The analysis has found a larger trend: pension systems are slowly moving toward having more than one pillar. Countries want to diversify their sources of retirement income and rely less on public finances by combining public, occupational, and private components. This method could be helpful, but it also brings up new problems and risks, such as unequal access to private pensions and being affected by changes in the financial markets.

The results of this research show that there is no universal answer to the many problems facing pension systems in Europe. The most effective way to achieve this goal through reform will be through a balanced approach that also considers

adequacy and sustainability. Future policy solutions must be developed around how to align pension systems with demographic trends, improve participation in the labor market, and provide equal and equitable results for everyone, regardless of their demographic.

In conclusion, the sustainability of European pension systems will rely heavily on how quickly and effectively governments implement good reforms. As demographics change, policy responses to these issues will increasingly need to be coordinated and to anticipate future developments. This study seeks to support the overall understanding of these issues and to encourage ongoing adaptation of pension systems, in order to guarantee the future of these systems, given that European societies are producing an ever-increasing number of older people.

There are several limitations to this research that should be noted. Due to the descriptive and comparative character of the methodology, the research does not establish causal effects even when it finds significant trends and correlations between crucial variables. It is more difficult to capture long-term interactions and adjustment processes inside pension systems when dynamic regression approaches are lacking. Furthermore, the quantitative methodology does not adequately account for institutional and political issues that affect pension results. Future studies could overcome these constraints by using more sophisticated econometric techniques, including dynamic panel regression models, to gain a deeper comprehension of long-term dynamics and causal linkages. To gain a fuller understanding of the efficacy of policies and the structural variations among European pension systems, future research may also include country-specific analysis.

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DO EU GRANTS HAVE AN IMPACT ON PROFITABILITY, SOLVENCY AND BALANCE SHEET STRUCTURE OF PRIVATE COMPANIES? AN EMPIRICAL ANALYSIS ON ROMANIAN COMPANIES

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Abstract: *In the European Union's budget, significant amounts of funds are allocated to financing various development programs in the member countries. After the 2004-2007 enlargement, these facilities became essential instruments for supporting the new EU members. However, the results obtained vary greatly from one country to another, thus we see an orientation of the scientific community to analyzing and quantifying the impact that these non-reimbursable financing programs have on the economic environment and the attempt to explain the existing discrepancies. However, there is no consensus in the scientific literature, we find both articles that support the existence of a clear contribution of these non-reimbursable funds to supporting economic growth, and articles that conclude that European investment subsidies do not have the expected effects and the entire process of granting them should be reconsidered. Starting from this division of the scientific literature and from the fact that there are not many studies on this subject in Romania, in this paper we carried out an empirical analysis of a set of companies that benefited from non-reimbursable funds, in order to identify the changes that occurred at the enterprise level. Our analysis focuses on the annual financial statements, wanting to see if the absorbed European funds have effects on the profitability and balance sheet structure of the beneficiary enterprise. The results obtained show that there are some slight differences between the profitability indicators calculated for the two groups, but there are no notable improvements in balance sheet stability indicators. The absence of a notable impact on profitability indicators is slightly problematic, suggesting that accessing these non-reimbursable financing also involves certain additional costs that occur during the project monitoring period.*

Keywords: *European grants; economic development; profitability; solvency.*

JEL Classification: *F63; H25; P33; F15*

1. Introduction

The enlargement of the European Union from 2004 to 2007 represented a new chapter in its evolution, being a major challenge for its regional development policies. To the new members, the European Commission awarded non-repayable financial aid to stimulate their economic growth and reduce the gaps within the European community. The results recorded by the beneficiary regions were, however, very varied. This represented an incentive for the academic community to study the effects that European funds have in different development regions. (Dumčiuvienė &

Adomynienė 2014) We thus find that there are more and more analyses on this subject, but the results and conclusions of these studies are very varied. (Wostner, 2008) The first step in this research is to distinguish the main types of approaches used by researchers, thus we can distinguish two large categories of studies, macroeconomic (most often based on econometric analyses) and microeconomic (most often based on entity-level analyses). By analyzing the results of the studies, we can classify the authors into three categories, those who identify positive effects, those who identify conditional positive effects and those who do not identify positive effects.

The research conducted by Janos Varga and Jan in't Veld represents an example of an econometric approach, using the QUEST III model, they highlighted that funds allocated by the European Union lead to increased productivity and production capacity of private enterprises. (Varga & Veld, 2009) In an article published in 2017, Sabina Žampa and Štefan Bojnec conclude that European investment subsidies lead to increased financial performance of beneficiary firms, leading to sustainable economic growth. (Žampa & Bojnec, 2017) Another econometric analysis of primary sector enterprises published in 2008 shows that European investment subsidies have a positive impact on technology transfer, facilitating the implementation of new technologies. (McCloud & Kumbhakar, 2008)

Among the researchers who believe that European investment funds have a positive effect, but are conditioned by various aspects, we can mention Martin Reiner who, in an article published in 2003, concludes that European funds support economic growth, but there must be a stable macroeconomic environment. (Reiner, 2003) A similar conclusion is reached by authors Sjef Ederveen, Henri L.F. Groot and Richard Nahuis, who state that the benefits of funds allocated by the European Union are conditioned by the efficiency of the institutional system in the member state. (Ederveen, Groot, & Nahuis, 2002) The importance of the institutional system is also highlighted in a paper published in 2025 that analyzes the volume of funds absorbed at the level of Bihor County. (Moş, Nicula, & Alboi, 2025) Other authors condition the positive effects on the quality of the selected projects, practically emphasizing the system of institutions that manage European investment programs. (Becker, Egger și Ehrlich 2018) Other researchers considers that the impact generated is dependent on the value of the non-refundable financial aid received. (Šelebaj & Bule, 2021)

During the literature review process, we also identified a number of authors who argue that grants allocated to private beneficiaries do not have a notable impact on economic development. In an article published in 2001, Frank Barry, John Bradley and Aoife Hannan argued that only grants allocated to public infrastructure projects led to sustained economic growth. (Barry, Bradley & Hannan 2001). A similar prioritization of public projects appears in a study published in 2025, which analyzes 10 countries in Central and Eastern Europe. (Moldovan, 2025) A similar view is expressed in an article published in 2013, which finds that private enterprises tend to behave irrationally when it comes to accessing non-reimbursable funds, proposing projects that aim to maximize the value of the subsidy, rather than responding to a real need of the enterprise. (Jureviciene & Pileckaitė, 2013) In 2025, another study highlighted a similar conclusion, identifying companies that, after implementing projects with non-reimbursable financing, recorded decreases in productivity. (Millot, Rawdanowicz, Sauvage, & Lieshout, 2025) In an article published in 2023, László Kállay and Tibor Takács found that only 10% of companies that benefited from European funds recorded notable improvements in performance indicators. (Kállay

& Takács, 2023) A 2013 study on primary sector enterprises found that only in certain countries did European subsidies have a positive impact on economic productivity. (Rizov, Pokrivcak, & Ciaian, 2013) Similar results were reported in 2018, following a study on a data set from 213 EU regions from 2004-2014, with the authors highlighting mixed effects of investment subsidies. (Garrone, Emmers, Olper, & Swinnen, 2018) (Garrone, Emmers, Lee, Olper, & Swinnen, 2019) A study conducted in Latvia in 2018, by Konstantins Benkovskis, Olegs Tkacevs, and Naomitsu Yashiro, shows that European funds addressed to enterprises lead to an increase in turnover and the number of employees, also having an effect on productivity, but only in the short term. (Benkovskis, Tkacevs, & Yashiro, 2018) A similar study conducted on Czech firms, indicates that European subsidies for private investments have had an effect on increasing labor productivity, but no notable changes are observed in terms of production or implementation of new technologies, thus suggesting that the effects are limited and a rethinking of the project evaluation and selection process is necessary. (Dvouletý & Blažková, 2019) At the Romanian level, a study published in 2023, by Ana-Maria Opria, Lucian Roșu and Corneliu Iațu, analyzes, through econometric methods, the impact that European LEADER funding has on economic growth, concluding that there are limited effects on the economic growth, the most notable contributions are the creation of new jobs and supporting local businesses. (Opria, Roșu, & Iațu, 2023)

2. Study hypotheses and methodology

Given that there is no consensus in the scientific literature and that there are not many analyses conducted on companies that have benefited from non-reimbursable financial aid in Romania, we consider it appropriate to address this issue. In order to see what impact this support instrument has had on Romanian companies, we want to analyze several indicators based on their annual financial statements. In this study, we propose two hypotheses: *H1 Firms that benefited from non-refundable financial aid register higher profitability than firms that do not benefit from these support instruments. This hypothesis is based on the idea of the cost of capital, when a firm receives non-refundable financial aid, it practically has access to a much cheaper source of financing compared to the alternatives (bank credit, financial leasing, operational leasing, etc.). The lower cost of capital should ensure higher profit rates. H2 Firms that benefited from non-refundable financial aid have a more stable balance sheet structure; This hypothesis also is based on the idea of the reduced cost of financing, which should lead to much greater balance sheet stability.* To test the two hypotheses, we propose to analyze a series of companies that have benefited from non-reimbursable financing for investments, comparing their financial results with those of a control group, consisting of companies that did not benefit from this facility. An important problem for this analysis is represented by possible interferences, when it comes to profitability or balance sheet structure the field of activity of a company can have a great impact, certain sectors of activity tend to register, inherently, higher profitability or require larger investments in assets. Thus, to test the defined hypotheses, we chose a financing line within which only several CAEN codes are eligible and the effect of interferences is minimal. The financing line on which we did the present study is sub measure 4.1 "Investments in agricultural holdings" from the National Rural Development Program 2014-2020 (financed by the European Union through the Common Agricultural Policy), which is mainly

addressed to companies operating in the primary sector. In order to build our groups of companies that we will analyze, we consulted the selection reports for this sub-measure (from the website of the - Agency for Financing Rural Investment www.afir.ro) from the 2015 session (we chose the first session, because we want to have as long a time horizon as possible for the analysis) and we identified 313 projects that were eligible and selected for financing and 227 ineligible, withdrawn or projects that were not selected for financing. From the total of these projects, we eliminated those promoted by entities without legal personality (PFA, II, IF) because they keep simpler accounting records that do not require annual financial statements (Balance Sheet, Profit and Loss Account, etc.). Of the total of 540 projects identified in the selection reports, 261 were promoted by entities with legal personality, which prepare annual financial statements, 170 with projects selected for financing (these companies will constitute Group 1) and 91 with ineligible, withdrawn or projects that were not selected for financing (these enterprises will constitute Group 2 - the control group).

After building the groups of enterprises that we are going to analyze, we proceeded to build a database with their annual financial statements centralizing public data from the website of the Ministry of Finance of Ramania (www.mfinante.gov.ro) and the National Trade Register Office of Romania (https://www.onrc.ro) for the period 2010-2024. The call for projects was in 2015, so our analysis focused on the period 2016-2024, but to ensure that the two groups of enterprises are comparable and the differences that would be identified can be attributed to non-reimbursable financing, we used a difference-in-difference approach, thus we calculated the six indicators defined below for the period 2010-2015 (the pre-project period) for the two groups of enterprises. For the pre-project period no statistically, representative differences were identified. Another factor that could affect our results is the case of enterprises that win a project, but for various reasons do not implement it, so we analyzed the evolution of fixed assets for enterprises in group 1, to ensure that the investment project was successfully implemented, 91 enterprises were eliminated because the evolution of their assets was not in accordance with the value of the selected project. Extreme values were eliminated from the data series using the interquartile range (IQR) method, using a coefficient of 1.5, so that the data series subjected to analysis presented a normal distribution. (Pintilescu, 2022)

3. Case Study

To test hypothesis H1, we will comparatively analyze a series of profitability indicators on the two groups of enterprises: net profit margin = net profit/turnover x 100, return on equity = net profit/equity x 100 and return on assets = net profit/total assets x 100. To test hypothesis H2, we will analyze a series of three solvency and balance sheet structure indicators: global debt ratio = total debt/total assets x 100, equity solvency = equity/total assets x 100 and financial leverage = total debt/equity; (Tabără, Horomnea, & Toma, 2005)

3.1. Net Profit Margin

The first indicator that we will analyze is the Net Profit Rate, this being a key indicator used in describing the profitability of a company. Practically, in order to validate the H1 hypothesis, the values of this indicator obtained for the companies in group 1 should be significantly higher than those obtained for the companies in group 2 (the control group). After determining the quartiles, respectively the interquartile distance, we proceeded to eliminate the extreme values. We then proceeded to perform an

analysis of the obtained data series. As we can see in Figure 1, the series has a normal distribution, the average being 17.266%, most of the values being positive. It is worth noting that from the analysis of the graphic representation we find that there are also enterprises that recorded losses during the analyzed period. We would be tempted to believe that not only the enterprises that did not benefit from investment subsidies could record losses, but from the analysis of the comparative graph we find that both groups have recorded negative values (Figure 1 - right).

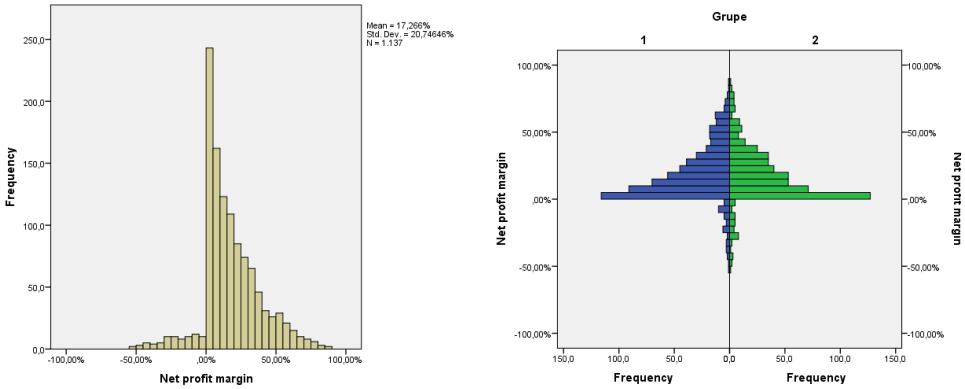


Figure *1* – Distribution of Values by subgroups Net profit margin
Source: author's calculations based on data from www.mfinante.gov.ro

From the graphical analysis we find that the two distributions have similar shapes, which would suggest that there are no notable differences between the groups. Determining the arithmetic means for the two groups we find that group 1 has an average value of 18.0354%, and group 2 16.4062%, the difference between the groups being only 1.6292 percentage points. Group 1 registers a higher value than group 2, but the difference is quite small, to test whether the difference is statistically representative, we applied an independent sample t test using the SPSS program (Table 1).

Tabel 1 – Independent sample t test - Net profit margin

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Net profit margin	Equal variances assumed	,171	0,679	1,322	1135	0,186	1,62923%	1,23202%	-0,78807%	4,04652%
	Equal variances not assumed			1,323	1122,072	0,186	1,62923%	1,23177%	-0,78760%	4,04605%

Source: author's calculations based on data from www.mfinante.gov.ro

The test results indicate that the difference between the groups is not statistically representative Sig. <0.05 (Table 1). The period that we analyzed was 2016-2024, in order to have a broad picture, we repeated the analysis on two sub-periods 2016-2020 and 2021-2024 to see if there are differences, the first period for short effects

and the second for medium term effects. The results obtained for these sub-periods are similar, in the short-term, group 1 registers a higher profit margin by 1.8268 percentage points, and in the medium-term, group 1 has an average value higher by 2.4714 percentage points, in both cases the difference were not representative according to the performed t-tests. So, from the perspective of this indicator, the stated hypothesis is partially confirmed, companies that benefit from non-refundable financial aid register a slightly higher profitability, but further analysis are needed.

3.2. Return on equity

The second indicator we analyzed in this study was Return on equity. Similar to the previous indicator, we would expect that the companies in group 1, which benefited from non-refundable financial aid, would register higher values than the control group. After determining the quartiles, we proceeded to eliminate the extreme values, obtaining a series of data with a normal distribution (Figure 2), which will allow us to apply several statistical tests. In the case of this indicator, we note that negative values are also recorded, even for the group of companies that benefited from non-refundable financial aid. The arithmetic mean of the global series is 27.485%, and from the graphic analysis of the shape of the two distributions, we note that there are differences, within group 1 there tend to be fewer companies with values in the 0%-5% range (Figure 2).

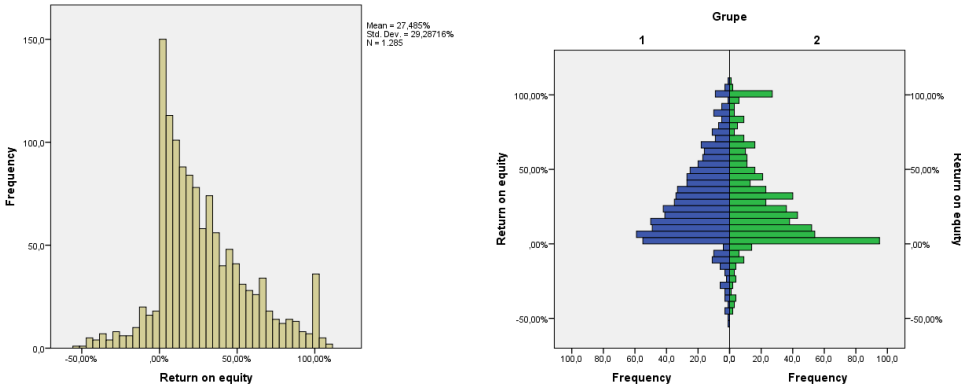


Figure *2* – Distribution of Values by subgroups Return on equity
Source: author's calculations based on data from www.mfinante.gov.ro

Continuing the analysis by subsets, for group 1 we obtained an average value of 28.1930%, and for group 2 (the control group) an average value of 26.6238%. We thus observe that the value for group 1 is higher than the value for the control group, but the difference is again small, only 1.6692 percentage points. In order to be able to decide on the first hypothesis of this study, we proceeded to apply an independent sample t test using the SPSS to see whether the difference between the means of the two groups is statistically representative or not.

Tabel 2 – Independent sample t test - Return on equity

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Return on equity	Equal variances assumed	1,668	0,197	1,021	1283	0,307	1,66927%	1,63482%	-1,53795%	4,87648%
	Equal variances not assumed			1,019	1260,965	0,308	1,66927%	1,63840%	-1,54502%	4,88355%

Source: author's calculations based on data from www.mfinante.gov.ro

The test results (Table 2) indicate that the difference is not statistically representative (Sig. >0.05). A similar analysis was also conducted on sub-periods 2016-2020 to test for short-term effects and 2021-2024 to test for medium-term effects. The results we obtained are similar to those of the period 2016-2024, in both cases group 1 registered a higher value of 1.3326 percentage points, respectively 2.4189 percentage points, but the t-tests did not indicate a statistically representative difference, thus we partially accept hypothesis H1.

3.3. Return on assets

The third indicator that we analyzed in order to test hypothesis H1 was Return on assets. And in this case, for the hypothesis H1 to be accepted, the companies in group 1 should register values higher than the control group, and the difference between the groups should be statistically representative. In accordance with the established working methodology, we proceeded to determine the quartiles and subsequently eliminate the extreme values, using the interquartile distance method with a coefficient of 1.5, thus obtaining a series with a normal distribution. The average value at the level of both groups is 6.0521%. From the perspective of the graphical analysis of the distributions between the two groups of companies, we did not observe notable differences (Figure 3). Subsequently, we proceeded to calculate the averages for the data subsets, thus for group 1 we obtained an average value of 6.2076%, and for the control group 5.8733%.

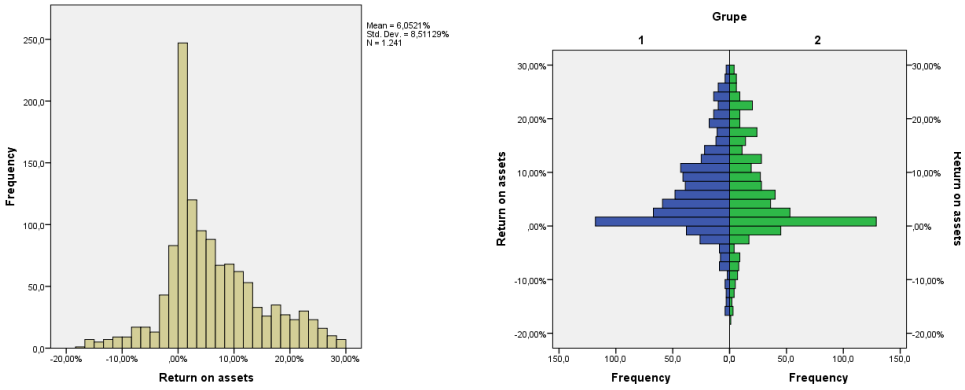


Figure *3* – Distribution of Values by Subgroups Return on assets
Source: author's calculations based on data from www.mfinante.gov.ro

In the case of this indicator too, we find that the analyzed group has a higher value than the control group, but the difference is only 0.3343 percentage points. We then proceeded to apply a comparison of means test, to see if the difference is statistically representative (Table 3).

Tabel 3 – Independent sample t test - Return on assets

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Return on assets	Equal variances assumed	3,258	0,071	,690	1239	0,490	0,33433%	0,48451%	-0,61622%	1,28488%
	Equal variances not assumed			,687	1188,950	0,492	0,33433%	0,48672%	-0,62060%	1,28926%

Source: author's calculations based on data from www.mfinante.gov.ro

Additionally, we also conducted a test on sub-periods in order to see if there are any short-term or medium-term effects. For the period 2016-2020 the difference between the groups is 0,4% (similar the previous result) but for the 2021-2024 period, group 1 has a return on assets greater with 1,278%, so the difference in the medium term is slightly higher than in the short term. For both the subperiods the results of the t test did not identify any representative differences between the two groups). The results for this indicator partially confirm the first hypothesis of this study, the differences between the means of the two groups are under 0,5% in the short term and not statistically representative, but the differences seem to change in the mid term period that we analyzed

3.4. Gearing ratio

To test the second hypothesis of this study, we proceeded to analyze a set of balance sheet structure indicators, the first of which was the gearing ratio. Given that the companies that benefited from projects received investment subsidies, we would expect to observe lower values of this indicator, compared to the control group. According to the established working methodology, we proceeded to calculate the quartiles, the interquartile distance and then to eliminate the extreme values, obtaining a series with a normal distribution and an average value of 47.5047%. Dividing the series into the two analyzed groups, we find even from the analysis of the histograms that there are notable differences between them (Figure 4 - right). The average for group 1 is 44.7962%, and for group 2 50.5712%. The fact that at the companies that benefited from non-refundable financial aid, the Gearing ratio is lower by 5.775 percentage points would lead us to the conclusion that the hypothesis is confirmed.

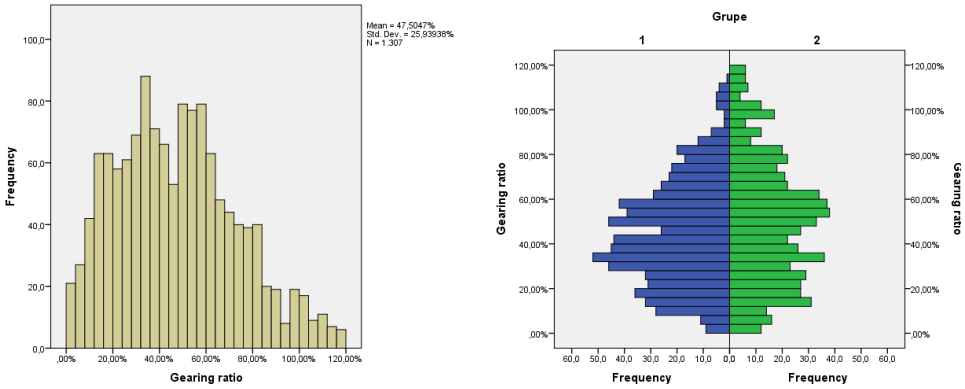


Figure *4* – Distribution of Values by subgroups Gearing ratio
Source: author's calculations based on data from www.mfinante.gov.ro

Next, we proceeded to apply an independent sample t test using SPSS to see if the difference is statistically representative.

Tabel 4 – Independent sample t test - Gearing ratio

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Gearing ratio	Equal variances assumed	20,967	0,000	-4,040	1305	0,000	-5,77496%	1,42940%	-8,57914%	-2,97078%
	Equal variances not assumed			-3,996	1198,072	0,000	-5,77496%	1,44516%	-8,61028%	-2,93964%

Source: author's calculations based on data from www.mfinante.gov.ro

The difference between means of 5.775 percentage points is statistically representative (Sig.<0.05) (Table 4). To see if the difference manifests itself differently in time, we proceeded to the analysis two subperiods 2016-2020 and 2021-2024. The results obtained show us that the difference is representative only in the short term, for the second period 2021-2024 the difference between the groups is only 1.8816 percentage points and it no longer is statistically representative, which would lead us to validate hypothesis H2 of the study, there is a clear positive effect only in the short-term.

3.5. Solvency Equity

The second balance sheet stability indicator that we analyzed was Solvency Equity. After determining the quartiles and eliminating extreme values, we obtain a normal distribution. From the graphical representation of the values, we find that the shapes of the two histograms are different, which indicates that there are differences between the values of the two sub-groups (Figure 5).

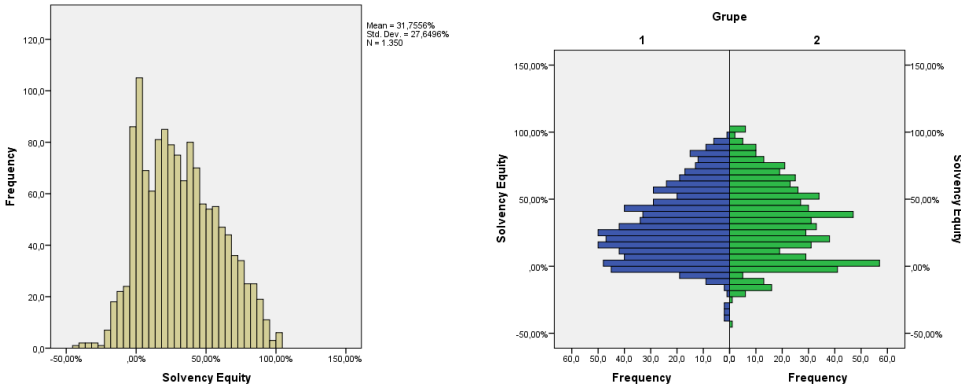


Figure *5* – Distribution of Values by Solvency Equity Subgroups
Source: author's calculations based on data from www.mfinante.gov.ro

We then proceeded to determine the average values, for group 1 30.3890%, and for group 2 33.2361%. The difference between groups of 2.8471 percentage points. In order to be able to definitively decide on hypothesis H2, we proceeded to apply an independent sample t test, using the SPSS (Table 5), to see if the difference is statistically representative or not.

Tabel 5 – Independent sample t test - Solvency Equity

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Solvency Equity	Equal variances assumed	7,425	0,007	-1,892	1348	0,059	-2,84719%	1,50482%	-5,79923%	0,10486%
	Equal variances not assumed			-1,886	1313,431	0,060	-2,84719%	1,50980%	-5,80906%	0,11469%

Source: author's calculations based on data from www.mfinante.gov.ro

However, the test results indicate that the difference is not representative (Sig.>0.05). In order to see if the effect manifests itself differently over time, we performed similar analyses on two subperiods 2016-2020 and 2021-2026 to see if there are differences in the short or medium term. For the first sub-period, the difference between the groups is 4.2638 percentage points in favor of the control group, the difference being representative according the the t-test, and in the medium-term the difference between the groups is 1.8434 percentage points, the t-test indicating it as unrepresentative, so from the perspective of this indicator, hypothesis H2 is not validated, in the short-term the companies that have benefited from European projects have a decrease in solvency, but the difference decreases in the medium term.

3.6. Financial Leverage

The last balance sheet stability indicator analyzed is financial leverage, given that investment subsidies ensure a capital infusion at the level of beneficiary companies, we should observe differences at the level of the two analyzed groups.

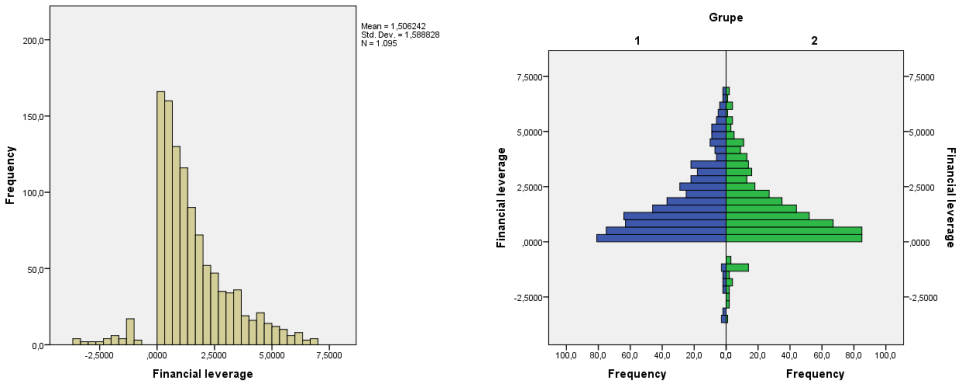


Figure *6* – Distribution of Values by Financial Leverage Subgroups
Source: author's calculations based on data from www.mfinante.gov.ro

After eliminating the extreme values using the interquartile method, we proceeded to the comparative analysis of the two groups of companies (Figure 6). For the group of companies that have received non-refundable financial aid, we obtained an average value of 1,629928, and for the companies in the control group, which did not receive investment subsidies, an average value of 1,378655, the difference between the groups is notable (18,23%).

Tabel 6 – Independent sample t test - Financial Leverage

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Financial leverage	Equal variances assumed	1,699	,193	2,623	1093	0,009	0,2512735	0,0957829	0,0633345	0,4392126
	Equal variances not assumed			2,625	1092,794	0,009	0,2512735	0,0957162	0,0634651	0,4390819

Source: author's calculations based on data from www.mfinante.gov.ro

The difference between the groups is statistically representative, as indicated by the independent sample t test (Table 6), the Sig. value being below the 0.05 threshold. The financial leverage values indicate that both groups of enterprises predominantly use borrowed capital to finance their activities, with values exceeding 1. The higher level of financial leverage obtained by companies in group 1 indicates that they are more financially exposed, assuming greater risks compared to companies in group 2. This situation can be explained by the fact that the projects involve a percentage of private co-financing (between 15% and 50% of the project value depending on the size of the enterprise), which is most frequently obtained from bank loans. Analyzing the two subperiods 2016-2020 and 2021-2024, we find that the difference between the groups is representative only in the short term, in the medium term the difference between the groups is on average smaller, not being classified as representative according of the t-tests. Thus, from the perspective of this indicator, hypothesis H2 is rejected, the companies that benefit from projects with non-

reimbursable financing being exposed to a higher financial risk than the companies in the control group.

4. Conclusions

Following the analyses and tests applied, we can conclude that Hypothesis H1 is partially validated, in the case of all profitability indicators that we analyzed the companies from group 1 tended to record higher values of profitability, but the differences were not statistically representative according to the independent sample t test that we performed. In order to definitively validate the H1 Hypothesis we need to extend the volume of data that we considered.

Regarding the second hypothesis, stated in this study, we can conclude that it is refuted, one of the three indicators that we analyzed presented clear positive influences in the short term, that can be attributed to the EU funded projects, but the other two indicator presented clear negative influences in the short term, the control group recorded a more stable balance sheet structure and less exposure to financial risks. This aspect could have several implications, on the one hand it could support the idea, stated by some authors, that private enterprises do not behave rationally when it comes to non-reimbursable financing, promoting over-sized and overvalued projects that meet the eligibility criteria rather than meeting the real needs of the company. On the other hand, the lack of a clear notable impact on profitability could be explained by the fact that non-reimbursable financing involves assuming certain commitments that generate additional costs (for example, creating and maintaining jobs, or respecting certain environmental conditions). The fact that these costs are not correctly assessed, indicates a poor quality of the project evaluation process, that is not oriented towards assessing the quality of the business plan but rather towards compliance with certain program result indicators.

The main limitation of this study is the volume of data considered, practically within this study we analyzed a single call for projects, the one from 2015 for the measure 4.1 of the PNDR 2014-2020, in the future we will proceed to expand the volume of data considered, analyzing subsequent sessions as well. Another limitation of this research is the exclusive reliance on t-tests, in future research we will try to incorporate a regression analysis with appropriate control variables.

Another aspect that we want to study in future research is the impact that European investment subsidies have on the productivity of beneficiary enterprises, which would allow us to have a broader picture of the changes that occur at the microeconomic level.

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IT'S NOT HOW MUCH, BUT HOW WELL: GOVERNMENT EFFECTIVENESS AND THE MACROECONOMIC IMPACT OF ALLOCATION, DISTRIBUTION, AND STABILIZATION FUNCTIONS IN OECD COUNTRIES

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Abstract: *This paper examines whether government effectiveness impacts macroeconomic effects of fiscal policies, using the three basic principles established by Musgrave (1959): allocation, distribution, and stabilization. The main question considered is why some states achieve good economic and social performance at modest rates of public expenditure while others fail to do so even with relatively higher expenses.*
The empirical part uses data from 15 OECD countries for the period 2010-2023 to classify states into three groups according to government effectiveness based on their Worldwide Governance Indicators WGI Government Effectiveness scores. The paper employs comparative descriptive approach combined with simple correlation analysis in order to find out the relationship between government effectiveness and macroeconomic variables such as income inequality (measured as Gini coefficient), GDP growth rate, and public expenditure allocations (using COFOG data).
The main results show that there is a strong relationship between government effectiveness and income inequality. States with higher government effectiveness demonstrate a much smaller Gini coefficient at 0.277 compared to 0.324 in the case of low government effectiveness. Despite better short-term GDP growth rates observed for low government effectiveness countries, this seems to be a consequence of a catch-up effect and is characterized by increased volatility. By contrast, higher government effectiveness is linked to more stable economic performance and better resource allocation (especially in healthcare and education).
The research adds to the literature by combining Musgrave's fiscal principles with government effectiveness measures and suggests a new concept, called Fiscal Effectiveness Score, as a way to improve the existing framework that solely focuses on expenditures. This means that improvement in institutions might be more valuable than an increase in government expenditure when it comes to economic and social benefits.

Keywords: *Government effectiveness; Musgrave functions; fiscal policy; OECD countries; institutional quality; WGI*

JEL Classification: *H50; E62; O43*

1. Introduction

This paper seeks to explore the issue of why some countries achieve high standards in terms of macroeconomic performance with moderate levels of public spending while others struggle despite high levels of spending. Sweden and Italy are two countries whose economic performance presents a paradox. According to OECD data (2024), Sweden spends about 45% of its GDP on public services and has consistently recorded high standards in terms of equality and economic stability. On the other hand, Italy spends almost 50% of its GDP on public spending while struggling with high levels of inequality, economic instability, and stagnation.

The main argument presented in this paper is that the factor to consider is not the amount spent but how efficiently these core functions are carried out.

The theoretical foundation of this study rests on Musgrave's (1959) seminal framework of public finance. Musgrave identified three fundamental functions of government: allocation (providing public goods such as infrastructure, education, and health), distribution (reducing income inequality through transfers and progressive taxation), and stabilization (maintaining economic stability through fiscal and monetary policy). These three functions remain the standard lens through which economists evaluate government performance (Stiglitz, 2000; Rosen and Gayer, 2014).

It is noted that the quality of government performance differs significantly across various countries. Kaufmann et al. (2010) developed Worldwide Governance Indicators (WGI) that measure six dimensions of governance, including Government Effectiveness. This dimension is based on the perceptions of the quality of public services, civil service, policy formulation, and policy implementation (World Bank, 2024). Empirical studies have shown that government effectiveness is positively related to economic growth, human development, and institutional quality (Rothstein, 2011; Fukuyama, 2013).

Of great importance is the fact that despite an extensive body of literature concerning public spending and governance individually, no previous studies have attempted to combine Musgrave's classification theory with the effectiveness ratings in the Worldwide Governance Indicators to investigate performance differences across countries. The convergence literature has shown considerable differences in performance between Nordic and Mediterranean countries in the OECD (Aghion et al., 2019; Blanchard & Giavazzi, 2003) however, previous literature has not considered governance implementation effectiveness as a factor behind such differences.

This study addresses the following research question: Does government effectiveness moderate the macroeconomic impact of allocation, distribution, and stabilization functions in OECD countries? Using panel data from 15 OECD countries covering the period 2010-2023, we classify nations into three groups based on their WGI Government Effectiveness scores. The High Effectiveness group includes Denmark, Finland, Netherlands, Norway and Sweden. The Medium Effectiveness group comprises France, Germany, Portugal, Spain and the United Kingdom. The Low Effectiveness group consists of Greece, Hungary, Italy, Poland and Turkey.

Based on Musgrave's (1959) framework, we test three hypotheses. Hypothesis 1 (H1) states that government effectiveness positively influences allocation function outcomes measured by public spending efficiency. Hypothesis 2 (H2) proposes that government effectiveness enhances distribution function outcomes reflected in

reduced income inequality. Hypothesis 3 (H3) asserts that government effectiveness improves stabilization function outcomes indicated by reduced output volatility.

This paper makes three novel contributions to the literature. First, we provide empirical evidence that high-effectiveness countries achieve significantly lower income inequality with a Gini coefficient of 0.277 compared to low-effectiveness countries with a Gini coefficient of 0.324. Second, we explain the Nordic-Mediterranean performance gap by demonstrating that Sweden (WGI: 1.69) outperforms Italy (WGI: 0.85) across all three Musgravian functions despite similar or lower spending levels (OECD, 2024). Third, we propose a Fiscal Effectiveness Score as an alternative to traditional spending-based metrics for EU policy coordination, building on recommendations from the European Fiscal Board (2023).

The rest of this paper is structured as follows. Section 2 discusses the pertinent literature in terms of Musgrave functions, quality of governance, and fiscal convergence. Section 3 describes the data and methodologies used in the paper. Section 4 discusses the empirical results. Section 5 discusses the implications of the paper. Finally, Section 6 concludes the paper with suggestions for further research.

2. Literature Review

This section analyzes the key strands of literature pertinent to this study, notably Musgrave's theory of public finance, the idea of government effectiveness as evaluated by the Worldwide Governance Indicators (WGI), and empirical studies on fiscal performance across OECD countries.

2.1. Musgrave's Three Functions of Government

By emphasizing three fundamental functions of government: allocation, distribution, and stabilization as the foundational principles for public finance, Musgrave (1959) established a system. The provision of public goods and services, such as infrastructure and education. Distribution functions are designed to decrease income inequality by introducing taxation and transfer mechanisms. The stabilization function is designed to ensure macroeconomic stability, which includes full employment and price stability.

Subsequent contributions have extended this framework. Information asymmetry plays essentially the role of some public sector performance as per Stiglitz (2000), while Rosen and Gayer (2014) describe modern applications such as social insurance and what it means to be in partnership with others. These studies primarily presume the efficient execution of government actions, without explicitly considering differences in quality of execution across countries.

2.2. Government Effectiveness and the WGI Framework

Kaufmann et al. (2010) created the Worldwide Governance Indicators (WGI) to measure institutional quality across different countries. There are six dimensions of Government Effectiveness: one that includes perceptions of the quality of public services and civil service performance, and a third dimension that covers policy implementation.

The correlation between higher government effectiveness and better development outcomes has been demonstrated through empirical research. Effective governments, as per Rothstein (2011), tend to have lower levels of corruption and greater social trust. State capacity is also a major factor in economic development,

Fukuyama (2013) said. Despite these findings, existing research does not differentiate between effectiveness and specific fiscal functions.

2.3. Fiscal Convergence and the Nordic-Mediterranean Gap

The literature on OECD countries' fiscal performance shows ongoing disparities, according to increasing evidence. According to Aghion et al. (2019) and Blanchard and Giavazzi (2003), the Northern and Southern European economies exhibit a performance gap that can be explained by various institutional and structural factors. However, most studies focus on expenditure levels, debt, and deficits, while overlooking the quality of fiscal implementation. The European Fiscal Board (2023) has emphasized the need for improved metrics that capture not only how much governments spend, but how effectively resources are used.

2.4. Research Gap and Contribution

The existing literature reveals an important gap. While public finance theory explains what governments should do, and governance literature explains how institutions function, few studies integrate these perspectives. To the best of our knowledge, this paper is among the first to combine Musgrave's functional framework with WGI Government Effectiveness indicators to analyze fiscal performance across countries. By doing so, it provides a more comprehensive understanding of how governance quality influences economic outcomes.

3. Methodology

This section describes the data sources, variable selection, country classification, and analytical approach used in this study.

3.1. Data Sources

This study utilizes secondary data from three main sources. First, government effectiveness scores are obtained from the Worldwide Governance Indicators (WGI) database published by the World Bank (2024). The WGI database provides annual governance estimates ranging from approximately -2.5 to +2.5, with higher values indicating better governance quality (Kaufmann, Kraay and Mastruzzi, 2010). Second, income inequality data measured by the Gini coefficient (disposable income) are extracted from the OECD Income Distribution Database (OECD, 2024). The Gini coefficient ranges from 0 to 1, where lower values indicate more equal income distribution. Third, economic growth data measured by annual GDP growth rates are obtained from the OECD National Accounts Database (OECD, 2024).

The sample period covers 2010 to 2023, providing 14 years of observations. This period was selected to ensure data availability for all variables across the selected countries while capturing post-global financial crisis dynamics and pre-and post-COVID-19 pandemic effects.

This study utilizes correlation and simple regression analysis to investigate the relationship between governmental efficacy and income inequality.

3.2. Country Selection and Classification

OECD member countries are included in this study based on data availability and representativeness of governance variation. Following the methodology of Kaufmann et al. (2010), countries are classified into three groups according to their 2023 Government Effectiveness scores from the WGI database (World Bank, 2024).

Table 1: Country Classification by Government Effectiveness (WGI 2023)

Group	WGI Score Range	Countries	Mean WGI Score
High Effectiveness	> 1.5	Denmark; Finland; Netherlands; Norway; Sweden	1.79
Medium Effectiveness	0.5 -1.5	France; Germany; Portugal; Spain; United Kingdom	1.14
Low Effectiveness	<0.5	Greece; Hungary; Italy; Poland; Turkey	0.44

Source of data: World Bank (2024) Worldwide Governance Indicators

This classification enables comparison of macroeconomic outcomes across distinct governance regimes while maintaining sufficient observations within each group.

3.3. Variables and Measurement

Three sets of variables are analyzed corresponding to Musgrave's (1959) three fiscal functions.

3.3.1. Distribution Function (Inequality)

The distribution function is measured using the Gini coefficient of disposable income after taxes and transfers (OECD, 2024). This indicator captures the extent of income inequality that government redistribution policies aim to address. Lower Gini values indicate more equal income distribution and thus more effective distribution function.

3.3.2. Stabilization Function (Growth)

The stabilization function is measured using annual real GDP growth rates expressed as percentage change from the previous year (OECD, 2024). GDP growth reflects the government's ability to maintain economic stability and promote macroeconomic performance. Higher and more stable growth rates indicate more effective stabilization function.

3.3.3. Allocation Function (Public Spending)

The allocation function is measured using general government expenditure by function (COFOG) across three categories: health, education, and economic affairs (OECD, 2024). These categories represent core public goods and services that governments provide. Expenditure levels are analyzed in national currency units at current prices.

3.4. Analytical Approach

The study adopts a comparative descriptive approach to examine differences across governance groups. Mean values for each variable are calculated for the most recent year (2023) to allow for direct comparison.

In addition, a simple correlation analysis is conducted to assess the relationship between government effectiveness and macroeconomic outcomes. This complementary approach provides further insight into the strength and direction of associations between governance quality and fiscal performance.

Group means are computed using the following formula:

(1) Group Mean = (Σ Value_i) / n

Where Value_i represents the indicator value for country i within the group, and n represents the number of countries in the group (n=5 for each group).

This comparative approach allows us to identify patterns and differences across governance regimes while acknowledging the descriptive nature of the findings. The small sample size (n=5 per group) precludes sophisticated econometric modeling but provides clear illustrative evidence of the relationship between government effectiveness and fiscal outcomes.

4. Results and Findings

This section presents the empirical findings of the study, structured according to Musgrave's three fiscal functions: distribution, stabilization, and allocation.

4.1. Distribution Function Results

The results reveal a clear relationship between government effectiveness and income inequality. Countries with high government effectiveness record significantly lower levels of inequality, with an average Gini coefficient of 0.277, compared to 0.321 for medium-effectiveness countries and 0.324 for low-effectiveness countries. This difference suggests that more effective governments are better able to design and implement redistributive policies, including taxation and social transfers, thereby achieving more equitable income distribution.

Table 1: Gini Coefficients by Governance Group (2023)

Governance Group	Mean Gini Coefficient
High Effectiveness	0.277
Medium Effectiveness	0.321
Low Effectiveness	0.324

Source of data: OECD (2024), Income Distribution Database (2024)

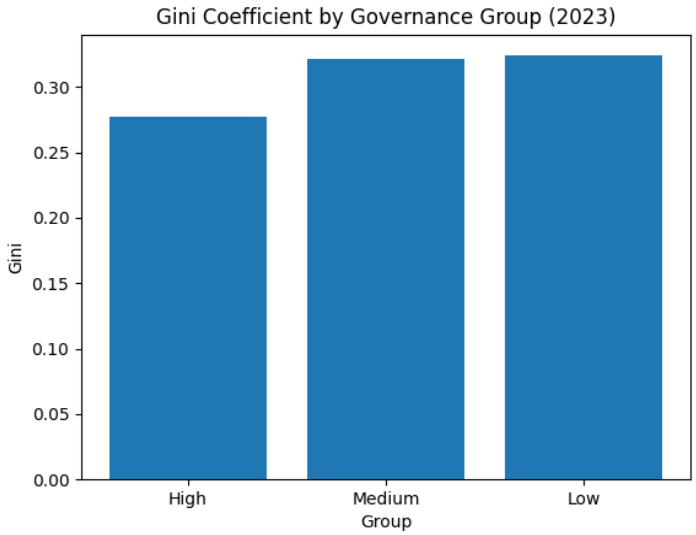


Figure 1: Gini Coefficient by Governance Group (2023)
Source of data: OECD (2024)

As shown in Figure 1, the High Effectiveness group exhibits the lowest income inequality (Gini: 0.277), while the Low Effectiveness group shows the highest inequality (Gini: 0.324). The difference between High and Low groups is 0.047, representing approximately 15 percent higher inequality in low-governance countries. This finding supports Hypothesis H2 that government effectiveness enhances distribution function outcomes.

4.2. Stabilization Function Results

Table 2: GDP Growth Rates by Governance Group (2023)

Governance Group	Mean GDP Growth (%)
High Effectiveness	-0.15
Medium Effectiveness	1.28
Low Effectiveness	1.51

Source of data: OECD National Accounts Database (2024)

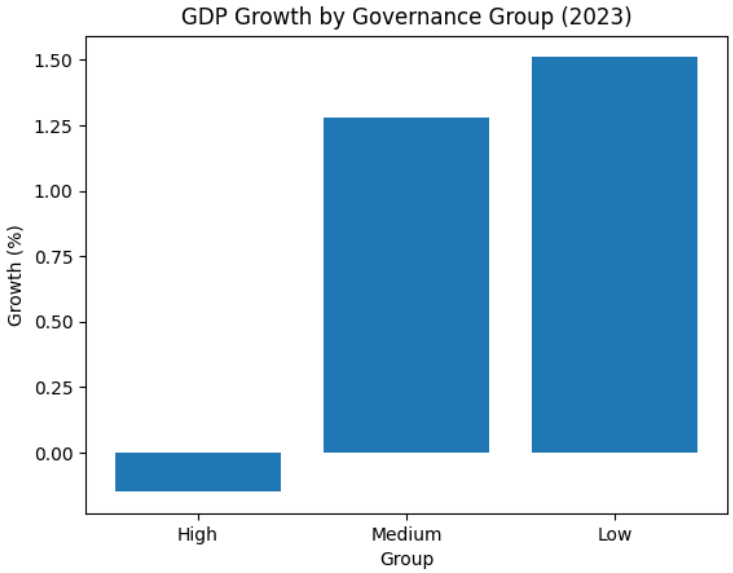


Figure 2: GDP Growth by Governance Group (2023)
Source of data: OECD (2024)

The results for economic growth present a more complex pattern. Low-effectiveness countries exhibit the highest average GDP growth rate (1.51%), followed by medium-effectiveness countries (1.28%), while high-effectiveness countries show slightly negative growth (-0.15%).
However, this finding should be interpreted with caution. The higher growth observed in low-effectiveness countries may reflect catch-up dynamics rather than superior economic performance. These economies often grow faster due to structural adjustments but tend to experience greater volatility.

In contrast, high-effectiveness countries appear to prioritize economic stability over short-term growth maximization, which is consistent with the objectives of the stabilization function.

4.3. Allocation Function Results

The allocation function is measured using general government expenditure on health, education, and economic affairs (infrastructure) as a percentage of GDP, based on COFOG data from OECD (2024).

Table 3: Government Expenditure by Function (% of GDP) by Governance Group (2023)

Group	Health (% GDP)	Education (% GDP)	Economic Affairs (% GDP)
High	8.0%	5.9%	4.9%
Medium	8.1%	4.8%	5.6%
Low	5.5%	4.4%	7.3%

Source of data: OECD (2024), COFOG Database (2024) and OECD (2024) National Accounts

The results reveal three important patterns. First, High and Medium effectiveness countries allocate significantly more resources to health (8.0-8.1 percent of GDP) compared to Low effectiveness countries (5.5 percent). Second, education spending follows a similar pattern, with High effectiveness countries investing 5.9 percent of GDP compared to 4.4 percent for Low effectiveness countries. Third, Economic affairs spending shows an inverse pattern, where Low effectiveness countries spend more (7.3 percent) than High effectiveness countries (4.9 percent).
This third finding suggests that countries with weak governance may require larger infrastructure investments to achieve comparable outcomes, reflecting inefficiency in implementation. These results support Hypothesis H1: government effectiveness positively influences allocation function outcomes, particularly in health and education sectors.

4.4. Correlation Analysis

Table 1: Correlation Matrix

	WGI	***Gini***	***GDP Growth***
WGI	1.00		
Gini	-0.62	1.00	
GDP Growth	-0.64	0.70	1.00

Source of data: World Bank (2024); OECD (2024)
The correlation results show a strong negative relatinship between government effectiveness and income inequality (-0.62). This means that higher levels of effectiveness are linked to lower Gini coefficients.

4.5. Regression Analysis

The regression results are reported in Table 2.

Table 2: Regression Results

Dependent Variable: Gini

Variable	Coefficient
Constant	0.3546
Government Effectiveness	-0.0523

Source of data: World Bank (2024); OECD (2024)
R-squared 0.985

The regression results show that government effectiveness has a strong negative effect on income inequality. In particular, a one-unit rise in government effectiveness correlates with a reduction of about 0.052 in the Gini coefficient. The high R-squared value (0.985) means that government effectiveness is a big part of why income inequality is so different across the sample.

4.6. The Sweden-Italy Comparison

Table 3 compares Sweden (High Effectiveness) and Italy (Low Effectiveness), two countries with similar spending levels but divergent outcomes.

Table 3: Sweden vs Italy Comparison (2023)

Indicator	Sweden	Italy
Government Effectiveness (WGI)	1.69	0.85
Gini Coefficient	0.289	0.325
GDP Growth (%)	-0.20	0.92

Source of data: World Bank (2024); OECD (2024)

A comparison between Sweden and Italy illustrates the central argument of the paper. Despite similar levels of public spending, Sweden achieves better outcomes in terms of income equality and overall fiscal performance. This case highlights that the effectiveness of policy implementation is more important than the level of expenditure itself.

4.7. Summary of Findings

Three main findings emerge from the analysis. First, high government effectiveness is associated with lower income inequality across OECD countries. Second, the relationship between effectiveness and growth is less clear, with low-effectiveness countries showing higher growth but potentially greater volatility. Third, the Sweden-Italy comparison demonstrates that spending levels alone do not determine fiscal outcomes; execution quality matters decisively.

5. DISCUSSION:

This section discusses the implications of the findings in relation to theory, empirical evidence, and policy design.

5.1. Government Effectiveness and Income Inequality

The outcomes suggest that countries with better government functioning exhibit lower income disparity. This finding supports the contention that good institutions help to design and implement redistributive policies. High effectiveness nations tend to have more progressive tax systems that are more geared towards social transfers, which helps to decrease inequality. On the other hand, low-effectiveness countries may experience difficulties with redistribution due to administrative inefficiencies, public funds being leaked, or weak policy enforcement. The conclusion aligns with previous investigations that have indicated the crucial role of institutional quality in determining social outcomes.

5.2. Government Effectiveness and Economic Growth.

It is not so obvious that government effectiveness can affect economic growth. Low effectiveness countries have higher growth rates, but this should not be interpreted as evidence of better performance.

These countries may be experiencing catch-up growth, as economies continue to grow at a faster rate as they approach higher income levels. However, this surge is commonly linked to increased volatility and macroeconomic fluctuations. Conversely, countries with high effectiveness prioritize long-term stability over short-year growth. Their economic policies are more predictable and effective, leading to lower volatility and more sustainable development.

5.3. The Efficiency of Governments and Public Spending.

According to the findings concerning the allocation function, government effectiveness plays a significant role in shaping public resources. Health and education, which are closely tied to human capital development and long-term growth, receive more funding from high countries of high effectiveness.

On the flip side, countries with low effectiveness allocate more resources to economic activities, particularly infrastructure. It could indicate inefficiencies, requiring increased spending to compensate for weak implementation capacity or governance issues. The outcomes reinforce the notion that public spending is not solely determined by its magnitude but also by the effectiveness of its management.

5.4. Policy Implications

The findings of this study have important implications for economic policy. Traditional fiscal indicators, such as total public spending or budget deficits, provide only a partial picture of government performance. This paper suggests that policymakers should focus more on improving institutional quality and governance effectiveness. Enhancing transparency, accountability, and administrative capacity can significantly improve the outcomes of fiscal policy.

The proposed Fiscal Effectiveness Score represents a step in this direction, as it emphasizes the importance of measuring how well governments use their resources rather than how much they spend.

The results of this study align with the current empirical literature. For instance, Rothstein (2011) discovers that higher quality institutions correlate with diminished inequality and enhanced social outcomes. Aghion et al. (2019) similarly emphasize the significance of institutional quality in elucidating variations in economic performance among nations. This study builds on earlier research by directly connecting government effectiveness to Musgrave's three fiscal functions, offering a more comprehensive insight into the impact of governance on fiscal results.

6. Conclusions

This paper examines the relationship between fiscal policy effectiveness and macroeconomic performance in OECD countries. Using governance indicators alongside Musgrave's framework enhances our understanding of fiscal performance. The results suggest that countries with more effective government systems tend to have lower income inequality and more efficient allocation of public resources. In nations with lower effectiveness, short-term growth may be comparatively higher, but this is often associated with greater economic instability and volatility.

The primary outcome of this investigation is that the impact on policy effectiveness is more important than public spending. Policymakers may therefore find that they achieve more positive outcomes from institutional reforms focused on improving governance quality than from increasing expenditure alone in terms of economic and social benefits.

However, several limitations should be acknowledged. Firstly, the small sample size (15 countries) limits the generalisability to non-OECD countries. Secondly, the descriptive approach cannot establish causal relationships between government effectiveness and fiscal outcomes. Thirdly, constraints on data availability prevent the inclusion of additional control variables, such as demographic factors or political institutions. Fourthly, COFOG expenditure data are presented in national currency units, limiting cross-country comparability without conversion to purchasing power parity or percentage of GDP.

Future research using a larger sample of countries is recommended to expand upon this analysis using econometric methods to examine the causal relationship between governance and fiscal outcomes.

In conclusion, this paper demonstrates that macroeconomic success is determined by how well governments execute their functions, rather than how much they spend. For policymakers, this implies that institutional reforms may offer a better return on investment than additional budget allocations.

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THE DYNAMICS OF MULTILINGUALISM IN THE EUROPEAN UNION: EVIDENCE FROM EUROBAROMETER SURVEYS

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Abstract: *This study examines the evolution of multilingualism in the European Union using data from the three waves of the European Commission's Europeans and their Languages survey conducted in 2005, 2012 and 2024. The surveys provide representative, self-reported data and use a largely comparable set of questions across waves, making it possible to analyse changes in multilingualism over time. The study adopts a repeated cross-sectional design and combines descriptive and regression-based analysis to examine the overall trends in multilingualism and its distribution across socio-demographic groups. In addition to documenting changes in the proportion of respondents who report speaking at least one, two or three foreign languages, the paper investigates the persistence of language inequalities across age, education, and occupational groups, with particular attention to younger cohorts. The results show that multilingualism increased in the European Union over the period under review, although the pace of growth slowed in the later period. At the same time, substantial inequalities in language skills persist and have changed only modestly over time. Higher levels of education and more advantaged occupational positions are consistently associated with better language outcomes, while generational differences appear to have narrowed modestly. Overall, the findings largely confirm the main patterns identified in the existing literature, while also providing updated evidence based on recent EU-wide survey data. The findings suggest that the progress in multilingualism has been uneven and that improvements in overall language proficiency have not eliminated persistent social disparities. By drawing on high-quality EU survey data, this study contributes to the literature by offering an updated comparative perspective on the development of multilingualism and its social stratification within the European Union.*

Keywords: *economics of languages; multilingualism; foreign language proficiency*

JEL Classification: *Z13; O52*

1. Introduction

Multilingualism has long been regarded as one of the European Union's core values and a major policy priority, dating back to the beginnings of European integration. One of its central aims has been to enable citizens to participate fully in European public life in their mother tongue while also developing proficiency in foreign languages and safeguarding linguistic diversity (European Commission, 2026a). The European Union represents a unique linguistic space, characterised by an exceptional concentration of languages within a single political and economic

framework (Romaine, 2013). In addition to its current 24 official languages, more than 60 regional or minority languages are also present (European Commission, 2026b).

At the same time, EU multilingualism policy has long embodied a dual logic, in which multilingualism appears both as a normative value and as an economic resource (Dendrinos, 2018). The literature has pointed out that this duality creates ambiguity in EU language policy, generating tensions in both the design and implementation of relevant strategies (Leech, 2017; Dendrinos, 2018). Despite the formal equality of languages, the literature has extensively documented the presence of linguistic hierarchies within the European Union (Els, 2005). Although there are 24 official languages with equal formal status, English, French, and German enjoy a clear predominance (Dendrinos, 2018). The distinction between working languages and official languages has tried to make it easier to manage linguistic issues within the Union (Marácz–Adamo, 2017). Sayers and Láncos (2017) describe this as a multilevel language hierarchy, in which certain languages have acquired a privileged status. Within this system, the dominance of English is especially evident, pointing in a direction that runs counter to the EU's declared objective of multilingualism. Romaine (2013) interprets this phenomenon as hegemonic multilingualism, referring to the persistence of hierarchical relations alongside linguistic diversity.

At the same time, the extent to which multilingualism has expanded across the EU population remains an empirical question, particularly when differences between social groups are also taken into account. This study examines the development of multilingualism in the European Union using data from the 2005, 2012 and 2024 waves of the Eurobarometer survey Europeans and their languages (European Commission, 2012a; 2012b; European Commission and European Parliament, 2025). It investigates not only broad trends in multilingualism, but also how language proficiency has evolved across different social groups. In doing so, the study contributes to the literature by providing updated comparative evidence and by confirming and refining the main findings of earlier research based on representative Eurobarometer data.

2. Literature review

Although multilingualism has long been promoted as a core European value, the literature points to a persistent tension between its normative framing and its economic function (Dendrinos, 2018; Leech, 2017). This tension became particularly visible after the period often described as the "golden age" of multilingualism between 2007 and 2010 (Gazzola, 2016a), followed by a partial loss of momentum after 2014 (Leech, 2017). More recent policy documents, including the 2019 Council Recommendation, reaffirm the "mother tongue plus two languages" objective (Council of the European Union, 2019; European Commission, 2016c), yet several authors argue that such goals remain broad and tend in practice to favour languages with greater economic weight (Sayers–Láncos, 2017). This raises the question of the extent to which multilingualism has actually spread across European societies, and whether the distribution of language competences can be regarded as equal across different social groups.

The available empirical evidence suggests that high levels of foreign-language proficiency are still not particularly widespread in Europe (Gazzola, 2016b). The range of foreign languages acquired within education systems is highly concentrated (Salinas, 2021) and, much like the EU's working-language structure, is dominated

by English, German, and French, while other languages are less widespread (Dendrinos, 2018). According to Costa and Albergaria-Almeida (2015), proficiency outcomes are substantially weaker in second foreign languages than in first foreign languages: while 42% of students reached the B1–B2 level in their first foreign language, only 25% did so in their second. These findings call into question the practical feasibility of the EU's "mother tongue plus two languages" objective.

The literature also emphasises that multilingualism is closely intertwined with social and economic inequality. Linguistic hierarchies not only shape the status of languages but also contribute to unequal access to economic and social opportunities (Romaine, 2013). Barakos and Selleck (2018) argue that language proficiency can be interpreted as a form of linguistic investment that contributes to the acquisition or reinforcement of social position, while "elite multilingualism" functions as a gatekeeping mechanism for access to higher-status groups (Barakos–Selleck, 2018). At the same time, language skills operate as an economic resource (Araújo et al., 2015), yet access to the benefits associated with them remains uneven. Foreign-language proficiency is linked to improved income and employability, especially at higher levels (Araújo et al., 2015), but socially disadvantaged groups are less likely to possess such competences (Gazzola, 2016a).

Overall, the literature is not uniform in its assessment of the extent to which EU multilingualism policies have contributed to the spread of language proficiency. One reason for this is that the EU primarily formulates recommendations, while implementation remains the responsibility of the member states, resulting in substantial variation (Dendrinos, 2018). Earlier waves of the Eurobarometer indicate that younger generations are more likely to possess knowledge of multiple foreign languages (Araújo et al., 2015), but this does not necessarily imply a reduction in inequalities (Gazzola, 2016a). It is also important to note that previous research has already highlighted the tension between the EU's multilingualism narratives and actual language practices (Els, 2005). Against this background, it is particularly important to examine the extent to which multilingualism has spread over the past two decades and whether this expansion has affected different social groups equally. The present study addresses this question through a comparative analysis of the 2005, 2012, and 2024 Eurobarometer surveys (European Commission, 2012a; 2012b; European Commission and European Parliament, 2025).

3. Materials and methods

This analysis uses three waves of the European Commission's Europeans and Their Languages survey, conducted in 2005, 2012, and 2024. This repeated cross-sectional survey provides a suitable basis for examining the longer-term development of multilingualism in the European Union, particularly in the post-enlargement period. The selected waves are broadly comparable in methodological terms, as they contain closely aligned questions on foreign-language proficiency.

The data were obtained from the archive of the GESIS Leibniz Institute for the Social Sciences (European Commission, 2012a; 2012b; European Commission and European Parliament, 2025). The present study relies on individual-level microdata rather then aggregated Eurobarometer results in order to analyse both the prevalence of foreign-language proficiency and its distribution across socio-demographic groups. The three datasets include 29,328 respondents in 2005, 26,751 in 2012, and 26,478 in 2024. EU-level descriptive estimates were calculated

using the aggregate weights provided for each survey wave. Accordingly, the 2005 figures refer to the EU25 context of that period, while later waves reflect the corresponding aggregate populations of their own survey years.

The main dependent variables are derived from respondents' first, second, and third foreign languages spoken well enough to hold a conversation. These individual-level responses were used to construct harmonised measures of multilingualism across survey waves, including the number of foreign languages spoken and indicators for speaking at least one, two, or three foreign languages. Invalid and non-substantive codes were excluded based on the original survey documentation. Socio-economic variables were harmonised across waves in order to ensure comparability. Occupation was recoded into broader categories based on a consistent mapping of the original classifications: self-employed, managers, other white-collar workers, manual workers, house persons, unemployed, retired, and students (Eurobarometer, 2024). Age was included as a continuous variable and, for descriptive purposes, was also grouped into four categories (15–24, 25–39, 40–54, and 55+). Education required separate harmonisation. The original Eurobarometer records the age at which respondents completed full-time education and distinguishes special categories such as "still studying" and "no full-time education". Rather than treating this measure as purely continuous, education was recoded into five categories: low, medium, high, no full-time education, and still studying. Educational attainment was classified according to the age at completion of formal education, with low defined as 15 years or below, medium as 16–19 years, and high as 20 years or above. This specification preserves important institutional and life-course differences.

4. Results

4.1. Results of the descriptive statistics

Wave-specific EU-level descriptive estimates indicate a moderate increase in foreign-language proficiency over time between 2005 and 2024. As shown in Table 1, the average number of foreign languages spoken rose from 0.77 to 0.97, while the share of respondents speaking at least one foreign language increased from 49.1% to 59.2%. A similar pattern can be observed for higher levels of multilingualism. These estimates are consistent with the official wave-specific Eurobarometer aggregates (Eurobarometer, 2024).

The growth in the share of those speaking at least three foreign languages is particularly noteworthy, as it points to an increase in higher-level multilingualism from 6.7% to 10.8%. These findings suggest that the general level of foreign-language proficiency in Europe has improved, although the pace of change should be characterised as gradual rather than dramatic.

The age breakdown shows a clear and stable pattern. In each survey year, younger respondents speak more foreign languages on average than older age groups. Among those aged 15–24, the average number of foreign languages spoken increased from 1.12 in 2005, to 1.22 in 2012 and to 1.31 in 2024, while older cohorts also showed improvement over time. Although absolute differences narrowed somewhat, the generational advantage of younger respondents remained in place. Among those aged 55 and over, average foreign-language proficiency rose from 0.53, then 0,61 to 0.74. This suggests that younger cohorts continue to benefit from more favourable opportunities and institutional conditions for language learning.

Occupational status also emerges as an important structuring factor in foreign-language proficiency. Higher-status groups, especially managers and other white-collar workers, consistently speak substantially more foreign languages than lower-status groups in every survey year (Eurobarometer, 2024).

A descriptive breakdown by education reveals a strong and persistent gradient in foreign-language proficiency. In all three survey waves, respondents with higher educational attainment reported substantially more foreign languages than those in the lower-education groups (Table 1). The average number of foreign languages spoken in the high-education group was 1.24 in 2005, 1.34 in 2012, and 1.39 in 2024, compared with only 0.25, 0.30, and 0.32 in the low-education group. This gap did not narrow over time; if anything, it widened slightly. While foreign-language proficiency increased modestly among the highly educated, gains among the lower-education groups remained limited, suggesting that the expansion of multilingualism has been socially uneven.

Table 1: Foreign-language proficiency by education group, 2005–2024.

	2005	**2012**	**2024**
Low	0.25	0.30	0.33
Medium	0.66	0.75	0.73
High	1.24	1.34	1.39

Source: Own calculations based on Eurobarometer microdata (European Commission, 2012a; 2012b; European Commission and European Parliament, 2025)

The education-based patterns shown in Figure 1. also show earlier findings on the difficulty of achieving the EU's "mother tongue plus two languages" objective.

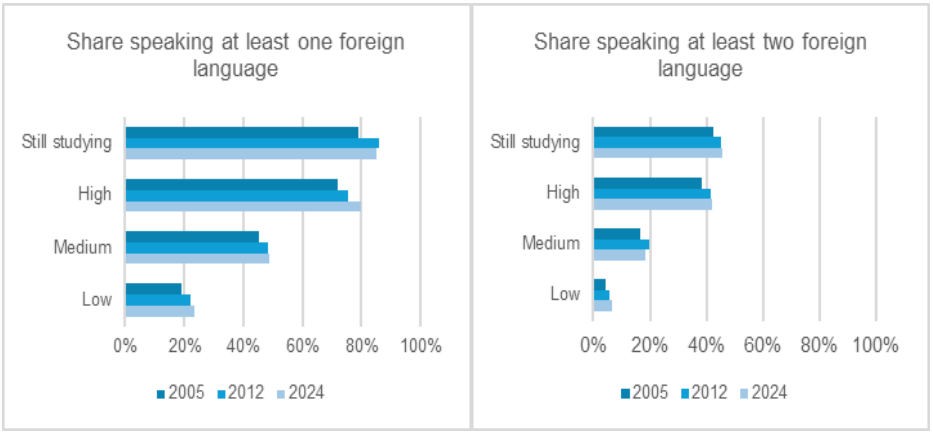


Figure 1: Educational differences in foreign language proficiency, 2005–2024
Source: Own calculations based on Eurobarometer microdata (European Commission, 2012a; 2012b; European Commission and European Parliament, 2025)

Although the share speaking at least one foreign language is comparatively high among medium-and high-education groups (49% and 80% in 2024), the proportion speaking at least two foreign languages is substantially lower (18% and 42% in 2024), especially among respondents with lower educational attainment. According

to the reported figure, this gap did not narrow over the period under review and may even have widened slightly. Taken together, these results suggest that the expansion of foreign-language proficiency has been concentrated primarily among the more highly educated.

4.2. Results of the regression analysis

The OLS estimates broadly confirm the descriptive patterns. Relative to the reference category of respondents who are still studying, lower levels of education are associated with substantially weaker foreign-language outcomes. The coefficients for no full-time education, low education, and medium education are all negative and highly significant. Age also shows a consistently negative association with foreign-language proficiency. By contrast, managers, other white-collar workers, the self-employed, and students report significantly better outcomes than the reference occupational category of house persons, while manual workers do not differ significantly from the reference group.

Table 3: Determinants of the number of foreign languages spoken (OLS estimates)

	(1)
Managers	0.268***
	(0.015)
Manual workers	-0.008
	(0.014)
Other white collars	0.117***
	(0.014)
Self-employed	0.163***
	(0.017
Age	-0.005***
	(0.000)
Education: No full-time	-0.755***
	(0.042)
Education: Low	-0.763***
	(0.010)
Education: Medium	-0.474***
	(0.008)
Year: 2012	0.119***
	(0.007)
Year: 2024	0.106***
	(0.007)
Observations	75377
R^2	0.292

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

Notes: Weighted OLS estimates. Standard errors in parentheses. Country fixed effects and survey-year dummies included. Reference categories: occupation = house persons; education = still studying; survey year = 2005

Source: Own calculations based on Eurobarometer microdata (European Commission, 2012a; 2012b; European Commission and European Parliament, 2025)

The logistic models reinforce the same core patterns. Relative to the reference category of respondents who are still studying, lower levels of education are associated with substantially lower odds of foreign-language proficiency. In particular, respondents in the low-education group have odds ratios of 0.139 for speaking at least one foreign language and 0.122 for speaking at least two, while the corresponding values for the medium-education group are 0.337 and 0.378. Age is negatively associated with language outcomes: odds ratios of 0.982 for speaking at least one foreign language and 0.989 for speaking at least two indicate that foreign-language proficiency declines with age. Managers and self-employed respondents show significantly more favourable outcomes than the reference occupational category of house persons, whereas manual workers do not differ significantly from the reference group. The positive year coefficients further suggest that the probability of speaking foreign languages was higher in both 2012 and 2024 than in 2005, even after controlling for socio-demographic composition and country fixed effects.

5. Conclusions

This study examined how foreign-language proficiency evolved in the European Union between 2005 and 2024 and whether the expansion of multilingualism was accompanied by a reduction in social inequalities. The results show that multilingualism increased over the period under review, but only moderately. Foreign-language proficiency improved across the EU population, yet the pace of change was slower between 2012 and 2024 than between 2005 and 2012. These results are consistent with the official wave-specific Eurobarometer aggregates (Eurobarometer, 2024). At the same time, language skills remained strongly socially stratified. Both the descriptive and regression results indicate that foreign-language proficiency is closely associated with age, educational attainment, and occupational status. In particular, higher levels of education and more advantaged social positions are consistently linked to better language outcomes. These findings suggest that the expansion of multilingualism has been gradual, but socially uneven.

The results point to a persistent tension between the EU's multilingual ambitions and the social distribution of actual language competences. Although multilingualism remains one of the most inclusive language regimes in the European context (Gazzola, 2016b), the relationship between linguistic diversity and social participation is not straightforward; rather, it is multidimensional and contradictory (Marácz and Adamo, 2017). This implies that the promotion of multilingualism cannot be treated merely as a symbolic commitment to linguistic diversity, but must also address the social inequalities that shape access to language learning.

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BRIDGING THE CULTURAL DIVIDE: A COMPARATIVE ANALYSIS OF HUNGARIAN AND SOUTH KOREAN BUSINESS CULTURES

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Abstract: *In recent years, South Korea has emerged as one of Hungary's preeminent capital investors, driven by the strategic framework of the "Eastern Opening" policy and robust bilateral trade agreements. While macroeconomic data indicates a rapidly growing investment partnership, foreign enterprises frequently encounter significant operational difficulties due to cultural expectations, practices, and behavioural norms at every stage of business engagement. The primary objective of this study is to analyse the cultural similarities and disparities between both countries. By examining these nuances, the paper aims to facilitate efficient and effective collaboration among business professionals from both nations.*
Based on a comprehensive review of academic literature, both cultures are analysed and compared through established value dimensions. The theoretical framework integrates Hall's concepts of context, time, and proxemics; Trompenaars and Hampden-Turner's seven-dimension model; and Lewis's LMR (linear-active, multi-active, reactive) typology.
The findings reveal that while both nations exhibit high-context communication characteristics, South Korea operates within a rigid hierarchical, face-saving protocol heavily influenced by Confucian values. Hungary demonstrates a hybrid nature, blending relationship-driven polychronic flexibility with universalist and achievement-oriented standards in modern business contexts. According to the Lewis model, Hungary is positioned between the linear-active and multi-active poles, whereas South Korea aligns closely with the reactive pole.
To translate massive Foreign Direct Investment (FDI) inflows into long-term success, Hungarian business actors must develop specific cultural intelligence. Success in bilateral cooperation relies heavily on mastering indirect communication, respecting strict age-and-rank corporate hierarchies, and investing substantial time in relationship-oriented pre-negotiations.

Keywords: *Hungary; South Korea; cultural dimensions; international business*

JEL Classification: *F23; M12; M16*

1. Introduction

Recent trends indicate a growing number of Hungarian companies engaging in business relations with South Korean firms. Driven by their formidable performance, numerous South Korean corporations have emerged as dominant actors in global markets. While foreign entities are increasingly interacting with South Korean enterprises, they frequently encounter difficulties during these operations due to the distinct expectations, practices, and behavioural norms that prevail at every stage of business engagement. These disparities primarily originate from cross-country cultural differences. Although South Korea is widely regarded as one of the most westernised nations in Asia, many South Koreans strongly maintain culturally rooted traditions, customs, and practices in the business sphere. Consequently, understanding South Korean cultural norms enables others to conduct business with South Korean counterparts more efficiently and effectively. Foreign business operations can achieve greater efficacy through a deeper comprehension of the value system underlying South Korean culture and by recognising its impact on business conduct. Ultimately, a more profound understanding of Korean culture allows outsiders to enhance the success of their business endeavours with South Koreans (Lee, 2012).

To date, South Korea has become one of Hungary's preeminent investors, indicating that Korean enterprises maintain confidence in the Hungarian economy. Within Asia, Hungary conducts its largest volume of trade with South Korea, surpassed only by China. Currently, approximately 300 South Korean companies operate in Hungary, employing more than 20,000 individuals (kormany.hu, 2022). South Korea represents the largest capital investor within the framework of the "Eastern Opening" policy in Hungary. This aligns with the government's objective to establish Budapest as a regional financial hub serving as a bridge between Asian and European markets. The further intensification of economic relations is supported by the investment promotion and trade development agreement signed between Seoul and Budapest in 2022 (mfor.hu, 2023; Rádi, 2023; vg, 2023).

According to the 2023 report of the Hungarian Investment Promotion Agency (HIPA), the results for 2023 exhibit outstanding growth in all respects compared to the previous year. On an annual basis, investment volume doubled from 6.5 billion euros to 13 billion euros, while the number of announced projects demonstrated an even more dynamic increase. The number of newly created jobs reached 19,692, representing a 30 percent year-on-year growth. This constitutes the highest number of newly created jobs ever recorded within a single year. These record figures are primarily attributable to the high level of activity from Eastern investors—namely China, South Korea, and Japan—whose investments accounted for nearly 82 percent of the inflowing Foreign Direct Investment (FDI) and 67 percent of the newly announced jobs. A total of 19 projects are linked to these countries. Chinese enterprises committed to investing over 7.6 billion euros across 8 projects, making China the largest investor in Hungary once again, following its previous leading position in 2020. South Korea ranked second in terms of investment volume with a total investment value of nearly 2 billion euros, surpassing Germany and the United States (hipa, 2024).

2. Methodology

Based on academic literature, this study analyses the cultures of Hungary and South Korea through the value dimensions established by renowned culture

researchers. The cultural dimensions of Edward T. Hall, Fons Trompenaars and Charles Hampden-Turner, as well as Richard R. Lewis, serve as the foundation for the subsequent comparative analysis. The objective of the research is to analytically explore the similarities and disparities between the cultures of the two nations. The findings may prove beneficial in facilitating seamless and efficient collaboration among business professionals and colleagues from both countries.

3. Results

3.1. Cultural dimensions of Edward T. Hall

In his seminal work (The Silent Language, 1959), Hall defines culture as communication (Loch, 2010). Every culture reflects within its language that which is valued by its members. Consequently, language becomes both the embodiment of culture and the primary instrument through which individuals communicate with others, whether within their own cultural sphere or in another (Adler, 2002 in Albaum et al., 2016). Herein, three of Hall's cultural dimensions will be examined: (1) Cultural Context: High-Context – Low-Context; (2) Conception of Time: Mono-chronic – Polychronic; and (3) Proxemics: Low – High Territoriality.

In Hall's interpretation, context refers to the comprehensive set of information available to the participants of communication in a given situation (Loch, 2010). In high-context cultures, words themselves carry relatively little inherent meaning. In these cultural environments, individuals must read between the lines to comprehend the intended meaning of a message. High-context cultures frequently employ silence during communication, and interaction is indirect rather than direct. When conflicts arise, they are managed with subtlety and discretion. Verbal statements reflect the underlying social relationship and its shared assumptions. In contrast, in a low-context culture, meaning resides within the words themselves, and the significance of a message can be separated from the context in which it appears. In a low-context language and culture, the message is explicit. In low-context environments, individuals state their expectations or desires directly; these cultures tend to be straightforward and highly verbal. Low-context cultures are predominantly found in Northern Europe and North America, including the Anglo-Saxon countries, Germany, and Switzerland. Conversely, high-context cultures are prevalent in Asia (e.g., Japan, China, Korea), Latin America, Southern Europe, the Middle East, and the Central and Eastern European region. Because members of low-context cultures prioritise directness, they typically view high-context communication as a waste of time. For instance, Americans tend to raise their voices, speak rapidly, and clearly express what is on their minds. In contrast, the Chinese are less overt and utilise body language, silence, and pauses to convey messages (Gesteland, 1999 in Albaum et al., 2016; Samovar et al., 2009 in Chaney – Martin, 2014; Deresky – Miller, 2023; Falkné Bánó, 2008; Szedlacskó, 2012). Hall also referred to low-context cultures as deal-oriented and high-context cultures as relationship-oriented (Csath, 2008). Heidrich (2001) formulates that in high-context scenarios, the message is already inherently present in the individual, requiring only a portion to be expressed in an explicit, coded form. In low-context scenarios, the majority of the message is explicitly coded, spoken, or written. According to research by Falkné Bánó (2008), Hungarians exhibit high-context characteristics. Heidrich (2001) also concludes that Hungarians belong to high-context cultures, noting that

they are continuously surrounded by a highly intensive information network. Holicza (2016) similarly identifies Hungary as a high-context culture, where a large portion of information is assumed to be known and universally understood. Nonverbal coding is substantial, and a significant portion of communication relies heavily on nonverbal cues. South Korea is a distinctly high-context culture, which is clearly manifested in its communicative specificities. According to Székács (2019), in Korea, the appropriate forms of establishing and maintaining relationships between communicating parties—including every aspect of behaviour—are traditionally determined by commitment to the community, strict adherence to hierarchy, and a pursuit of harmony and order. Communicating parties are guided by collective responsibility rather than individual interest. Within this framework, communication is characteristically governed by age, gender, social rank, position, and status.

Conception of Time: Members of cultures following a monochronic time orientation perform only one primary activity at a time, whereas those following a polychronic time orientation work on multiple activities simultaneously. In monochronic cultures, time is viewed as something tangible; people use expressions such as "wasting time" or "time is money." Time is perceived as linear and manageable, and tasks become more important than human relationships. Engaging in two or more activities simultaneously is considered impolite. These are generally characteristic of low-context cultures (Kopf – McCroskey, 2007 in Chaney – Martin, 2014; Loch, 2010; Szedlacskó, 2012). In polychronic cultures, people are well-adapted to doing several things at once, executing multiple tasks in parallel. For members of polychronic cultures, people and personal relationships are more important than adherence to schedules. This results in a lifestyle that is more unstructured than that of monochronic individuals (Samovar et al., 2009 in Chaney – Martin, 2014). High-context cultures typically fall into this category (Szedlacskó, 2012). Falkné Bánó (2008) cites the view of Hall (1990) that the two-time orientations do not mix. She adds, however, that Hall's view is not unequivocally true, as numerous cultures—including Hungarian culture—blend monochronic and polychronic traits. Adherence to schedules is important, which is a mono-chronic trait; at the same time, Hungarian culture is strongly relationship-oriented, human relations are more important than deadlines, and emotions carry significant weight, all of which are polychronic traits (Falkné Bánó, 2008). Falkné Bánó (2008) and Lewis (2006) write that Hungarians exhibit both time orientations: polychronic in friendships and monochronic in formal relations. Meetings begin punctually and agendas are strictly followed, but if participants engage in a lively conversation, they tend to lose their sense of time. According to Holicza (2016), Hungary is a monochronic culture, which implies that punctuality is expected and meetings proceed according to a specific agenda. Regarding relationships, however, polychronic traits are also present. The research findings of both Szalay (2005) and Heidrich (2001) substantiate that Hungarians have a polychronic time orientation. South-East Asian countries are polychronic, while most Eastern European countries exhibit a slightly polychronic time management (Gesteland, 2000 and Bartosik-Purgat, 2006 in Adamczyk, 2017). South Koreans are highly industrious and rarely waste time. They are relatively punctual and possess an Americanised attitude, meaning they aim to condense as many tasks as possible into a given timeframe (Lewis, 2006).

Cultures also differ in their perception of physical space. We possess our own sense of personal space and feel uncomfortable when others violate it. Conversational distance is smaller in Latin America than in Northern Europe or the United States

(Cavusgil et al., 2017). Proxemics addresses the impact of proximity and space on communication (Deresky – Miller, 2023). In personal relations, Hungarians sit and stand close to one another. Physical contact is frequent, and handshakes are practically mandatory (Lewis, 2006). In Hungary, people stand further than an elbow's length apart, but close enough to touch wrists. Close friends and relatives greet each other with a kiss on the cheek, provided at least one of them is a woman. Hungarian men greet each other with a handshake, which differs from the Western handshake as it is restricted to a single grasp without shaking the hand. The handshake lasts no longer than one or two seconds (Holicza, 2016). South Korea is a crowded country, and space, particularly in large cities, is scarce. South Koreans are accustomed to working in close proximity to one another; however, they require clearly defined personal space in formal situations. They do not prefer physical touch (Lewis, 2006).

3.2. Cultural dimensions of Fons Trompenaars and Charles Hampden-Turner

Trompenaars and Hampden-Turner developed their model after studying human values and preferences across numerous cultures over a ten-year period. They found that individuals from different cultures do not differ randomly, but in highly specific and even predictable ways. In fact, every culture possesses its own mode of thinking, its own values and beliefs, as well as distinct preferences based on a variety of factors. They concluded that what distinguishes people of one culture from another is where these preferences are situated along the following seven dimensions: (1) Universalism vs. Particularism, (2) Individualism vs. Communitarianism, (3) Specific vs. Diffuse, (4) Neutral vs. Emotional, (5) Achievement vs. Ascription, (6) Sequential time vs. Synchronic time, and (7) Inner-directed vs. Outer-directed (Holtbrügge, 2022).

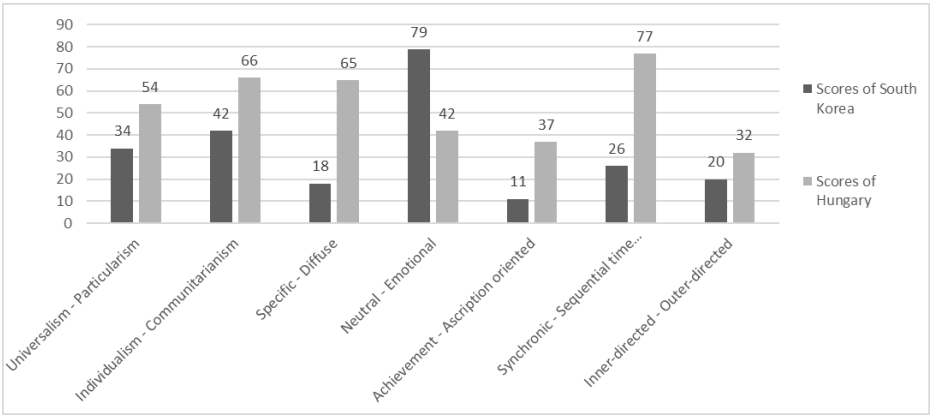


Figure 1: Scores of Hungary and South-Korea based on the Cultural Dimensions of Trompenaars and Hampden-Turner
Source: own editing based on thtconsulting.com (2025)

Universalism vs. Particularism: This dimension pertains to the extent to which rules are accepted and applied, as well as the degree to which deviation from rules is tolerated by considering the unique circumstances of a specific case (Loch, 2010). The universalist approach applies rules and systems objectively, without regard to

individual circumstances, whereas the particularist approach places primary obligation on relationships, operating on the principle that "everything depends on who is who" (Csath, 2008; Deresky – Miller, 2023). Examples of universalist cultures include Anglo-Saxon countries, Switzerland, and Germany, while particularism is characteristic of Mediterranean cultures, France, Spain, Central and Eastern Europe, and the Middle East (Szedlacskó, 2012). The particularist approach is highly prevalent in Asian countries and is thus characteristic of South Korea as well (Deresky – Miller, 2023; Holtbrügge, 2022). According to Figure 1, Hungary lies in the intermediate value range, whereas Korea's score indicates a particularist society. A particularist perspective evaluates individuals through their interpersonal relationships. Friends, siblings, colleagues, and children hold special importance for a given person, placing unique demands on their emotions. Therefore, supporting, protecting, and judging a person must be conducted independently of the rules (Trompenaars – Hampden-Turner, 2012 in Ylikortes, 2020). The research finding of Gaál et al. (2005) from 2004 reflects a universalist orientation for Hungary. Falkné Bánó (2014) also confirms a universalist orientation through her own research, as do Holicza (2016), Trompenaars – Hampden-Turner (1997), as well as Kovács (2006) in Tompos (2015), and Hidasi – Lukinykh (2009).

Individualism vs. Communitarianism: This dimension examines the extent to which individuals prioritise individual interests over the interests of the community. This dimension corresponds to Hofstede's "individualism vs. collectivism" dimension (ecampusontario, 2023; Loch, 2010). Individualism is particularly strong in Western Europe and North America. Communitarianism prevails in Asia, Africa and Latin America (Holtbrügge, 2022). Hungary is characterised by an individualistic culture, whereas South Korea possesses a collectivistic one (theculturefactor.com, 2025). Osváth (2019) emphasises that Korea is characterised by high power distance and collectivism. Consequently, hierarchy plays a significant role, and individual interests are subordinated to those of the community. The corporate community is perceived as a large family where the leader assumes a paternal role—acting strictly and issuing directives, yet simultaneously providing care for loyal subordinates. This collective sentiment is further reinforced by corporate uniforms and company anthems. Furthermore, corporate management endeavours to involve employees' family members in the life of the company through various leisure programs. Korean business leaders encourage informal, after-hours social gatherings over food and drinks, which typically extend late into the night. It is believed that these activities strengthen team spirit and mutual trust. Korean employees frequently maintain the appearance of intense industriousness and remain in the office until late hours. However, this does not imply that their work is more efficient. The Korean employee feels that projecting the appearance of diligent work is a societal expectation; hence, they see no reason to finish work by 5:00 p.m. when they are expected to stay much longer. Al-Alawi and Alkhodari (2016) also refer to South Korea as a collectivistic society where emphasis is placed on long-term commitment and the cultivation of inter-group relationships. Ting-Ying (2013) classifies South Korea as a highly or moderately highly collectivistic culture. Székács (2019) emphasises the influence of Confucianism on behaviour, which is heavily shaped by group spirit, male dominance, and respect for age and rank. Individuals position themselves based on their status within the group, and they approach others, dress, behave, and communicate accordingly. Individual interests are systematically overridden by the collective interest, which also entails a sense of responsibility toward the community.

Individuals must identify with their community, and failure to do so results in the loss of the protection their community provides. Through primary research, Milassin (2020) confirms the findings of the aforementioned author, emphasising that the typical Korean identifies with their respective group, and its expectations guide their every action. An individual's identity is determined by the group. Koreans are highly situation-dependent people. Lee (2012) describes South Korea as a highly collectivistic society. Kim (2000) also notes that strong in-group solidarity is a key cultural characteristic of the Korean people. The primary foundations for the formation of such in-groups include a shared alma mater, place of birth, workplace, and social clubs, among others. The research finding of Gaál et al. (2005) from 2004 shows an individualistic orientation for Hungary. This is also confirmed by Holicza (2016) and Hidasi – Lukinykh (2009). According to Tompos (2015), citing Trompenaars – Hampden-Turner (1997) and Kovács (2006), Hungary is situated rather between the two poles. According to Figure 1, Hungary is rather an individualistic society, whereas South Korea is more a collectivist society.

Specific vs. Diffuse: This dimension indicates the degree of separation between the private sphere and social existence, examining the extent to which an individual commits themselves to things, persons, and relationships (Loch, 2010). In specific cultures, individuals separate work and personal matters, isolate their professional life from their private life, and tend to be more open and direct. In diffuse cultures, work and personal relationships intermingle (Deresky – Miller, 2023). A specific culture can be referred to as deal-oriented, while a diffuse culture can be termed relationship-oriented (Csath, 2008). The research finding of Gaál et al. (2005) from 2004 reflects a specific orientation for Hungary. The research results of Falkné Bánó (2014) also support a specific orientation, though she mentions diffuse tendencies as well. Holicza (2016) and Hidasi – Lukinykh (2009) share a similar view. Specific and diffuse cultures are also referred to as low-context and high-context cultures, respectively. This indicates how much we need to know prior to communication, how much shared knowledge we take for granted, and how many references are made to implicit common ground. Low-context cultures are generally more adaptable and flexible; a stranger will not face significant difficulties in joining the communication. The Korean language is highly contextual. Contextual countries are typically sophisticated and may never be truly comprehensible to foreigners who have not fully assimilated (Trompenaars – Hampden-Turner, 2012 in Ylikortes, 2020). According to Figure 1, the score for South Korea indicates a diffuse culture, whereas that for Hungary points to a specific culture.

Neutral vs. Emotional: This dimension expresses the extent to which the public expression of emotions is acceptable, and how desirable it is to keep emotions under control or concealed (Loch, 2010). In neutral cultures, business relationships are goal-oriented and serve efficiency; there is no place for emotions within them. Such cultures are found in the Anglo-Saxon region and Northern Europe. Members of affective cultures engage in business relationships with their full personality, and emotions carry importance as well. Such cultures are found in South America, the Middle East, and Central and Eastern Europe (Szedlacskó, 2012). The research finding of Gaál et al. (2005) from 2004 shows a value close to the average for Hungary. Individuals belonging to a culture with such a value view those with a more neutral orientation as placing primary emphasis on containing and suppressing thoughts and emotions, and on unemotional conduct during negotiations. This is also confirmed by Tompos (2015), citing Trompenaars – Hampden-Turner (1997)

and Kovács (2006). The research results of Falkné Bánó (2014) also show mixed traits. Holicza (2016) mentions Hungary as a neutral culture. Hidasi – Lukinykh (2009) write that the value of the neutral orientation (56) is stronger than that of the emotional orientation (44). According to Figure 1, the score for South Korea indicates a neutral culture, whereas that for Hungary shows an affective culture.

Achievement vs. Ascription: This dimension refers to the method of acquiring status (Loch, 2010). In an achievement-based society, status and influence are based on individual performance. Women, minorities, and young people generally have an equal opportunity to acquire positions based on their accomplishments. In an ascription-oriented society, people attribute status based on class, age, gender, etc. (Deresky – Miller, 2023). For instance, Anglo-Saxon cultures are achievement-oriented, while Central and Eastern European or Mediterranean countries are ascription-oriented (Szedlacskó, 2012). The research finding of Gaál et al. (2005) from 2004 shows a value close to the average for Hungary. This is also confirmed by Tompos (2015), citing Trompenaars – Hampden-Turner (1997) and Kovács (2006). According to the research results of Falkné Bánó (2014), Hungarians are rather achievement-oriented, but there are also traits indicating an ascription orientation. According to Hidasi – Lukinykh (2009), a slight achievement orientation can be observed in Hungarian culture. According to Figure 1, the scores for both countries indicate ascription-oriented cultures, although this tendency is stronger in South Korea.

Confucianism permeates South Korean culture. Status is determined by age, gender, education, family background, wealth, qualifications, and political alignment. Social connections have an impact on success. Younger generations are considerably more materialistic than their parents and grandparents. Origin and background are important, determining how people are treated in this hierarchical society (Chaney – Martin, 2014).

Sequential time vs. Synchronic time: This dimension examines the extent to which a culture prefers doing things one at a time in an orderly manner, as opposed to a more flexible schedule that allows for performing multiple things simultaneously and in parallel (ecampusontario, 2023). The sequential conception of time corresponds to Hall's monochronic conception of time, while the synchronic conception corresponds to the polychronic conception of time (Loch, 2010). Sequential people adhere to pre-prepared schedules and value punctuality. Time is divided among various intervals, and actions are typically executed in a clear order. Any change or disturbance in the sequence makes sequential individuals more insecure. Time is constructed as a series of events occurring at regular intervals between people. The future can be directed by personal achievement and internally directed effort only in the short term, having no impact on the distant future. Time can also be viewed as cyclical and repetitive in sequential cultures. In contrast, synchronic cultures view the past, present, and future as intertwined periods. Koreans attribute greater importance to the future and the least to the past, but they see all periods as overlapping with one another. They carry their past through the present into the future and are reluctant to change unless they are convinced that their heritage is secure (Trompenaars – Hampden-Turner, 2012 in Ylikortes, 2020). According to Figure 1, the score for South Korea indicates a synchronic society, whereas that for Hungary indicates a sequential time orientation society. However, based on previous research findings (Trompenaars, 1999 in Holicza, 2016; Trompenaars – Hampden-Turner, 1997 and Kovács, 2006 in Tompos 2015) Hungarians were rather

characterized by synchronic time management. In line with Hall's time concept (3.1) and the dual nature of Hungarian temporal perception, we can conclude that the Hungarian culture exhibits a combination of synchronic and sequential time management styles.

Inner-directed vs. Outer-directed: This dimension pertains to the relationship with nature and examines the extent to which members of a culture believe they can control themselves and their environment (ecampusontario, 2023). Members of outer-directed cultures view themselves as part of nature, recognise the power of nature, and frequently believe in some force guiding the world. Inner-directed cultures consider themselves to be more than nature and seek to dominate it. Members of these cultures feel they can control their own destiny, and that their success depends solely on themselves (Loch, 2010). Examples of the most inner-directed cultures include much of Europe and Anglo-Saxon cultures, while the most outer-directed cultures are the Arab world and much of Asia (Szedlacskó, 2012). The research finding of Gaál et al. (2005) from 2004 shows a value close to the average for Hungary. According to Holicza (2016) and Hidasi – Lukinykh (2009), Hungarians are rather characterized by outer direction. According to Figure 1 the scores of both countries indicate outer-directed cultures.

3.3. Culture Model of Richard L. Lewis

Richard D. Lewis posits that cultures can be classified into three distinct categories: linear-active, multi-active, and reactive. He illustrates his cultural model as a triangle (Figure 2), in which countries are positioned along the lines connecting the two vertices (Lewis, 2000).

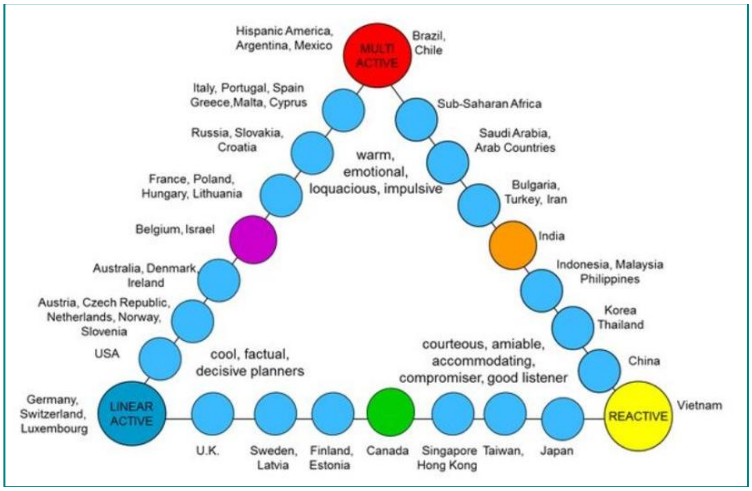


Figure 2: Culture Model of Lewis
Source: Jaakkola – Thalheim (2014)

The linear-active group encompasses the Anglosphere—namely North America, Great Britain, Australia, and New Zealand—as well as Northern Europe, including Scandinavia and the Germanic countries. Members of this group are task-oriented, highly organised planners who execute chains of action by completing one task at a time, preferably adhering to a linear agenda (stray-partners, 2023).

The reactive group comprises the countries of Asia. They are excellent listeners who rarely initiate action or conversation, preferring first to listen to the other party's position, and then react to it to formulate their own opinions (straypartners, 2023).
The multi-active group is more dispersed, spanning Southern Europe, the Mediterranean countries, South America, Sub-Saharan Africa, the Arab world and other cultures in the Middle East, India, Pakistan, and most Slavic countries. Although these cultures are highly diverse geographically, as well as in their religions, beliefs, and values, they can be categorised as a group because their behaviour follows the same pattern characterised by the following traits and commonalities: emotionality, loquacity, dramatic expression, eloquence, persuasiveness, expressive body language, the importance of religion or creed, the primacy of family bonds, low-trust societies, unpunctuality, variable work ethic, inadequate planning, capacity for empathy, collectivism, relationship orientation, reservation toward formalities, sociability, nepotism, irritability, volatility, historical consciousness, and an aversion to strict discipline (straypartners, 2023).
As illustrated in Figure 2, Hungary is positioned between the linear-active and multi-active poles, though slightly closer to the multi-active group. South Korea is situated between the multi-active and reactive poles, practically in the direct vicinity of the reactive pole.
Hungarians, similarly to Latins, sit and stand close to one another. Physical contact is frequent, and handshakes are essential. Although they arrive punctually to scheduled appointments, they frequently lose their sense of time as soon as a lively conversation commences. Regarding their perception of time, much like Latins, they are people-oriented rather than clock-oriented. Eye contact is important. Women are generally idealised in an old-fashioned manner, although this does not necessarily preclude them from assuming prominent roles in business. Resembling Germanic cultures, Hungarians tend to engage in much deeper analyses. They are prone to pessimism and painting a negative picture of situations, often elaborating on problems without proposing solutions. Similar to Spaniards, Hungarians can be sensitive and easily offended (Lewis, 2010).
South Koreans are energetic conversationalists with a highly flexible perception of truth. They are polite listeners in true Asian fashion, yet they often give the impression of anticipating what will be said to them. They frequently provide animated feedback and may pose questions on matters already discussed. Maintaining face is of paramount importance to them. Protocol is strictly observed. If a South Korean is not granted the respect corresponding to their rank, status, or age, they will withdraw and avoid their partner in the future. If an individual fails to observe the fundamental rules of social interaction and appropriate respect in Korea, they become "impersonal"; from that point on, South Koreans will disregard them, even if they remain polite. In fact, they can exhibit aggressive behaviour toward impersonal individuals. Touching another person constitutes an insult. Business professionals now engage in handshakes to demonstrate modernity, but they frequently bow simultaneously. Punctuality is reasonable, yet considered less critical than in China or Japan (Lewis, 2006).

4. Conclusions and Recommendations

The comparative analysis of Hungarian and South Korean cultures through the multidimensional frameworks of Hall, Trompenaars and Hampden-Turner, and

Lewis reveals a complex landscape of both synergies and profound disparities. These cultural nuances carry significant weight in the context of the rapidly expanding macroeconomic partnership between the two nations. While both countries are classified as high-context cultures where communication relies heavily on implicit shared knowledge and non-verbal cues, the operationalisation of this trait differs substantially. South Korea exhibits a much more rigid and extreme form of high-context interaction, deeply governed by Confucian values, strict hierarchical protocols, and the paramount importance of maintaining "face." In contrast, while Hungarian culture values personal relationships and displays polychronic tendencies in social dimensions, its business environment has increasingly adapted to Western European standards of universalism, directness, and achievement-oriented status.

This dichotomy creates a unique challenge for intercultural business operations. On one hand, both cultures recognise the primacy of relationship-building over purely transactional, deal-oriented interactions. On the other hand, the highly structured, age-and-rank-governed nature of Korean corporate hierarchy can create friction with the more flexible and egalitarian approaches often found in contemporary Hungarian management. To translate the massive Foreign Direct Investment (FDI) inflows and strengthening bilateral trade agreements into long-term organisational success, specific cultural intelligence must be applied.

Based on these academic findings, the following strategic recommendations are formulated for Hungarian business professionals, diplomats, and managers engaging with South Korean counterparts:

• Prioritise meticulous protocol and hierarchy: Hungarian negotiators must strictly observe the rank, age, and status of their Korean partners. Communication and decision-making should flow through appropriate hierarchical channels. Failing to grant the expected level of respect or bypassing a superior can cause the Korean partner to lose face, which may result in them withdrawing from the cooperation entirely or treating the Hungarian party as "impersonal."

• Master the art of indirect communication: Given the highly contextual and reactive nature of Korean communication, Hungarians should avoid overly blunt, aggressive, or purely linear arguments. Silence, pauses, and non-verbal cues should be respected rather than filled with rapid speech. Criticism should never be voiced publicly; instead, it must be addressed with utmost subtlety, discretion, and ideally in private settings to preserve the harmony of the group.

• Bridge the gap in time perception: While Hungarians tend to lose their sense of time during engaging discussions, they must recognise that South Koreans, despite their polychronic worldview, operate with an intensely industrious and punctual "Americanised" attitude toward daily tasks. Respecting schedules and demonstrating a high work ethic are critical to building initial trust.

• Invest heavily in relationship-oriented pre-negotiations: Since Korean business culture is deeply particularist, trust is not placed in abstract contracts but in the individuals representing the companies. Hungarian professionals should be prepared to invest substantial time in informal socialising, dining, and network-building before expecting concrete business commitments.

Ultimately, the synergy between Hungarian adaptability and South Korean formidable industrial execution can yield outstanding results, provided that both actors—particularly the Hungarian side as the host and partner—actively decode and respect the cultural value systems governing their counterparts' behaviour.

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KOMMUNIKATION DURCH KLEIDUNG / COMMUNICATION THROUGH CLOTHING

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Abstract: *Nonverbal communication is an essential component of social interactions, contributing to the transmission of messages and the formation of perceptions about others. Among the elements of nonverbal communication is clothing, which functions as a symbolic language through which individuals convey information about their identity, social status, personality, and cultural values. The way a person dresses can influence others' perceptions and contribute to the formation of first impressions in social interactions. This paper analyzes the role of clothing as a form of nonverbal communication, highlighting the psychological, social, and cultural dimensions of this phenomenon. The theoretical foundations of nonverbal communication are presented, and the main functions of clothing in the process of conveying social messages are analyzed. Additionally, the meanings of colors and clothing styles are addressed, as well as their role in building personal and professional image. The paper also analyzes the role of clothing in the organizational environment, where it can reflect the institutional culture and values of the organization. The conclusions highlight the fact that clothing is an important tool of social communication, influencing interpersonal perceptions, social relationships, and the professional image of the individual in contemporary society.*

Keywords: *communication; nonverbal; clothing; image; colors*

JEL Classification: *Z13*

1. Einleitung

Kommunikation ist einer der grundlegenden Prozesse des menschlichen Daseins und bildet die Basis für soziale Interaktionen und die Organisation der Gesellschaft. Durch Kommunikation vermitteln Menschen Informationen, Emotionen, Einstellungen und Werte und tragen so zur Bildung zwischenmenschlicher Beziehungen und zur Konstruktion sozialer Identitäten bei. Traditionell wurde Kommunikation hauptsächlich mit der verbalen Sprache in Verbindung gebracht, doch Forschungen aus den Bereichen Sozialpsychologie und Soziologie haben gezeigt, dass ein Großteil der in sozialen Interaktionen vermittelten Bedeutungen durch nonverbale Mittel kommuniziert wird.

Nonverbale Kommunikation umfasst eine Vielzahl von Elementen wie Mimik, Gestik, Körperhaltung, Blickkontakt, Proxemik und das äußere Erscheinungsbild des Individuums. Diese Kommunikationsformen können verbale Botschaften ergänzen oder sogar widersprechen und tragen dazu bei, subtile Informationen über die Emotionen und Einstellungen der Gesprächspartner zu vermitteln. Laut Mehrabian

(1972) spielen nonverbale Elemente eine wichtige Rolle bei der Vermittlung von Emotionen und der Interpretation sozialer Botschaften.

Ein wesentliches Element der nonverbalen Kommunikation ist die Kleidung. Die Art und Weise, wie sich eine Person kleidet, kann Informationen über den sozialen Status, die Persönlichkeit und die kulturellen Werte des Individuums vermitteln. Kleidung ist oft das erste Element, das in einer sozialen Interaktion wahrgenommen wird, und kann die Wahrnehmung der Gesprächspartner bereits in den ersten Augenblicken der Begegnung beeinflussen.

Der Soziologe Erving Goffman (1959) hat untersucht, wie Individuen ihre soziale Identität durch den Prozess der „Selbstdarstellung" konstruieren. Im Rahmen dieses Prozesses wenden Menschen verschiedene Strategien an, um den Eindruck zu steuern, den sie auf andere machen. Die Kleidung ist eine der wichtigsten dieser Strategien, da sie Aussagen über den sozialen Status, die berufliche Rolle und die kulturelle Identität des Einzelnen vermitteln kann.

Zudem können Mode und Kleidungsstile die soziale Struktur und die Unterschiede zwischen den sozialen Schichten widerspiegeln. Soziologen wie Georg Simmel (1904) und Pierre Bourdieu (1984) haben die Rolle der Mode in der Gesellschaft analysiert und dabei hervorgehoben, dass Kleidung als Indikator für den sozialen Status und das kulturelle Kapital fungieren kann.

In der heutigen Gesellschaft, die durch eine ausgeprägte Ausrichtung auf Image und visuelle Darstellung gekennzeichnet ist, wird die Kleidung zu einem wichtigen Instrument der sozialen Kommunikation. Im beruflichen Umfeld kann die Art und Weise, wie sich eine Person kleidet, die Wahrnehmung ihrer Kompetenz und Glaubwürdigkeit beeinflussen. Gleichzeitig kann der Kleidungsstil die kulturelle Identität und die persönlichen Werte des Einzelnen widerspiegeln.

Die vorliegende Arbeit hat zum Ziel, Kleidung als Form der nonverbalen Kommunikation zu analysieren und dabei die psychologischen, sozialen und kulturellen Dimensionen dieses Phänomens hervorzuheben. In diesem Sinne werden die theoretischen Grundlagen der nonverbalen Kommunikation, die Rolle der Kleidung bei der Bildung des ersten Eindrucks, die Bedeutung von Farben sowie der Einfluss des kulturellen Kontexts auf Kleidungsstile untersucht. Zudem befasst sich die Arbeit mit der Rolle der Kleidung im organisatorischen Umfeld und dem Zusammenhang zwischen Mode und sozialer Schichtung.

Mit dieser Analyse soll aufgezeigt werden, dass Kleidung nicht nur ein ästhetisches oder funktionales Element darstellt, sondern auch ein komplexes Instrument der sozialen Kommunikation, das die Wahrnehmungen, zwischenmenschlichen Beziehungen und die Identität von Individuen in der heutigen Gesellschaft beeinflusst.

Vor dem Hintergrund dieser theoretischen Überlegungen wird die Analyse der Kleidung als Form der nonverbalen Kommunikation relevant für das Verständnis der Mechanismen, durch die Individuen soziale Botschaften vermitteln und ihre Identität im Rahmen alltäglicher Interaktionen konstruieren.

2. Nonverbale Kommunikation – theoretische Grundlagen

Nonverbale Kommunikation ist ein wesentlicher Bestandteil sozialer Interaktionen und wurde in Disziplinen wie Sozialpsychologie, Soziologie und Kommunikationswissenschaft ausführlich untersucht. Im Allgemeinen wird nonverbale Kommunikation als die Gesamtheit der Verhaltensweisen und Signale definiert, durch die Individuen Informationen ohne direkten Einsatz verbaler Sprache

vermitteln. Zu diesen Kommunikationsformen gehören Mimik, Gestik, Körperhaltung, Blickkontakt, Proxemik, Stimmlage und äußeres Erscheinungsbild.
Studien im Bereich der Kommunikationswissenschaft zeigen, dass nonverbale Elemente eine erhebliche Menge an Informationen über die emotionalen Zustände und Einstellungen von Menschen vermitteln können. Albert Mehrabian (1972) betont, dass Menschen nonverbalen Elementen bei der Interpretation der Emotionen ihrer Gesprächspartner große Bedeutung beimessen. Obwohl sein Modell manchmal vereinfacht interpretiert wurde, haben seine Forschungen die wichtige Rolle der nonverbalen Kommunikation bei der Vermittlung emotionaler Botschaften aufgezeigt.
Mark Knapp, Judith Hall und Terrence Horgan (2013) identifizieren mehrere Funktionen der nonverbalen Kommunikation. Erstens kann sie verbale Botschaften ergänzen und zusätzliche Informationen über die Emotionen oder Absichten einer Person liefern. Zweitens kann nonverbale Kommunikation verbale Botschaften unterstreichen oder im Widerspruch zu diesen stehen. Zudem trägt nonverbale Kommunikation zur Regulierung sozialer Interaktionen bei, indem sie den Grad der Beteiligung der Gesprächspartner anzeigt und den Gesprächsverlauf erleichtert.
Ein wichtiges Element der nonverbalen Kommunikation ist das äußere Erscheinungsbild des Einzelnen. Kleidung, Frisur und Accessoires sind sichtbare Elemente, die Informationen über die soziale und kulturelle Identität einer Person vermitteln. In vielen sozialen Situationen ist die Kleidung das erste Element, das von den Gesprächspartnern wahrgenommen wird, und trägt so zur Bildung erster Eindrücke bei.
Zusammenfassend lässt sich sagen, dass nonverbale Kommunikation ein komplexes System zur Übermittlung sozialer Botschaften darstellt und die Kleidung eine wichtige Komponente dieses Systems ist, da sie Informationen über den sozialen Status, die Persönlichkeit und die Werte des Einzelnen vermitteln kann.

3. Kleidung als soziale Sprache

Kleidung kann aus soziologischer Perspektive als soziale Sprache betrachtet werden, durch die Individuen Botschaften über ihre Identität und ihre Stellung in der Gesellschaft vermitteln. Kleidung ist nicht nur ein funktionales Objekt zum Schutz des Körpers, sondern auch ein kulturelles Symbol, das die Normen und Werte einer Gemeinschaft widerspiegelt.
Roland Barthes (1967) betrachtete Mode als ein mit der Sprache vergleichbares Zeichensystem, in dem jedes Kleidungsstück eine bestimmte Bedeutung vermittelt. So können Farbe, Material, Schnitt oder Stil eines Kleidungsstücks Informationen über den sozialen Status, den Beruf oder die Persönlichkeit des Einzelnen vermitteln.
Die Kleidung spiegelt oft den sozialen und kulturellen Kontext wider, in dem der Einzelne lebt. In verschiedenen historischen Epochen wurde Kleidung genutzt, um Unterschiede zwischen sozialen Schichten zu markieren oder die Zugehörigkeit zu bestimmten sozialen Gruppen hervorzuheben. In modernen Gesellschaften fungiert Kleidung, obwohl diese Unterschiede weniger offensichtlich sind, weiterhin als Indikator für den sozialen Status.
Der Soziologe Georg Simmel (1904) betrachtete Mode als ein soziales Phänomen, das durch zwei widersprüchliche Tendenzen gekennzeichnet ist: den Wunsch nach Anpassung und den Wunsch nach Differenzierung. Einerseits übernehmen

Individuen bestimmte Kleidungsstile, um sich in eine soziale Gruppe zu integrieren. Andererseits versuchen sie, ihre Individualität durch unverwechselbare Kleidungselemente zum Ausdruck zu bringen.

Zudem kann die Kleidung die Selbstwahrnehmung des Einzelnen beeinflussen. Studien von Adam und Galinsky (2012) haben gezeigt, dass Kleidung das Verhalten und die Leistungsfähigkeit von Menschen beeinflussen kann – ein Phänomen, das als „Enclothed Cognition" bekannt ist. Diese Forschungen legen nahe, dass Kleidung nicht nur Botschaften an andere vermittelt, sondern auch die Art und Weise beeinflussen kann, wie Menschen sich selbst wahrnehmen.

In diesem Zusammenhang stellt die Kleidung nicht nur eine Form des Ausdrucks sozialer Identität dar, sondern auch einen wichtigen Faktor im Prozess der Bildung zwischenmenschlicher Wahrnehmungen. Somit kann die Art und Weise, wie sich eine Person kleidet, die Eindrücke beeinflussen, die andere von ihr gewinnen – ein Aspekt, der im folgenden Kapitel analysiert wird.

4. Kleidung und die Entstehung des ersten Eindrucks

Der erste Eindruck ist ein grundlegender Aspekt sozialer Interaktionen, da er die Art und Weise beeinflusst, wie Individuen von anderen wahrgenommen und bewertet werden. Studien aus dem Bereich der Sozialpsychologie zeigen, dass Menschen sich bereits in den ersten Sekunden einer Begegnung eine Meinung über eine Person bilden (Ambady & Rosenthal, 1992).

Die Kleidung ist einer der Hauptfaktoren, die zur Bildung dieses ersten Eindrucks beitragen. Kleidung kann Informationen über den sozialen Status, die Persönlichkeit des Einzelnen und dessen Professionalität vermitteln. So kann beispielsweise formelle Kleidung Seriosität, Verantwortungsbewusstsein und fachliche Kompetenz suggerieren, während legere Kleidung Entspannung und Kreativität vermitteln kann. Das als „Halo-Effekt" bekannte psychologische Phänomen erklärt, wie ein sichtbares positives Merkmal die Gesamtbewertung einer Person beeinflussen kann (Nisbett & Wilson, 1977). So kann eine gut gekleidete Person als kompetenter oder intelligenter wahrgenommen werden, auch wenn diese Eigenschaften nicht direkt beobachtbar sind.

Im beruflichen Umfeld kann die Kleidung einen erheblichen Einfluss auf den Erfolg einer Person haben. Untersuchungen zeigen, dass Personen, die sich dem beruflichen Kontext entsprechend kleiden, als glaubwürdiger und kompetenter wahrgenommen werden.

Somit wird die Kleidung zu einem wesentlichen Element der nonverbalen Kommunikation, trägt zur Bildung sozialer Wahrnehmungen bei und beeinflusst die Art und Weise, wie Menschen in verschiedenen sozialen und beruflichen Kontexten bewertet werden.

5. Die Bedeutung von Farben in der Kleidung

Mioara Tatarescu (2021) ist der Meinung „Wir wählen unsere Kleidung aus, und diese Wahl spiegelt unsere Stimmung, unsere Wünsche und Absichten, aber auch unsere Persönlichkeitsmerkmale wider. Die Farbe ist ein äußerer Faktor, der zu einer subjektiven Instanz wird, die unseren emotionalen Bereich beeinflusst oder nährt, mit sichtbaren Auswirkungen auf unsere Absichten, unser Verhalten, unsere Handlungen und unsere Beziehungen. Wenn wir den Kleiderschrank öffnen und ein Kleidungsstück auswählen, ist das erste Auswahlkriterium unbewusst die Farbe, denn sie muss mit dem übereinstimmen, was wir fühlen, oder das ausdrücken, was wir fühlen möchten."

Farben sind ein grundlegendes Element der kleidungsbezogenen Kommunikation, da sie symbolische und emotionale Botschaften vermitteln, die die soziale Wahrnehmung beeinflussen können. Die Wahl der Farben in der Kleidung ist kein zufälliger Prozess, sondern wird von psychologischen, kulturellen und sozialen Faktoren beeinflusst. In vielen Situationen können Farben Informationen über den emotionalen Zustand einer Person, über ihre Persönlichkeit oder über die Rolle, die sie in einem bestimmten sozialen Kontext einnimmt, vermitteln.

In der Farbpsychologie geht man davon aus, dass verschiedene Farbtöne unterschiedliche emotionale Reaktionen hervorrufen und die Art und Weise beeinflussen können, wie eine Person von anderen wahrgenommen wird. Elliot und Maier (2014) heben hervor, dass die Wahrnehmung von Farben eng mit kognitiven und emotionalen Prozessen verbunden ist und dass die damit verbundenen Bedeutungen das Ergebnis kultureller und sozialer Erfahrungen sind.

So wird beispielsweise die Farbe Rot oft mit Energie, Leidenschaft und Dominanz assoziiert. In bestimmten sozialen Kontexten kann sie auf eine starke Persönlichkeit und ein hohes Maß an Selbstvertrauen hindeuten. Gleichzeitig kann der übermäßige Einsatz dieser Farbe im beruflichen Umfeld auch Aggressivität oder dominante Tendenzen vermitteln. Studien zeigen, dass Personen, die die Farbe Rot tragen, als stärker oder wettbewerbsorientierter wahrgenommen werden können.

Die Farbe Blau wird häufig mit Stabilität, Vertrauen und Professionalität assoziiert. Aus diesem Grund verwenden viele Organisationen diese Farbe in ihrer visuellen Identität oder in den Uniformen ihrer Mitarbeiter. Im Geschäftsleben wird Blau als eine Farbe wahrgenommen, die Ruhe, Rationalität und Glaubwürdigkeit vermittelt.

Schwarz gilt in vielen Kulturen als Symbol für Eleganz, Autorität und Raffinesse. Schwarze oder marineblaue Anzüge werden im beruflichen Umfeld häufig getragen, da sie Professionalität und Kontrolle vermitteln. In bestimmten kulturellen Kontexten kann Schwarz jedoch auch mit übertriebener Förmlichkeit oder Traurigkeit assoziiert werden.

Auf der anderen Seite werden helle Farben wie Gelb oder Orange mit Optimismus, Kreativität und Energie assoziiert. Diese Farben können auf eine gesellige und offene Persönlichkeit hindeuten und werden häufig in kreativen Bereichen oder in informellen Kontexten verwendet.

Ein wichtiger Aspekt der Kommunikation durch Farben ist die kulturelle Variabilität ihrer Bedeutungen. So wird beispielsweise in der westlichen Kultur die Farbe Weiß mit Reinheit und freudigen Ereignissen assoziiert, während sie in bestimmten asiatischen Kulturen mit Trauer und Traurigkeit in Verbindung gebracht wird. Dies verdeutlicht, dass die Interpretation von Farben vom kulturellen Kontext beeinflusst wird.

Daher stellen Farben ein wesentliches Element der Kleidungskommunikation dar und tragen dazu bei, subtile Botschaften über die Persönlichkeit, den emotionalen Zustand und den sozialen Status des Individuums zu vermitteln.

6. Kleidung im organisatorischen Umfeld

Kleidung spielt im organisatorischen Umfeld eine wichtige Rolle, da sie zur Schaffung eines professionellen Images und zur Vermittlung institutioneller Werte beiträgt. Die Art und Weise, wie sich Mitarbeiter kleiden, spiegelt die Unternehmenskultur wider und beeinflusst die Wahrnehmung von Kunden, Kollegen und Geschäftspartnern.

Rafaeli und Pratt (1993) vertreten die Ansicht, dass die Kleidung im Unternehmenskontext ein wichtiges Instrument der institutionellen Kommunikation darstellt. Die von Organisationen festgelegten Kleidungsvorschriften sind nicht nur formale Regeln, sondern auch Mittel, mit denen Organisationen Werte wie Professionalität, Disziplin und Verantwortungsbewusstsein vermitteln.

In vielen Organisationen gibt es klare Regeln für die Kleidung der Mitarbeiter, die als Kleiderordnung bekannt sind. Diese Regeln können je nach Tätigkeitsbereich und Organisationskultur variieren. In Bereichen wie Finanzen, Recht oder öffentlicher Verwaltung gilt formelle Kleidung als Zeichen von Professionalität.

In anderen Organisationen, insbesondere in kreativen oder technologischen Bereichen, herrscht eine größere Flexibilität hinsichtlich des Kleidungsstils. In diesen Kontexten wird der informelle Stil mit Kreativität, Innovation und freier Meinungsäußerung assoziiert.

Uniformen sind ein klares Beispiel für die Rolle der Kleidung im organisatorischen Umfeld. Sie werden in Berufen wie Medizin, Polizei, Militär oder Luftfahrt verwendet, da sie Autorität, Verantwortung und Zugehörigkeit zu einer Institution vermitteln. Uniformen tragen zudem dazu bei, ein Zugehörigkeitsgefühl zu schaffen und die berufliche Identität zu stärken.

Kleidung kann auch das Verhalten der Mitarbeiter beeinflussen. Studien zeigen, dass Personen, die Kleidung tragen, die mit Professionalität assoziiert wird, dazu neigen, sich verantwortungsbewusster und disziplinierter zu verhalten.

Daher ist die Kleiderordnung nicht nur eine ästhetische Frage, sondern ein strategisches Element der institutionellen Kommunikation und des Image-Managements.

So spiegelt die Kleidung nicht nur die berufliche Identität des Einzelnen wider, sondern auch die soziale Struktur und die Werte der Gesellschaft. In diesem Sinne stellt die Beziehung zwischen Mode und sozialer Schichtung einen wichtigen Aspekt der soziologischen Analyse der Kleidung dar.

7. Kleidung und soziale Schichtung

Kleidung ist eines der offensichtlichsten Mittel, mit denen Individuen ihre Position innerhalb der sozialen Struktur zum Ausdruck bringen. Im Laufe der Geschichte hatte Kleidung nicht nur eine praktische Funktion zum Schutz des Körpers, sondern auch eine wichtige symbolische Funktion, da sie dazu diente, den sozialen Status, die wirtschaftliche Stellung und die Zugehörigkeit zu bestimmten sozialen Gruppen widerzuspiegeln. In vielen traditionellen Gesellschaften waren bestimmte Arten von Stoffen, Farben oder Kleidungsstilen ausschließlich den sozialen Eliten vorbehalten, und der Zugang zu ihnen wurde durch soziale Normen oder sogar durch Gesetze geregelt.

Aus soziologischer Perspektive kann Kleidung als Indikator für Unterschiede zwischen den sozialen Schichten und für Machtverhältnisse innerhalb der Gesellschaft analysiert werden. Thorstein Veblen (1899) führte das Konzept des auffälligen Konsums (conspicuous consumption) ein, das sich auf die Tendenz von Individuen bezieht, sichtbare Güter zu nutzen, um wirtschaftlichen Erfolg und soziale Stellung zu demonstrieren. In diesem Zusammenhang werden Luxuskleidung, seltene Stoffe oder teure Accessoires zu Symbolen für soziales Prestige und die Zugehörigkeit zu den privilegierten Schichten. Der auffällige Konsum ermöglicht es dem Einzelnen, Signale über seinen wirtschaftlichen Status zu senden und seine Position in der sozialen Hierarchie zu festigen.

In modernen Gesellschaften spielt die Kleidung bei der sozialen Schichtung nach wie vor eine bedeutende Rolle, auch wenn die Unterschiede zwischen den sozialen Schichten weniger offensichtlich sind als in der Vergangenheit. Markenkleidung, raffinierte Kleidungsstile oder der Zugang zu bestimmten Marken sind oft Indikatoren für den wirtschaftlichen Status und das kulturelle Kapital von Individuen. Die Wahl bestimmter Kleidungsstile kann nicht nur das Einkommensniveau, sondern auch den Bildungsstand, das soziale Umfeld und die kulturellen Werte einer Person widerspiegeln.

Pierre Bourdieu (1984) bietet eine komplexe Perspektive auf die Beziehung zwischen Geschmack, Lebensstil und sozialer Schichtung. In seiner Theorie des kulturellen Kapitals argumentiert Bourdieu, dass die soziale Position von Individuen nicht nur durch wirtschaftliche Ressourcen bestimmt wird, sondern auch durch kulturelle Ressourcen wie Bildung, ästhetische Vorlieben oder Lebensstil. Zum kulturellen Kapital gehören unter anderem Vorlieben für bestimmte Kunstformen, die in sozialen Interaktionen verwendete Sprache und der gewählte Kleidungsstil. Diese Elemente tragen zur Definition der sozialen Identität und zur Unterscheidung zwischen sozialen Gruppen bei.

In seinem Werk *„Distinction: A Social Critique of the Judgement of* Taste“ argumentiert Bourdieu, dass ästhetische Vorlieben, einschließlich Kleidungsvorlieben, soziale Strukturen widerspiegeln und zu deren Reproduktion beitragen. Der Kleidungsstil wird so zu einem sozialen Marker, der die Zugehörigkeit zu bestimmten sozialen Klassen anzeigt und die Unterschiede zwischen diesen festigt. Laut Bourdieu ist Geschmack nicht nur eine individuelle Präferenz, sondern ein sozialer Mechanismus, durch den Individuen innerhalb der Gesellschaft klassifizieren und klassifiziert werden.

Zudem kann Kleidung als Instrument der sozialen Unterscheidung fungieren, durch das Individuen versuchen, sich von anderen sozialen Gruppen abzugrenzen. Beispielsweise werden bestimmte Kleidungsstile oder Marken mit kulturellen oder wirtschaftlichen Eliten assoziiert und können dazu dienen, die Zugehörigkeit zu diesen Gruppen zu signalisieren. Gleichzeitig ist Mode durch einen kontinuierlichen Veränderungsprozess gekennzeichnet, da die von den Eliten übernommenen Stile oft von anderen sozialen Gruppen nachgeahmt werden. Dieses Phänomen veranlasst die Eliten dazu, neue Stile anzunehmen, um die sozialen Unterschiede aufrechtzuerhalten.

In der heutigen Gesellschaft haben die Globalisierung und die Entwicklung der Modeindustrie dazu beigetragen, den Zugang zu bestimmten Kleidungsstilen zu demokratisieren. Doch auch wenn viele Kleidungsstücke einem breiten Publikum zugänglich sind, zeigen sich soziale Unterschiede weiterhin in Feinheiten des Stils, der Materialqualität oder der verwendeten Marken. Aktuelle Studien zeigen, dass Mode nach wie vor ein Indikator für soziale Hierarchien und ein Mechanismus ist, durch den Individuen ihre soziale Identität aushandeln.

Darüber hinaus kann die Kleidung beeinflussen, wie Individuen in verschiedenen sozialen Kontexten wahrgenommen werden. Im beruflichen Umfeld beispielsweise werden bestimmte Kleidungsstile mit Autorität und Kompetenz assoziiert, und deren Übernahme kann zur Festigung des sozialen Status des Individuums beitragen. Gleichzeitig können informelle Kleidungsstile die Zugehörigkeit zu Subkulturen oder alternativen sozialen Gruppen widerspiegeln.

Daher stellt die Kleidung ein wichtiges Element der sozialen Schichtung dar, da sie die wirtschaftlichen, kulturellen und symbolischen Unterschiede zwischen Individuen

widerspiegelt. Kleidung ist nicht nur ein Gebrauchsgegenstand, sondern auch ein soziales Symbol, das Botschaften über die Identität, den Status und die Werte der Person vermittelt, die sie trägt. Die Analyse der Kleidung aus soziologischer Perspektive ermöglicht ein besseres Verständnis dafür, wie soziale Beziehungen und Klassenhierarchien in der heutigen Gesellschaft aufgebaut und reproduziert werden.
Daher verdeutlicht die Analyse der Kleidung aus der Perspektive der sozialen Schichtung, dass Kleidung als soziale Symbole fungiert, durch die Individuen ihre Position innerhalb sozialer Hierarchien zum Ausdruck bringen.
8. Kleidung als kultureller Ausdruck
Kleidung ist eine wichtige Form des Ausdrucks kultureller Identität und spiegelt die Werte, Traditionen und Normen einer Gesellschaft wider. Kleidung ist nicht nur ein funktionales Objekt, sondern auch ein kulturelles Symbol, das Informationen über die Zugehörigkeit zu einer Gemeinschaft, über den sozialen Status und über die kollektiven Werte einer Gesellschaft vermittelt. In diesem Sinne kann Kleidung als ein System kultureller Zeichen analysiert werden, durch das Individuen Informationen über ihre Identität und ihre Beziehung zum sozialen Umfeld vermitteln.
In vielen traditionellen Gesellschaften sind Kleidungsstile eng mit der kulturellen Identität und den sozialen Normen verbunden. Traditionelle Kleidung kann den Familienstand, die soziale Stellung oder die Zugehörigkeit zu einer bestimmten Gemeinschaft widerspiegeln. Beispielsweise können in bestimmten Kulturen Farben oder Stoffmuster auf die Zugehörigkeit zu einer bestimmten ethnischen Gruppe oder einer bestimmten geografischen Region hinweisen. So wird Kleidung zu einem wichtigen Instrument, durch das kollektive Identität zum Ausdruck gebracht und von Generation zu Generation weitergegeben wird.
Joanne Entwistle (2000) betont, dass Kleidung im sozialen und kulturellen Kontext betrachtet werden muss, in dem sie auftritt. Ihr zufolge stellt Kleidung eine Schnittstelle zwischen Körper, Kultur und Gesellschaft dar. Die Art und Weise, wie sich Menschen kleiden, wird von kulturellen Normen, sozialen Werten und den wirtschaftlichen Strukturen der Gesellschaft, in der sie leben, beeinflusst.
Zudem kann die Kleidung die sozialen und kulturellen Veränderungen einer Gesellschaft widerspiegeln. Im Laufe der Geschichte haben politische, wirtschaftliche und kulturelle Umwälzungen die Kleidungsstile beeinflusst. So trugen beispielsweise die industriellen Revolutionen und die Entwicklung der Textilindustrie dazu bei, den Zugang zu Kleidung zu demokratisieren und die Kleidungsstile zu diversifizieren.
In der heutigen Gesellschaft hat die Globalisierung einen erheblichen Einfluss auf die Mode und die Kleidungsstile gehabt. Die Interaktion zwischen verschiedenen Kulturen hat zur Entstehung hybrider Stile geführt, die traditionelle und moderne Elemente miteinander verbinden. Die globale Mode ermöglicht die schnelle Verbreitung von Kleidungsstilen und Trends zwischen verschiedenen Regionen der Welt.
Diana Crane (2000) zeigt, dass die zeitgenössische Mode die sozialen und wirtschaftlichen Veränderungen der globalen Gesellschaft widerspiegelt und zu einem Mittel wird, durch das Individuen ihre Identität in einem multikulturellen Kontext zum Ausdruck bringen. In diesem Sinne kann Kleidung als Instrument interpretiert werden, mit dem Individuen das Verhältnis zwischen Tradition und Moderne aushandeln.

Ein weiterer wichtiger Aspekt der Kleidung als kultureller Ausdruck ist ihre Rolle bei der Konstruktion kollektiver Identitäten. In vielen Gemeinschaften wird traditionelle Kleidung bei religiösen Zeremonien oder wichtigen kulturellen Veranstaltungen getragen. Diese Kleidungsstücke tragen zur Stärkung der kulturellen Identität und zur Bewahrung von Traditionen bei.

Gleichzeitig ermöglicht die zeitgenössische Mode dem Einzelnen, seine persönliche Identität durch den Kleidungsstil zum Ausdruck zu bringen. Die Wahl bestimmter Kleidungsstücke, Accessoires oder Stile kann ästhetische Vorlieben, persönliche Werte oder die Zugehörigkeit zu bestimmten Subkulturen widerspiegeln.

Daher stellt die Kleidung ein komplexes kulturelles Phänomen dar, das die Beziehung zwischen Individuum und Gesellschaft widerspiegelt. Kleidung kann sowohl als Symbol kollektiver Identität als auch als Mittel zum Ausdruck von Individualität fungieren.

Somit kann Kleidung als komplexes kulturelles Phänomen interpretiert werden, das sowohl die kollektiven Werte einer Gesellschaft als auch die individuelle Identität der Personen widerspiegelt, die bestimmte Kleidungsstile annehmen.

9. Kleidung und persönliches Erscheinungsbild

Das persönliche Erscheinungsbild ist die Art und Weise, wie ein Individuum von anderen im Rahmen sozialer Interaktionen wahrgenommen wird. Es wird von mehreren Faktoren beeinflusst, wie zum Beispiel dem Verhalten, der verbalen und nonverbalen Sprache sowie dem äußeren Erscheinungsbild. In diesem Zusammenhang spielt die Kleidung eine wesentliche Rolle bei der Gestaltung des persönlichen Erscheinungsbilds und bei der Vermittlung von Botschaften über die Identität des Individuums.

Kleidung kann Informationen über die Persönlichkeit, die Werte und den Lebensstil einer Person vermitteln. Die Art und Weise, wie sich eine Person kleidet, kann auf den Grad an Professionalität, den sozialen Status oder die kulturelle Zugehörigkeit hindeuten. So kann beispielsweise formelle Kleidung Seriosität und Verantwortungsbewusstsein vermitteln, während legere Kleidung Kreativität und Offenheit suggerieren kann.

David Leathers (1997) argumentiert, dass das äußere Erscheinungsbild ein wichtiges Element der nonverbalen Kommunikation darstellt und die Glaubwürdigkeit einer Person beeinflussen kann. Personen, die sich dem sozialen oder beruflichen Kontext entsprechend kleiden, werden oft als kompetenter und verantwortungsbewusster wahrgenommen.

Im beruflichen Umfeld spielt das persönliche Erscheinungsbild eine wichtige Rolle für den beruflichen Erfolg. Zahlreiche Studien zeigen, dass die Kleidung beeinflussen kann, wie eine Person bei Vorstellungsgesprächen oder Geschäftstreffen bewertet wird. Eine professionelle Kleidung kann dazu beitragen, ein Bild von Kompetenz und Professionalität zu vermitteln.

Zudem kann die Kleidung das Selbstvertrauen einer Person beeinflussen. Studien aus der Sozialpsychologie zeigen, dass eine Person, die sich in ihrer Kleidung wohl und selbstbewusst fühlt, in sozialen Interaktionen eine sicherere und offenere Haltung an den Tag legen kann.

In der heutigen Gesellschaft wird das persönliche Image auch durch das digitale Umfeld und soziale Netzwerke beeinflusst. Online-Plattformen haben die Bedeutung des visuellen Erscheinungsbildes verstärkt und zur Entwicklung einer Kultur der Selbstdarstellung beigetragen. In diesem Zusammenhang wird die Kleidung zu

einem wichtigen Instrument, mit dem Menschen ihre Identität aufbauen und ihr öffentliches Image gestalten.
Zudem kann der Kleidungsstil die Zugehörigkeit zu bestimmten sozialen Gruppen oder Subkulturen widerspiegeln. So werden bestimmte Kleidungsstile beispielsweise mit spezifischen künstlerischen, beruflichen oder kulturellen Gruppen assoziiert. Durch die Übernahme dieser Stile können Individuen ihre Zugehörigkeit zu einer bestimmten Gruppe zum Ausdruck bringen und Botschaften über ihre soziale Identität vermitteln.
Daher stellt die Kleidung ein wesentliches Element des persönlichen Erscheinungsbildes und ein wichtiges Instrument der nonverbalen Kommunikation dar. Die Art und Weise, wie sich Menschen kleiden, beeinflusst die Wahrnehmung durch andere und trägt zur Konstruktion der sozialen und beruflichen Identität bei.
In diesem Sinne wird die Kleidung zu einem wichtigen Instrument, mit dem Menschen ihr persönliches Image im Rahmen sozialer und beruflicher Interaktionen aufbauen und steuern.

10. Schlussfolgerungen

Kleidung ist eine der sichtbarsten Formen nonverbaler Kommunikation und stellt ein wichtiges Instrument dar, mit dem Menschen Informationen über ihre Identität, ihren sozialen Status und ihre kulturellen Werte vermitteln. Die im Rahmen dieser Arbeit durchgeführte Analyse zeigt, dass Kleidung nicht nur als funktionale Gegenstände zum Schutz des Körpers betrachtet werden sollte, sondern auch als soziale Symbole, die die Struktur und Dynamik der Gesellschaft widerspiegeln.
Zunächst einmal trägt die Kleidung zur Vermittlung komplexer sozialer Botschaften und zur Bildung zwischenmenschlicher Wahrnehmungen bei. Die Art und Weise, wie sich eine Person kleidet, kann beeinflussen, wie sie von anderen wahrgenommen wird, insbesondere in den ersten Momenten einer sozialen Interaktion. Studien aus dem Bereich der Sozialpsychologie zeigen, dass Menschen sich schnell Eindrücke von anderen aufgrund ihres äußeren Erscheinungsbildes bilden, und die Kleidung spielt dabei eine wichtige Rolle.
Zweitens spiegelt die Kleidung die soziale Struktur und die Unterschiede zwischen den sozialen Schichten wider. Im Laufe der Geschichte wurde Kleidung genutzt, um den sozialen Status und die wirtschaftliche Stellung von Individuen anzuzeigen. Selbst in heutigen Gesellschaften können Kleidungsstile und die getragenen Marken als Indikatoren für das wirtschaftliche und kulturelle Kapital von Individuen dienen.
Drittens stellt Kleidung eine wichtige Form des Ausdrucks kultureller Identität dar. Kleidungsstile spiegeln die Werte, Traditionen und Normen einer Gesellschaft wider und können zur Stärkung kollektiver Identitäten beitragen. Gleichzeitig ermöglicht die zeitgenössische Mode es dem Einzelnen, seine Individualität und ästhetischen Vorlieben zum Ausdruck zu bringen.
Zudem spielt Kleidung eine wichtige Rolle im beruflichen Umfeld, wo sie die Wahrnehmung von Kompetenz, Glaubwürdigkeit und Professionalität beeinflussen kann. In vielen Organisationen werden Kleiderordnungen genutzt, um ein einheitliches institutionelles Image zu schaffen und Werte wie Seriosität und Verantwortungsbewusstsein zu vermitteln.
In der heutigen Gesellschaft, die durch eine starke Ausrichtung auf Image und visuelle Darstellung gekennzeichnet ist, wird Kleidung zu einem wichtigen Instrument der persönlichen Imagepflege. Kleidung kann beeinflussen, wie Menschen in verschiedenen sozialen Kontexten wahrgenommen werden, und zur Konstruktion der persönlichen und beruflichen Identität beitragen.

Daher bietet die Analyse der Kleidung aus der Perspektive der nonverbalen Kommunikation einen wertvollen Einblick in die Art und Weise, wie Menschen ihre Identität aufbauen und in der modernen Gesellschaft interagieren. Kleidung kann als komplexes soziales Phänomen verstanden werden, das die Beziehungen zwischen Individuum, Kultur und Gesellschaft widerspiegelt.

Zusammenfassend lässt sich sagen, dass Kleidung ein zentrales Element der nonverbalen Kommunikation und ein wichtiges Instrument darstellt, mit dem Individuen ihre soziale und kulturelle Identität zum Ausdruck bringen. Die Analyse dieses Phänomens bietet einen relevanten Einblick in die Art und Weise, wie Image, Symbole und soziale Werte die zwischenmenschlichen Beziehungen und die Struktur der heutigen Gesellschaft beeinflussen.

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LA COMMUNICATION RSE DE L'ENTREPRISE: PRATIQUES ET STRATÉGIES DISCURSIVES / CORPORATE SOCIAL RESPONSIBILITY COMMUNICATION: PRACTICES AND DISCURSIVE STRATEGIES

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Abstract: *In this paper, we will demonstrate how the company has diversified its areas of interest and scope of activity beyond manufacturing, paying increasing attention to the impact of its operations on society and the environment, as well as to the need to prioritize internal and external communication. The importance of communication strategies, the proliferation of media channels, and the constant renewal of topics have become imperative due to societal changes and legal obligations. Against the backdrop of demands to protect the environment and society, the concepts of social responsibility and sustainable development have increasingly concerned not only authorities but also corporate leadership and communication managers. In recent years, social communication has become increasingly important, which is why companies have strived to organize activities and events that strengthen solidarity and social bonds, develop strategies, and implement social responsibility initiatives, which they then publicize. In addition to the requirement to include social responsibility topics in management reports, many companies have incorporated information about their Corporate Social Responsibility (CSR) strategies into their official websites. These are both part of the strategy to build and present the organization's identity and part of its marketing strategy. Using methods and concepts from the field of discourse analysis, we will examine how discourse is constructed on the official websites of medical device manufacturers, what information is selected, how it is prioritized and organized, and what proportion of the website's content is dedicated to CSR-related information. Last but not least, we will highlight the need to enrich the curriculum of business language courses with digital materials related to social communication.*

Keywords: *Communication; Corporate Social Responsibility; Discourse Analysis; Reporting; Reputation; Sustainability*

JEL classification: *M14; Z13; Z19*

1. Introduction

Le concept de Responsabilité Sociale des Entreprises (RSE) n'a pas été inventé par une seule personne. Historiquement, le crédit revient surtout à Howard R. Bowen, considéré comme le père fondateur de la RSE moderne. Bowen pose les bases théoriques de la RSE dans son ouvrage, "Social Responsibilities of the Businessman" (1953). L'idée centrale est la suivante: les entreprises ont des

obligations envers la société, au-delà du simple profit, et doivent tenir compte des impacts sociaux et éthiques de leurs décisions.

Carroll (1991) va plus tard formaliser le concept avec sa pyramide des responsabilités. La pyramide comporte quatre niveaux, classés de la base vers le sommet: la responsabilité économique, la responsabilité légale, la responsabilité éthique, la responsabilité philanthropique. La base (économique) est indispensable pour que les niveaux supérieurs (légal, éthique, philanthropique) soient possibles. Cette hiérarchie montre que la RSE n'est pas seulement une question de philanthropie: l'entreprise doit d'abord être viable économiquement et respecter la loi.

Bocquet (2014: 145) étudie l'évolution du discours sur la RSE en réfléchissant aux origines de la notion et démontre que l'on a affaire à « l'un des éléments de notre modernité qui entretient probablement des liens très anciens, jusqu'à l'époque médiévale »: les corporations de métier avaient « le souci du bien commun » et effectuaient de nombreuses tâches civiques, en jouant un rôle économique et social important. La chercheure affirme que la RSE est fondée sur une éthique universelle, sur la morale et qu'elle promet « un avenir meilleur au sens matériel comme moral ». Selon Bocquet, les notions de gestion et la communication s'allient et la RSE devient un outil stratégique visant l'extension du champ de l'influence de l'entreprise vers l'espace public.

En analysant le Discours de Pie XII aux patrons, Vaccari affirmait dès 1949 la nécessité d'une « responsabilité » dans le domaine économique et social, soulignait le rôle social des patrons, l'exigence de dépasser l'individualisme et de focaliser la vie de la collectivité. Les patrons et les travailleurs devaient collaborer, en étant pleinement responsables envers la société. Ainsi, Vaccari (1949: 23) parle d'une « communauté des responsabilités » et de l'importance du « progrès moral » qui devrait accompagner l'essor économique: « C'est vrai que l'organisation productive et l'entreprise se trouvent aujourd'hui en face de perspectives de rapide évolution qui permettront à la personne humaine du travailleur de prendre la place qui lui est due. Mais il est indispensable qu'une telle évolution soit une évolution vers le mieux qui ne tende pas seulement à un relèvement économique, mais encore à un progrès moral. »

Quelques décennies plus tard, la responsabilité sociale est devenue un des sujets de prédilection du discours des entreprises. Celles-ci ont le devoir de contribuer au bien-être de la société, à la protection de l'environnement, au respect des règles éthiques. Comme le remarquent Gendron, Lapointe & Turcotte (2004), « la responsabilité sociale semble être devenue la panacée à nos problèmes de mondialisation »; dans un article consacré à l'analyse du potentiel régulatoire de la responsabilité sociale dans un contexte de mondialisation économique, ces chercheurs reprennent l'idée de Friedman (1970), selon lequel « une entreprise responsable sera, à terme, une entreprise rentable ». Ainsi, le progrès moral offrirait des récompenses à ceux qui ne visent pas seulement le gain financier.

Nous remarquons que la signification de la notion de responsabilité sociale a beaucoup évolué au cours du XXe siècle. Gendron, Lapointe & Turcotte (2004: 78-79) montrent qu'au début la responsabilité sociale ne concernait que la moralité des gens d'affaires (corruption); dans les années 1970, l'entreprise a commencé à prendre en considération l'impact environnemental de ses activités, les grands événements de l'actualité (guerres) et à mettre en place des actions pour lutter contre les discriminations (égalité des sexes, racisme); dans les années 1990, la

responsabilité sociale devient une « dimension de la performance corporative », une composante du processus d'évaluation de l'entreprise. Au cours des années, le concept a subi un processus de transformation, étant actuellement un « impératif inhérent à la nature de l'entreprise du nouveau millénaire », et non plus un « choix stratégique ». Ces chercheurs considèrent que la responsabilité sociale a trois dimensions: les pratiques (initiatives volontaires ayant des objectifs sociaux et environnementaux), le discours (contribution à l'intérêt général, non seulement à des intérêts privés) et le questionnement (questions sur la pertinence sociale de son projet productif et sur le rôle de l'entreprise dans le cadre d'un nouveau modèle de développement post-fordiste).

Dinia et Chakor (2018: 166) soulignent que la signification de la notion de responsabilité sociale peut varier d'un espace culturel à l'autre. Dans la conception anglo-saxonne (Corporate Social Responsibility), l'adjectif « social » fait référence à la fois aux relations que l'entreprise entretient avec ses parties prenantes et avec la société dans son ensemble. Dans la conception francophone, il concerne uniquement les relations entre l'employeur et l'employé. « L'entreprise est "socialement" responsable envers ses seuls salariés, mais elle est "sociétalement" responsable envers les autres parties prenantes en plus de ses employés. » À l'instar de Dinia et Chakor, nous considérons ici le terme « social » dans son sens large.

2. Définitions et thèmes de la démarche RSE

En 1976, l'OCDE propose des « Principes directeurs pour les entreprises multinationales », qu'elle révise en 2000, en introduisant des objectifs relatifs à la protection de l'environnement, au respect des droits de l'homme, à la lutte contre la corruption. L'OCDE définit la RSE comme « la contribution des entreprises au développement durable ».

La définition donnée par la Commission Européenne est la suivante: « l'intégration volontaire, par les entreprises, de préoccupations sociales et environnementales à leurs activités commerciales et leurs relations avec les parties prenantes ». (https://eur-lex.europa.eu/legal-content/FR/TXT/HTML/?uri=CELEX:52006DC0136)

Comme le soulignent Dinia et Chakor (2018), l'engagement est volontaire et s'appuie sur un objectif de développement durable. En outre, la notion concerne également la prise en compte, par l'entreprise, des besoins de ses parties prenantes.

À la fin des années 1990 nous assistons à l'internationalisation du concept de RSE. L'ONU souligne la nécessité de respecter des valeurs universelles. Ainsi, les entreprises commencent à les intégrer à leurs actions et à leur culture organisationnelle. Ces valeurs, partagées au niveau mondial, sont inscrites dans le Global Compact (GC) ou le Pacte Mondial, lancé en juillet 2000. De nombreux pays adhèrent volontairement à cette charte et s'engagent à respecter et à promouvoir ses principes.

Dinia et Chakor (2018) analysent plusieurs définitions de la RSE, en constatant que ce concept, né aux États-Unis et diffusé dans d'autres contextes culturels, est très subjectif.

La norme ISO 26000, le standard international en matière de RSE, décrit les lignes directrices et les thèmes essentiels d'une démarche RSE:

- Gouvernance de l'organisation

- Droits de l'homme
- Relations et conditions de travail
- Environnement
- Loyauté des pratiques
- Questions relatives aux consommateurs
- Communautés et développement local

Pour chacun de ces thèmes, la norme indique plusieurs domaines d'action. Il y a 34 domaines d'action dans lesquels tous types d'organisations peuvent initier des actions concrètes et des démarches afin de s'engager en faveur du développement durable. Les actions que l'organisation peut mettre en œuvre ont pour but de contribuer au bien-être de la société et à l'environnement.

Ces actions peuvent influencer, entre autres, les avantages concurrentiels de l'organisation, sa réputation, la motivation et l'engagement de ses employés, les opinions des investisseurs, des sponsors et de la communauté financière, ses relations avec les autres organisations (entreprises, institutions publiques, autorités, médias).

3. Le « reporting » RSE

En voulant assurer la transition vers un système économique et financier durable et inclusif, les nouvelles normes européennes prescrivent une obligation de « reporting ». Il s'agit d'un « processus d'amélioration de la transparence des pratiques des entreprises ». (Fotinopoulou Basurko et al., 2023: 92)

La directive (UE) 2022/2464 ("Corporate Sustainability Reporting Directive" - CSRD) impose aux grandes entreprises et aux PME cotées en bourse de communiquer, dans leur rapport de gestion, des informations relatives à l'impact de leurs activités sur l'environnement et sur la société, non seulement des informations financières. Le rapport de durabilité décrit des indicateurs de performance sur les volets environnementaux (l'impact de l'entreprise sur la planète), sociaux (l'impact de l'entreprise sur les employés, les clients, les fournisseurs) et de gouvernance (fonctionnement transparent et équitable).

L'organisation devra sélectionner, hiérarchiser, traiter les informations qu'elle rendra publiques et choisir des stratégies appropriées de transmission des informations. Parmi les bénéficiaires des informations rendues publiques dans ces rapports on trouve les investisseurs, les syndicats et les représentants des travailleurs, les clients et les consommateurs.

En complément de ses rapports de durabilité, l'organisation est libre d'élaborer d'autres types de documents (par exemple: code éthique, bulletin d'information, déclaration, communiqué) et de publier des informations concernant la RSE sur son site internet. En outre, elle peut organiser des événements, participer à des foires et des fêtes, faire des actions de mécénat, organiser des campagnes de communication et disséminer au public des informations sur sa culture et ses actions.

Par conséquent, le discours RSE a des publics, des objectifs, des visées, des dispositifs, des formes, des thèmes très variés. Dans la présente communication nous nous proposons d'examiner la manière dont les organisations accomplissent ces nouveaux rôles et devoirs, les dispositifs médiatiques utilisés, les objectifs du discours RSE, les stratégies discursives adoptées afin de satisfaire aux obligations

de transparence et de montrer la pertinence sociale de leurs activités, en nous appuyant sur la méthode de l'analyse du discours.

4. Communication sociale et discours RSE

Dans les domaines économique et juridique, la littérature sur la responsabilité sociale de l'entreprise est très riche. Toutefois, nous signalons qu'il y a moins d'études qui examinent le discours RSE du point de vue des sciences du langage. La plupart de ces études appartiennent aux chercheurs en sciences de l'information et de la communication et sont publiées dans des revues spécialisées (*Communication & Organisation, Études de communication, Les Enjeux de l'information et de la communication*).

Krieg-Planque (2015: 133) parle de la collaboration des chercheurs en sciences du langage et des chercheurs en sciences de l'information et de la communication, en soulignant l'importance de la contribution de l'analyse du discours médiatique (images, représentations, construction de l'événement) et de l'analyse du discours politique (interactions verbales, ethos). La linguiste suggère l'intérêt des travaux conjoints pour l'étude des organisations et des institutions. En sciences du langage, notamment en analyse du discours, la communication est envisagée comme une activité discursive. La linguiste insiste également sur l'apport de plusieurs autres disciplines dans l'étude du fait organisationnel, à savoir la sémiotique et la sémiologie de l'image, la narratologie, l'analyse des interactions verbales, l'étude de la pluralité des langues.

Nous pensons qu'une approche discursive peut apporter des indices sur la manière dont l'organisation intègre les exigences de la responsabilité sociale dans ses politiques et sur les stratégies auxquelles elle recourt pour les faire connaître au personnel et au public.

Krieg-Planque (2012: 29) définit la communication comme « un ensemble de savoir-faire (plus ou moins professionnels, plus ou moins intuitifs, plus ou moins standardisés...) relatifs à l'anticipation des pratiques de reprise, de transformation et de reformulation des énoncés et de leurs contenus ». Nous adhérons à l'opinion de la linguiste, qui considère la communication comme « une activité éminemment stratégique ». (Krieg-Planque, 2015: 138)

Dans un cours portant sur la communication des organisations, adressé à des étudiants en master, Stockinger (2016-2017) affirme que « la communication des organisations a comme objectif de créer ou de maintenir des relations durables entre un acteur collectif (l'organisation sociale) et une très grande diversité d'autres acteurs sociaux (individuels ou collectifs) […] dans un contexte social, économique, … donné. » Il s'agirait d'un « écosystème » dont les éléments constitutifs sont: les secteurs d'activité, les « annonceurs », les publics, les domaines spécialisés, les objets et les messages de communication, les enjeux et les objectifs de la communication, les médias, techniques et instruments de communication, l'activité centrale (la campagne de communication), d'autres activités (plan de communication, études et évaluations), des métiers et des compétences de communication, des agences de communication et de média.

Stockinger (2016-2017) dresse une typologie des domaines de communication. Nous y retrouvons la *communication non-marchande (sociale)*, dont l'objectif est de « faire savoir l'engagement social, éthique » de l'organisation. Les objectifs de l'entreprise ne se limitent pas à la recherche du profit; ils incluent également des

finalités sociales comme la création et le maintien de liens sociaux, la solidarité et la défense d'une cause.

Gendron, Lapointe et Turcotte (2004: 79) remarquent eux aussi que « chaque entreprise doit contribuer au bien commun tout en poursuivant ses propres fins ». En s'engageant dans une démarche de communication sociale, l'entreprise affirme ouvertement sa volonté et son devoir de « contribuer à l'intérêt général ».

Selon Peeters (2004: 34), « La RSE commence et se termine par de la communication ». L'entreprise communique ses engagements et ses valeurs par des « outils » de RSE », à savoir:

- l'affichage des engagements (les labels et codes de conduite)
- la mise en œuvre de la RSE
- les audits externes
- des rapports et des bilans sociaux et sociétaux.

À partir d'un corpus constitué des rapports de développement durable de grandes entreprises, Igalens (2007) fait remarquer qu'il ne s'agit pas d'un simple compte rendu sur les performances financières des entreprises, mais d'une tentative de construire un monde dans lequel les entreprises « se présentent en héros positif ». Les rapports de développement durable sont souvent des « récits de la légitimation », ayant pour objectif de créer ou de renforcer la légitimité de l'existence des entreprises multinationales aux yeux des parties prenantes; en même temps, ils constituent un mélange de types de discours extrêmement différents, construits selon une logique descriptive et une logique de témoignage.

Ces rapports sont publiés sur les sites web des entreprises. Nous montrerons ci-après que le thème de la responsabilité sociale est présent non seulement dans les rapports, mais aussi dans toutes les sections de ces sites, contribuant à la construction du sens et de à la promotion de l'image de l'entreprise.

5. Étude de cas: le site web de Coloplast

Notre corpus comprend les sites web de grandes entreprises spécialisées dans la fabrication de dispositifs médicaux, qui possèdent des sites de production dans plusieurs pays, exportent leurs produits et emploient plus de 3 000 personnes (par exemple: Coloplast, ConvaTec, Hollister Incorporated, Welland Medical) et ont comme objectif principal de faciliter et d'améliorer la vie des patients atteints de maladies graves. Les sites web existent en anglais et dans plusieurs autres langues. Les versions anglaises sont extrêmement complexes et comportent une section distincte consacrée à la RSE. Les versions dans d'autres langues sont plus succinctes et axées davantage sur la présentation des produits en vue de leur commercialisation.

Nous avons examiné la manière dont le thème de la RSE est intégré dans la structure des sites, si des sections spéciales lui sont consacrées et si des informations sur les objectifs de la RSE apparaissent également dans d'autres sections.

Le but même de ces entreprises s'inscrit dans la thématique de la RSE, car la volonté d'aider les gens et de leur faciliter la vie est une composante fondamentale de la RSE. Compte tenu de la brièveté de cet article, nous présenterons une seule étude de cas, plus précisément l'analyse du site web de la compagnie danoise Coloplast, en montrant que la thématique de la RSE est présente dans presque

toutes les sections, constituant un pilier important du discours identitaire et de la stratégie marketing de l'entreprise.

La société Coloplast a vu le jour en 1954, née de la volonté d'une infirmière d'aider sa sœur à mener une vie décente et à rester active après une opération du cancer colorectal. Elle a créé la première poche de stomie adhésive et a trouvé un fabriquant qui a mis en œuvre cette idée en acceptant d'investir dans la production du dispositif médical. Au cours des années suivantes, l'entreprise a produit des dispositifs de plus en plus variés dans les domaines de l'incontinence, des soins des plaies et de l'urologie interventionnelle.

La page d'accueil de la version française du site de l'entreprise contient le nom, le logo et la barre d'accès aux différentes rubriques. Elle présente également les derniers produits et les pathologies pour lesquelles ils sont indiqués, en associant texte et images (photos, tutoriels). Il s'agit d'articles courts contenant l'information essentielle, qui se suffisent à eux-mêmes (« entrées informatives »), dont le sujet est développé dans un article accessible en cliquant dessus. La page est interactive, les clients ayant la possibilité de remplir un formulaire en ligne pour tester gratuitement les produits. Les explications sont données dans un langage accessible, l'entreprise ayant pour objectif d'informer les clients afin d'établir une relation de confiance avec eux.

On peut accéder à la section consacrée à la présentation de l'entreprise en cliquant sur les boutons « Coloplast » ou « À propos de nous ». La section contient les photos des fondateurs et plusieurs entrées informatives, formées d'une photo, d'un titre et d'un court texte. L'histoire de l'entreprise et l'histoire familiale de l'infirmière qui a inventé la poche de colostomie sont présentées sur une page contenant du texte et un document vidéo; le film contient deux « voix », celle de la protagoniste, qui parle à la première personne du singulier et celle du PDG, qui parle au nom de l'entreprise à la première personne du pluriel. Le langage utilisé est familier, le ton chaleureux, sincère et le discours empreint de subjectivité. Le message vidéo fait partie intégrante du processus de construction de l'identité de la marque, remplissant à la fois une fonction informative et une fonction de séduction. Comme l'expliquait Bordeau (2020: 81), de nos jours « le besoin de sens est ré-appuyé par la notion de raison d'être », les « voix » des porte-paroles de l'entreprise créent de l'authenticité, de la mémoire, une identité.

Le discours se poursuit à la première personne du pluriel (« nous »), l'entreprise étant présentée comme une communauté soudée de personnes qui interagissent et sont animées par une vision commune. Bocquet (2014: 158) rappelle qu'« au-delà de sa dimension gestionnaire, la communication institutionnelle de l'entreprise porte et construit un horizon communautaire ».

Dans la rubrique « Mission », on retrouve l'idée de répondre aux besoins des clients et la promesse de leur rendre la vie plus facile. Le texte est accompagné d'une vidéo présentant des patients qui peuvent poursuivre leurs activités grâce à l'utilisation des produits de l'entreprise. Dans la rubrique « Valeurs », aux côtés de « Proximité » (écoute, empathie, engagement à agir) et « Passion », on retrouve « Respect et Responsabilité » (réduction de l'impact des traumatismes et atténuation des tabous qui y sont associés). Agir en responsabilité, s'engager, promettre, sont les points focaux de cette écriture claire et sincère.

La rubrique suivante, dont le titre représente le slogan de la compagnie (« Rendre la vie plus facile »), accueille, grâce aux photos et aux vidéos, les voix des patients ayant bénéficié des produits Coloplast. Les témoignages contribuent eux aussi à la

mise en discours de l'image de la compagnie. Le vidéo inclus dans la rubrique « 60e anniversaire » met sur le premier plan les partenaires de la compagnie et la promesse de continuer l'activité « ensemble ».

Dans la même section, on trouve un document intitulé « Code de conduite BEST » (Business Ethical Standards), mis à jour en 2025, qui s'articule en quatre chapitres (« Faire la différence », « Notre culture », « Notre éthique des affaires », « Nos interactions »). Il s'agit d'un guide destiné à l'ensemble du personnel de l'entreprise, qui rassemble les valeurs, les principes et les règles auxquels celui-ci doit se conformer dans l'exercice de ses activités, ainsi que des informations sur les pratiques commerciales de l'entreprise: « il explique notre engagement à faire ce qui est juste et nous aide à faire les bons choix. » Dans ce code de conduite, le concept de responsabilité joue un rôle primordial, étant présent tant dans les titres (« Notre responsabilité », « Nous sommes tous responsables », « Communiquer de manière responsable ») que dans le corps des articles (« Nous écoutons. Nous promouvons et soutenons un environnement de travail inclusif et veillons à ce que toutes les voix soient entendues. », « Coloplast s'engage à mener des opérations commerciales durables et éthiques. […] Nous nous engageons à assurer le bien-être des personnes et de la planète. Nous respectons les droits de l'homme, agissons en faveur du climat, réduisons les disparités en matière de soins de santé et donnons la priorité à la santé, à la sécurité, à la diversité, à l'inclusion, à l'équité et à la confiance dans l'ensemble de nos activités et de notre chaîne d'approvisionnement. […] », « Chez Coloplast, nous communiquons sur nos produits et services de manière appropriée, véridique, transparente, objective, juste et équilibrée. »)

La rubrique « Innovation » met en avant la capacité de l'entreprise à fabriquer des produits innovants, de manière responsable, en veillant à la sécurité des travailleurs et à la protection de l'environnement. L'article, intitulé « Comment développons-nous nos produits de stomie? », illustre certains des objectifs RSE, en les structurant à l'aide de sous-titres: « Guidés par notre passion »; « Respecter les normes internationales »; « La responsabilité a toujours fait partie de notre façon de gérer les affaires »; « Nous nous engageons à réduire nos émissions de CO2 ». La passion et l'engagement de la fondatrice inspirent constamment l'ensemble de la communauté de l'entreprise. Celle-ci considère la responsabilité comme une composante de sa stratégie de gestion, non seulement comme une obligation imposée par les normes et la législation: « La responsabilité a toujours fait partie de notre façon de gérer les affaires ». Parallèlement, l'entreprise s'engage à réduire ses émissions de CO2 en utilisant de nouveaux emballages et des modes de transport plus propres – une des exigences fondamentales des appels d'offres. Tous ces engagements, qui reprennent des thèmes importants de la RSE (réduction des émissions de CO2, recyclage des déchets), sont exprimés à la première personne du pluriel.

Les mots-clés décrivant les valeurs de l'entreprise (proximité, passion, excellence), la volonté de s'impliquer (engagement), le vocabulaire lié aux objectifs RSE (vérité, équité, objectivité, équilibre, confiance, intégrité, transparence, inclusion, soutien, dons), à la qualité (innovations, réalisations extraordinaires) et les termes techniques (du domaine médical) expliqués pour le public s'associent harmonieusement et dessinent l'image d'une entreprise fonctionnant selon une logique d'efficacité et de clarté.

La version anglaise comporte une section distincte, intitulée « Sustainability », structurée en rubriques: « Social sustainability », « Reducing emissions », « Product

sustainability », « Collaboration and partnerships », « Targets and reporting ». Cette section présente le même modèle de communication, la même structure énonciative et la même organisation textuelle que la version française du site. Chaque rubrique associe de courts textes à de nombreuses images. Par exemple, la rubrique « Social sustainability » présente des photos représentant des consommateurs des produits de l'entreprise; dans la rubrique « Reducing emissions », les images des sites de production de l'entreprise accompagnent l'énumération et l'explication des objectifs spécifiques; la rubrique « Product sustainability » se distingue par les témoignages de consommateurs sous forme de vidéos. L'importance de la collaboration entre les services de l'entreprise et les partenaires externes en vue de la réalisation des objectifs RSE est mise en évidence dans la rubrique « Collaboration and partnerships ». Les rapports annuels de l'entreprise sont accessibles dans la rubrique « Targets and reporting ». Ceux-ci comprennent des informations détaillées sur les résultats des activités RSE.

En analysant la mise en discours de la RSE, nous avons constaté que la stratégie RSE de la compagnie fait partie intégrante de son identité et de la manière dont elle établit une relation de confiance avec ses parties prenantes, ses partenaires commerciaux et ses clients. Comme le disait Bocquet (2014: 159), la RSE est « parfois élevée au rang de mythe moderne par la communication ». En effet, la RSE est devenue la clé de voûte du discours de l'entreprise et en assure la cohésion.

6. Conclusion

En utilisant « une langue nourrie de faits, de témoignages, d'exemples, de démonstrations » (Bordeau, 2020: 43), les entreprises s'efforcent de plus en plus de communiquer sur leur identité et leurs initiatives commerciales, sur l'impact de leurs activités sur la société et l'environnement, ainsi que sur leur stratégie RSE. Il ne s'agit pas seulement d'une obligation imposée par les législations nationales et internationales, mais la communication RSE est une composante essentielle de la communication d'entreprise.

Tout d'abord, elle contribue à forger l'image de l'entreprise, son éthique, sa crédibilité et sa légitimité au sein de la société, ainsi que sa réputation. Ensuite, elle renforce le sentiment d'appartenance à une communauté, la direction et les employés de l'entreprise formant un tout cohérent, animés par la même vision et partageant les mêmes valeurs.

Parmi les objectifs de la communication RSE figurent la volonté d'aider le plus grand nombre de personnes possible, en agissant avec intégrité et transparence et en respectant l'environnement, la volonté de jouer un rôle important dans la société, mais aussi l'intention de gagner la confiance de l'ensemble des parties prenantes.

La manière dont le discours RSE est construit sur le site web de l'entreprise est complexe: il fait appel à la fois à la raison et aux sentiments. Le discours est imprégné de marques de subjectivité, l'engagement et la promesse sont les actes de langage prédominants, les textes sont accompagnés de photos et de vidéos, les documents officiels émanant de l'entreprise sont publiés aux côtés de témoignages et de commentaires de clients, le discours est traversé par de nombreuses « voix », le vocabulaire spécialisé est accompagné d'explications en termes courants pour le grand public.

Enfin, nous estimons qu'il serait utile d'intégrer la thématique et les documents relatifs à la RSE dans les cours de communication d'affaires en langues étrangères.

Ceux-ci contribuent à une meilleure compréhension de la manière dont l'entreprise communique, de la complexité de son discours et du contexte économique actuel. Ainsi, les étudiants peuvent prendre conscience du fait que la responsabilité, l'intégrité, l'esprit communautaire, la vérité, la transparence, le respect de l'environnement et des valeurs humaines sont désormais des impératifs du monde des affaires.

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COMMUNICATION FOR THE CIRCULAR ECONOMY: EMPIRICAL EVIDENCE FROM A STUDY APPLIED TO STUDENTS IN ECONOMIC ENGINEERING

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Abstract*: This paper examines the role of communication in the implementation of circular economy, focusing on how students specialising in economic engineering receive and interpret sustainability-related information, as their perceptions may directly shape the extent to which circular-economy practices are understood, adopted, and integrated into future economic and engineering contexts. Based on a quantitative survey method, the study evaluated students' awareness, attitudes, and perceived relevance of circular-economy communication and practices. The findings show that students generally recognise the importance of sustainability communication but differ in terms of how they actually apply circular-economy concepts. The study emphasizes the central role of communication in stimulating sustainability-related behaviours among future engineers, while also highlighting the importance of integrating circular-economy principles into educational and professional environments.*

Keywords: *Circular economy; communication; behavioural change; message; action; sustainability.*

JEL Classification: *Q53; Q56; A23*

1.Introduction

The transition towards circular economy is essential for environmental sustainability and efficiency as regards the use of resources. However, there is still a gap between awareness as regards circular economy principles and their practical implementation.

This paper investigates how communication might influence the understanding and implementation of circular economy principles among future engineers, since communication is increasingly considered a catalyst for behavioural change in contexts that relate to sustainability.

In order to meet these aims, the study focuses on students studying economic engineering, who directly focus on aspects such as resource management, technological innovation and sustainable industrial processes. Examining how they interpret and engage with information on circularity is essential for evaluating the effectiveness of communication in supporting the transition to more sustainable economic systems. The study therefore aims to identify:

1. Which communication channels and message types most effectively promote sustainable behavioural change?

2. To what extent do persuasive, emotional, or informational messages lead to concrete actions?

Based on these two research questions, the study proposes the following hypotheses:

1. Messages targeted at students studying economic engineering may increase the likelihood that circular-economy principles will be put into practice.
2. Messages that combine technical information with emotional appeal generate the strongest behavioural shifts.

2. Theoretical Underpinnings

2.1. Concepts, principles and implementation models that relate to the circular economy

Circular economy emphasizes the idea that natural resources are finite and must therefore be used efficiently. Compared to the traditional linear model, it aims to limit the extraction of raw materials, reduce environmental degradation, and extend the life of existing resources through reuse, repair, and recycling.

Its main principles include:

1. Product life cycle optimization – Designing products with longer lifespans, ensuring they can be reused, repaired, recycled, or biodegraded at end of their life cycle.
2. Waste minimization – Reducing waste throughout production and consumption.
3. Reuse and recycling – Encouraging repeated use of materials to decrease reliance on raw materials.
1. Resource efficiency – Using natural resources responsibly so as to reduce environmental pressure and support long-term economic sustainability.

These principles relate to both producer responsibility and customer care. At the same time, successful transition towards a circular economy depends on the collaboration among governments, businesses, universities, and civil society to develop supportive policies, innovative business models, and shared systems that enable circular practices. Examples: circular production systems, which rely on renewable resources, minimise waste, and keep materials circulating within the economy; models that support circularity by promoting shared access to goods and services, reducing the need for new production and improving resource efficiency; laws and economic instruments, such as waste taxes, extended producer-responsibility schemes, or subsidies, which create favourable conditions for circular practices to develop.

2.2. Advantages and benefits of the circular economy

The circular economy offers a wide range of environmental, economic, and social advantages that strengthen its capacity to support sustainable development. By promoting more efficient use of materials and energy, it reduces reliance on natural resources while lowering waste generation through reuse, repair, and recycling, keeping products and materials in circulation for longer. These practices not only limit pressure on the environment but also stimulate job creation in sectors such as recycling, repair, and waste management. At the same time, the circular economy encourages innovation and competitiveness by stimulating the redesigning of products, the adoption of cleaner technologies, and the implementation of more

efficient business models. Its emphasis on responsible resource management contributes to public health, cleaner environments, and improved quality of life. Taken together, these benefits highlight the potential of circular economy to support economic stability, social well-being, and a development model grounded on ecological sustainability.

3.Organizational and social communication

Recent academic and policy actions are directed towards limiting the growing crisis driven by climate change, ecosystem degradation, and rapid technological change. In this context, communication is increasingly viewed as a mechanism that can sustain and promote circular-economy strategies, shape public understanding and stimulate behavioural change. This analytical perspective is in line with the central focus of this study, namely: (a) how students studying economic engineering interpret messages related to sustainability; and (b) which message types are most likely to determine a change in behaviour related to circular economy.

Major international frameworks, including the European Green Deal and the UN Sustainable Development Goals, now treat communication as a strategic tool for promoting the shift from a linear to a circular model. However, this transition remains complex and requires time, cooperation, and shared principles, while its success depends on behavioural change among consumers, companies, and public authorities.

Salvioni and Almici (2020, p. 8) reinforce this view by demonstrating that effective circular-economy strategies depend on coordinated action from governments, universities, companies, and consumers. To engage actors with diverse interests, shared principles are essential, and communication is able to have an influence upon multiple levels of intervention such as policy, education, and market behaviour.

A recurring theme in the literature is the need for communication strategies aimed at a specific audience. Jha and Verma, 2024 argue that the effectiveness of messages depends on how they are structured in terms of content and the communication channels chosen so as to properly reach target groups. Hernández (2016) and Scarpellini et al. (2020) further show that regional initiatives function most efficiently when communication is adapted to receivers' needs, motivations and comprehension levels of specific communities. This insight is directly relevant to the present research, which examines how a specific generational and educational group (students in economic engineering) respond to sustainability messages.

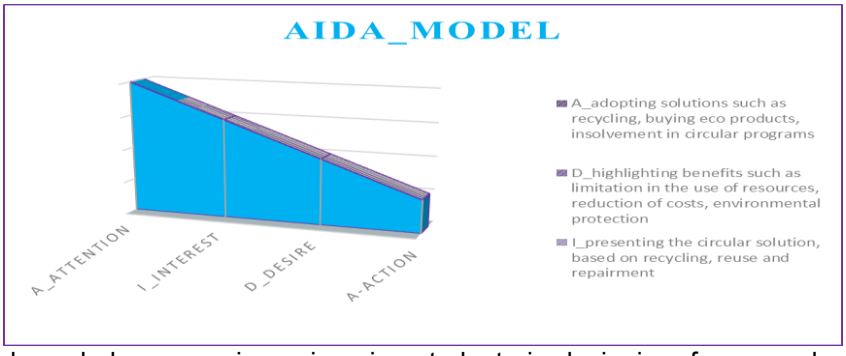
Scholars also emphasise the importance of integrating psychological and socio-demographic variables into communication design. Thus, McKenzie-Mohr (2000) highlights the relevance of demographic and cultural variables. Carbonell Alcocer et al. (2025) further stress the importance of clear, well-designed messages and the shared responsibility of public authorities, businesses, and academia in promoting sustainable behaviour. Other perspectives reinforce the role of communication in the adoption of circular economy principles.

From a behavioural perspective, Serra and Alfinito (2025) identify key motivational factors, such as raising awareness, countering negative perceptions of recycled products, and leveraging social norms, which are in line with the persuasion theory and its focus on attitudes, beliefs, and social expectations. These ideas directly support the hypotheses of this study, particularly the assumption that messages combining technical information with emotional appeal may generate stronger behavioural shifts.

Taken together, the literature demonstrates the role of communication strategies in turning abstract knowledge into concrete behaviours that support the circular economy. Therefore, it can be argued that effective messages can shape how environmental challenges are understood by specific groups. Targeted communication raises awareness with regard to the relevance of circular economy, influences attitudes by designing it as a field of innovation, and clarifies both benefits and perceived barriers associated to feasibility or cost. Communication motivates people to turn theory into action by choosing circular products, supporting reuse and repair, or integrating circular principles into the process of decision-making. An effective strategy relies on simple, clear language and concrete examples that make concepts accessible. With regard to younger generations, in particular contemporary students, their perceptions are also shaped by constant exposure to digital technologies. Therefore, receive, filter and internalise information in ways that differ dramatically compared to previous generations. As noted by Marcon and Sehnem (2026), who examine strategies for integrating circular-economy principles in schools, this requires using multiple channels (for example courses, seminars, and social media) to reach a broader section of students' community. It is argued that students' involvement the interpretation of information further strengthens their skills and increases their commitment to circular practices.

Building on such ideas, emphasized in literature, several real-world initiatives illustrate how circular-economy principles are already being applied and communicated in practice. Companies such as Patagonia, which promotes a product-life-cycle approach centred on reuse and repair, and IKEA, which has reduced production-related waste by 50% in recent years, demonstrate how clear sustainability messages can stimulate the commitment of organisations to adopt circularity. Similarly, models based on shared-access, such as Zipcar car-rental system show how alternative consumption patterns can reduce resource use and environmental impact. These examples highlight the importance of practical communication that connects circular principles with visible, relatable actions, which can be efficient in the case of students who might prefer concrete, real-world examples.

Communication models traditionally used in marketing can also be adapted to support circular-economy education. The **AIDA model** (Attention, Interest, Desire, Action) offers a structured way to design messages that guide audiences from awareness to behavioural engagement.



This model can help economic engineering students in designing, for example, a reusable packaging system for a university cafeteria: *Attention* through visuals

showing daily waste; *Interest* through explanations of how the system works; *Desire* by emphasising cost savings and environmental benefits; and *Action* through incentives such as return-and-discount schemes. Such applications not only strengthen students' managerial and analytical skills but also demonstrate how communication can transform circular-economy concepts into real, implementable projects.

Good practices can also be supported by educational institutions that integrate circular-economy principles into curricula and communication practices. The University of Cambridge, for example, offers courses that combine theory with case studies, helping students connect abstract concepts with real-world applications. In Romania, the Association of Economic Engineering Students organises seminars that bring experts and students together for interactive discussions, while universities such as the University of Bucharest use digital platforms to disseminate examples of good practice and extend engagement beyond the classroom. These initiatives show how educational communication can contribute to the development of informed and motivated future professionals.

4.Methodology

The present study examines how students from the Faculty of Electrical Engineering and Information Technology, University of Oradea, specialising in Economic Engineering, perceive and respond to communication about circular economy. The methodological approach was designed to identify elements that make communication effective for this generational group (the characteristics of the message, the channels chosen).

In terms of its design, this study is based on a quantitative, questionnaire-based research that aimed to provide data on students' knowledge, attitudes and communication preferences, which might relate to circular economy.

The answers were provided by a number of 77 undergraduate students from the University of Oradea, Faculty of Electrical Engineering and Information Technology, specialising in the field of Economic Engineering in the Electric, Electronic and Energetic Domain, who agreed to answer the 40 items of a questionnaire devised by the authors, based on existing literature on sustainability-related communication and circular economy. To ensure content validity and clarity, the questionnaire was pre-tested to a group of students who were not included in the final sample.

The respondents were given one hour to answer the questionnaire. The participation was fully voluntary.

Data was collected during the second semester of the academic year 2025-2026 (March 2026).

The questionnaire, structured into six thematic sections, combines multiple-choice items with a smaller number of open-ended questions and is designed to explore students' knowledge, attitudes, competencies, and communication preferences related to the concept of circular economy.

In terms of anticipated results, this research will highlight:

a. How to identify the channels and types of messages that generate the greatest behavioural impact.

b. A communication model adapted for the implementation of the circular economy with the students from the economic engineering specialization

The collected data were analysed using statistical techniques that allowed us to present the results in terms of percentages. Open-ended questions were analysed through qualitative content analysis, which allowed us to identify aspects that relate to message clarity, perceived barriers and motivational factors.

5.Interpretation of Results

The first section of the research reveals a homogeneous sample, made up entirely of undergraduate students, but highlights a significant information gap regarding the circular economy:

• Limited knowledge (88%): The overwhelming majority of respondents declare a minimal level of familiarity with the concept of circular economy, with 66% being “slightly familiar” and 22% “unfamiliar” with the subject.

• Marginal expertise (11%): Only 8 students consider themselves familiar, while only one respondent (1%) declares an advanced level of knowledge.

Interpretation: The results confirm that circular principles are not yet integrated into students’ academic journeys, requiring urgent curricular intervention to align their skills with the current demands of the field.

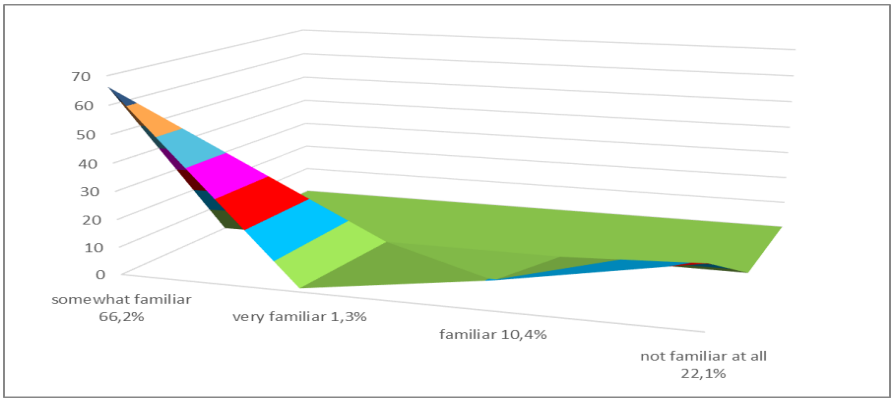


Figure 1: Respondents’ familiarity with the concept of circular economy

The second section shows a clear gap between students’ interest in circular economy and its limited academic presence. Only 17 of 77 students had encountered the topic in their curriculum. Yet 75 students (97%) consider it important or very important. In the absence of curricular integration of circular economy as a subject, 69 students (90%) rely mainly on online and social-media sources, while getting information from scientific materials represent only 10%.

These result highlight the fact that students turn to informal channels of communication when ideas related to circular economy are not found in academic materials. This supports hypothesis 1, which assumes that targeted messages can influence the adoption of expected behaviour. Overall, the results indicate an underexploited educational opportunity: students are highly motivated to engage with sustainability topics but must depend on unverified information due to insufficient institutional provision.

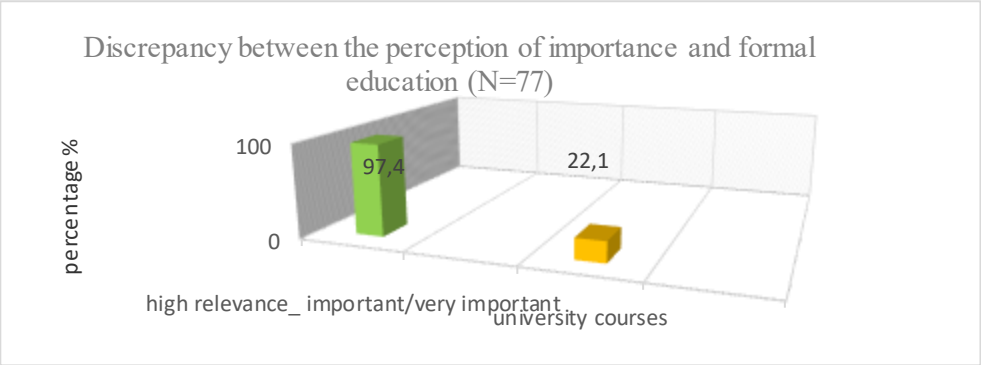


Figure 2. Perception of importance and formal education

The third section examines students' practical experience and the skills needed to apply circular-economy principles. The data show very limited practical exposure: only 7 of 77 respondents (9%) had participated in a circular-economy project. This lack of practice is reflected in their self-evaluations, as most feel only partially prepared and report moderate confidence in applying circular principles.
Regarding essential skills, students prioritise sustainable product and service design (59 mentions), followed by waste management and economic impact analysis. These results indicate strong interest in circular-design competencies and highlight the need to shift from theory to practical, project-based learning.

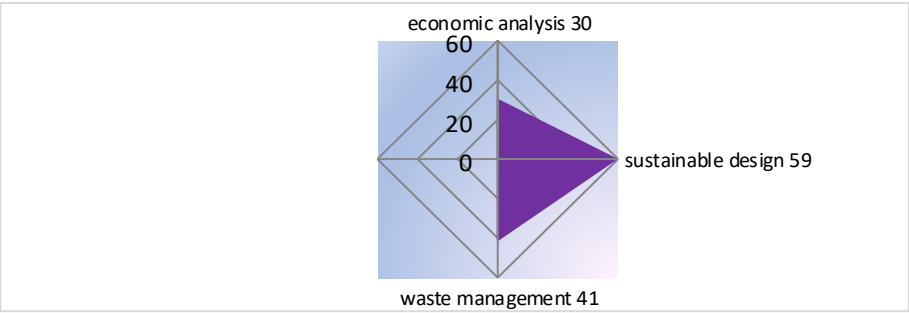


Figure 3. Essential Competencies for Implementing Circular Economy

In conclusion, future professionals clearly consider that interventions at the design stage rather than end-of-life solutions are important for a genuine transition towards more sustainable economic practices.
The fourth section explores how circular principles are part of the respondents' everyday behaviours and waste-reduction efforts. However, a practical perception gap emerges: although only 31 students reported involvement in circular-economy "projects," further detail reveals broader engagement, with 38 students practising recycling and 21 reusing products. This indicates that students often fail to associate individual actions with the formal concept of circularity. They actually engage in circular practices, but do not conceptualise them as being part of circular economy. This lack of conceptual understanding highlights the importance of communication in this process.

All respondents consider student participation in sustainability initiatives important. Waste management and reduced consumption are priorities for 80% of students, though a small minority (6) regard these issues as unimportant. Willingness to change is high, with 76 students (98%) being prepared to adopt more sustainable lifestyles.

Overall, the findings show that students already engage in multiple sustainable practices, yet these are insufficiently connected to the theoretical ideas supporting the circular economy. Strengthening this conceptual link is essential for stimulating the adoption of informed behaviour that supports circular economy.

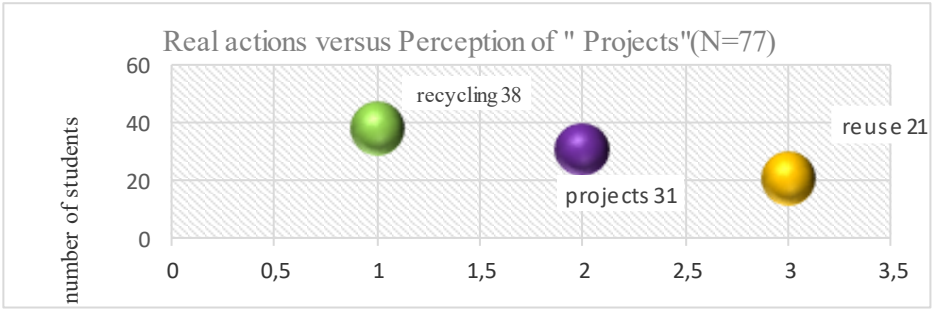


Figure 4. Participation in Projects that Relate to Circular Economy

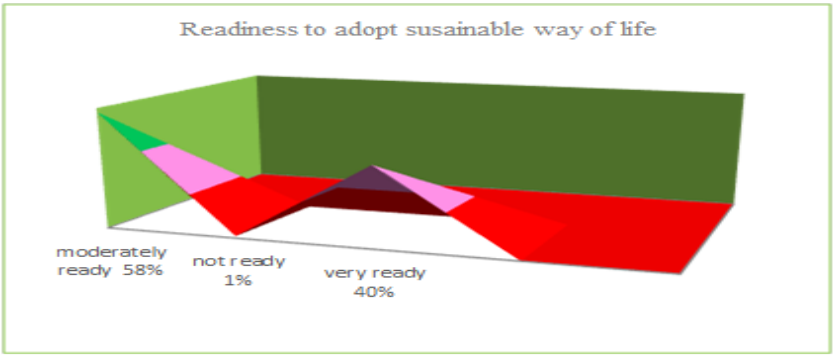


Figure 5. Readiness to Adopt a Sustainable Way of Life

In conclusion, the responses to questions included in the fourth section of the questionnaire indicates a positive tendency: students already engage in concrete sustainability practices, even if they do not consistently use formal academic terminology.

The fifth section examines students' involvement in research, innovation, and future perspectives related to circular economy. Participation in research is minimal, with only 4 of 77 respondents (5%) having taken part in related projects. Nevertheless, technological innovation is viewed as the primary driver of circular transition, identified by 75 students (95%). Interest in new business models is also notable, with 35 students (44%) highlighting their importance, while public policies are prioritised by only 17 respondents (21%).

Overall, although direct research experience is largely absent, students consider technology and circular entrepreneurship as central to future development. The

findings show that innovation laboratories could turn this theoretical interest into practical solutions.

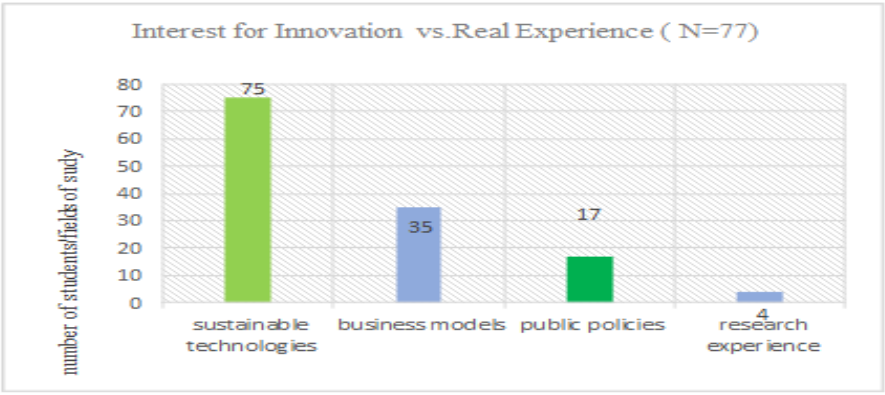


Figure 6. Interest for Innovation and Real Experience

The final section analyses students' preferred communication channels, formats, and communication-related elements that would motivate them to adopt circular-economy behaviours. Students clearly favour dynamic, visual platforms: YouTube (48) and Instagram (38) are their primary information sources, while short-form videos and graphic content are perceived as most effective. Traditional tools such as newsletters or email receive minimal attention (4 mentions). Although university platforms retain moderate relevance, students express a strong preference for experiential formats, with 27 favouring practical workshops and 10 preferring lectures by industry professionals. Message characteristics also matter.

To test Hypothesis 2 (whether messages combining technical information with emotional appeal generate stronger behavioural shifts), a comparison was made between students preferring purely informational messages and those preferring mixed emotional-informational messages.

52 students (67%) prefer concise communication, and visual elements are essential for 60 respondents. Preferences regarding tone are divided between informative (38) and emotional or humorous (35) approaches. Messages emphasising the negative consequences of waste have slightly greater persuasive impact (37 students) than those highlighting positive outcomes (28), while mixed text-and-image messages generate high or moderate impact for 97% of respondents.

Overall, the findings indicate that effective communication in a university context must be visual, multichannel, and supported by actual, hands-on learning opportunities. Short, visually engaging messages that balance warnings with constructive solutions appear most effective in translating awareness into concrete action.

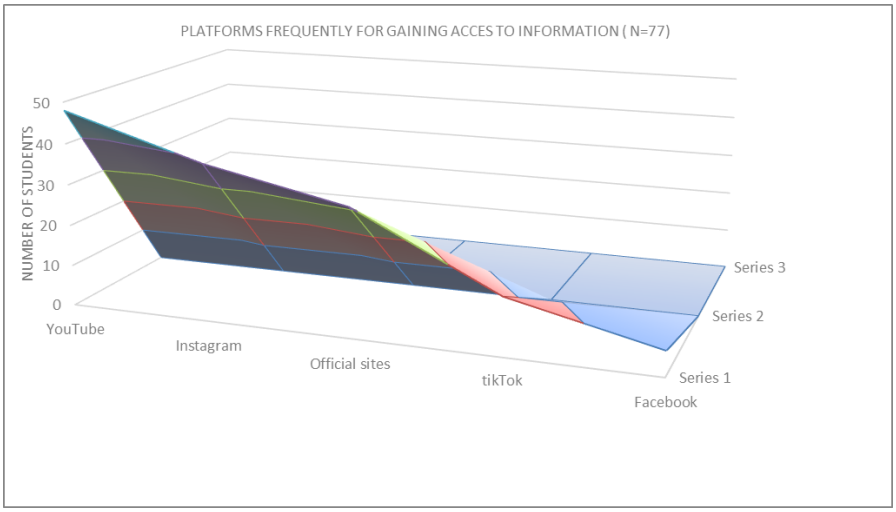


Figure 7. Platforms Accessed for Information on Circular Economy

Therefore, the transition to a circular economy depends on the ability of universities to translate everyday practices such as recycling and reuse into coherent academic concepts, to digitise communication through the visual platforms students prefer, and to provide infrastructure that supports technological innovation and sustainable design.

When asked to describe circular-economy initiatives they would like to see implemented at their university, students mentioned: improving recycling practices, including general recycling programmes, particularly dedicated systems for electronic waste; more selective-collection bins across campus; awareness-raising through seminars, workshops, interactive activities, and accessible written materials such as brochures and leaflet; inter-departmental recycling competitions, repair courses for recovering materials from old electronics; demonstrations of proper recycling techniques, reuse programmes, digital communication to reduce printed materials, and fairs for functional second-hand items. Together, these ideas reveal a preference for practical, visible, and easy-to-use initiatives that make sustainable behaviour more convenient and engaging.

In terms of what would personally motivate them to adopt circular-economy principles, students emphasised: the negative impact of poor waste management; balanced messages that present both the risks and the benefits of circular practices; intrinsic motivation; accessible recycling options and dedicated information spaces; external incentives, including discounts, promotions, or financial rewards for returning used products; cleaner cities, wildlife protection, and stronger engagement from companies and citizens. Overall, the responses suggest that effective motivation requires a blend of emotional engagement, supportive infrastructure, and policy measures that make circular practices both appealing and feasible.

6.Conclusions

This study shows that students in the Economic Engineering programme display strong motivation to understand circular-economy principles, but their learning is

limited by curricular aspects and minimal practical experience. The findings indicate that students are willing to adopt sustainable behaviours but lack s opportunities to develop the competencies required for applying circular practices in real contexts.

Strengthening the curriculum is therefore essential: at the Economic Engineering program, the circular economy should be taught through both theory and practical experience, enabling undergraduates to understand core principles while developing concrete skills in sustainable product design, waste management, and circular innovation. These desiderates can be achieved through projects, research activities, and community engagement.

The findings, which can be related to the initial research questions, demonstrate that the effectiveness of communication - both in terms of message type and the delivery channel - plays a decisive role in shaping students' openness towards sustainable forms of conduct. The study shows that messages which are clear, adapted to targeted audiences, are more likely to turn into concrete actions. This points to the conclusion that universities must do more than transmit information - they need to adopt communication methods that truly motivate students to act**.**

In relation to reinforcing circularity-related communication strategies within the economic engineering programme at the University of Oradea, a series of coordinated actions are necessary: introducing students to the core principles and benefits of circularity, integrating practical learning experiences that involve designing sustainable products and applying waste-management strategies, and engaging them in projects centred on recycling, reuse, and waste reduction. These efforts should be complemented by opportunities to participate in research and innovation activities that support the development of new circular solutions, as well as by encouraging involvement in community initiatives that promote circular practices beyond the university. Within the field of economic engineering, it is also essential to analyse the economic implications of circularity, teach students how to develop sustainable and circular business models, and incorporate circular solutions into engineering projects. Together, these actions ensure that circularity is not only taught in theory but becomes an integral part of students' professional formation.

Overall, the research illustrates that communication and curriculum design can support and accelerate sustainable practices and guide the development of sustainability initiatives with high impact for students in economic engineering.

However, even if the study provides valuable insight into students' perceptions, its validity and broader relevance are constrained by several limitations. The sample of 77 respondents is adequate for understanding tendencies, but too small to represent Romanian students more broadly or different academic fields. The exclusive focus on undergraduates limits understanding of how circular-economy knowledge develops at higher levels. This highlights the need for larger, more diverse samples and objective measures in future research.

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Appendix 1

Questionnaire: Evaluating the Understanding and Practical Application of the Circular Economy Principles Among Economic Engineering Students

S1. General questions

What is your level of education?

a. Bachelor's Degree
b. Master's Degree
c. Doctorate

How familiar are you with the concept of circular economy?

Very familiar
a. Familiar
Somewhat familiar
Not familiar at all

S2. Education and raising awareness

Have you been provided with information about circular economy at the university courses?

a. Yes
b. No

How important do you think the circular economy is for sustainable development?

Very important
a. Important
Somehow important
Not important at all

What sources of information about the circular economy have you used?

University courses
Scientific articles
a. Internet
Social networks
Other (specify)

S3. Developing competences:

Did you have the opportunity to be part of projects that relate to the circular economy?

a. Yes
b. No

How prepared do you think you are to implement principles of circular economy in your professional activity?

Very prepared)
a. Prepared
Somehow prepared
Not prepared at all

Which competencies do you consider essential for effectively implementing the circular economy?

The design of sustainable products and services
Waste management
The analysis of the economic impact
Others (specify)

S4. Projects and initiatives

Have you contributed to projects or initiatives that promote circular economy?

a. Yes

b. No

What types of projects or initiatives have you participated in?

a. Recycling
b. Reuse

Limiting waste
Others (specify)

How important is, in your view, the involvement of students in projects and initiatives aimed at circular economy?

Very important
Somehow important
Not important at all

- To what extent do you consider issues such as waste, recycling or reducing consumption important?

- How willing are you to adopt sustainable behaviours in your daily life?

S5. Research and Innovation

- Have you conducted research or innovation projects in the field of circular economy?

a. Yes
b. No

- What research areas do you consider to be most relevant for the circular economy?

a. Sustainable technologies
b. Circular business models: product-as-a-service models: examples: leasing services, subscription services, pay-per-use, product-as-a-service.
c. Public-policies
d. Others (specify)

S6. Questions relating to communication

- What kind of content helps you to receive information more easily in general and ideas about the circular economy in particular:

a. Short-videos (Tik-Tok, Instagram Reels, YouTube Shorts)
b. Posts on social networks
c. Newsletter sent by email
d. Online platforms (Microsoft Teams; Moodle)
e. University courses
f. Student clubs
g. Interactive workshops or practical laboratories at the university
h. Lectures with guests working in industry

- What platforms do you use most often to get information (Instagram, TikTok, YouTube, Facebook, official websites)?

- How much does it matter that the messages are visual, interactive or emotional?

- Do you receive informative messages more easily or those that include an emotional/humorous component?

- Do you prefer short messages or detailed explanations?

- Do you find messages that show the negative consequences of waste or those that present positive benefits of sustainable behaviours more convincing?

S7. Read the following message and then answer questions relating to its efficiency

Every year, the electrical and electronics industry generates over 50 million tons of waste, and less than 20% is properly recycled. The rest ends up in landfills, where rare metals – lithium, cobalt, copper, gold – are lost forever.

As future engineers, you will decide whether these resources continue to be wasted or reintegrated into the economy.

Every repair instead of a replacement, every design designed for easy disassembly, every piece of equipment collected separately means less pollution, lower costs for the industry and a reduced dependence on the import of critical materials.

The circular economy is not a slogan – it is a technical competence and a professional responsibility.

Choose to design, use and recycle so that resources circulate, not disappear.

S8. To what extent would this message motivate you to take action?

a. High extent
b. Moderate

Little extent

Which element of the message seems more convincing to you?

The image (the questionnaire included an image of a pile of electronic waste)

a. The words

S9. What type of communication would make the circular economy more attractive to you?

S10. Describe a circular economy initiative you would like to see at your university.

S.11. What would motivate you personally to adopt circular economy principles?

ARTIFICIAL INTELLIGENCE, WORK FRAGMENTATION AND INEQUALITY IN AN UNCERTAIN ECONOMY

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Abstract: *The adoption of artificial intelligence is accelerating within a global economic environment characterized by persistent inflation, tighter financial conditions, and geopolitical uncertainty. Under these constraints, firms increasingly deploy AI to enhance efficiency, control costs, and reorganise production processes. This study examines patterns of AI adoption across firms and analyses their implications for job stability and career trajectories. Evidence suggests that AI is primarily implemented at the task level, reshaping work organization, intensifying performance expectations, and modifying pathways of upward mobility. At the same time, integration of AI technologies remains uneven, favouring larger firms and workers with stronger complementary skills, while exposing routine and lower skilled roles to greater risks of stagnation and displacement. These dynamics are further explored through the case of Romania, a semi-peripheral economy embedded in European production networks and characterised by structural inequalities, labour shortages, and limited digital skills. In this context, AI adoption interacts with pre-existing constraints, including regional disparities, demographic pressures, and uneven access to education and technological infrastructure. Rather than generating uniform productivity gains, AI is likely to reinforce existing divisions between firms and workers, widening gaps in opportunities and outcomes. The findings suggest that AI operates not only as a driver of efficiency, but also as a mechanism that reshapes labour market inequalities under conditions of economic uncertainty.*

Keywords: *Artificial Intelligence; Labour Market Transformation; Job Stability; Economic Uncertainty; Inequality.*

JEL Classification: *O00; O38; J08*

1. Introduction

Recent global economic developments point to a period marked by overlapping pressures rather than a single dominant trend. The International Monetary Fund notes that inflation has proven more persistent than initially expected, while overall growth has slowed compared to pre-pandemic levels (IMF,2025). Geopolitical tensions have also played a role. The World Bank highlights rising uncertainty linked to conflict and trade disruptions (World Bank, 2025), a pattern that can be seen in the continued effects of the war in Ukraine and reinforced by ongoing conflicts in the Middle East. In parallel, tighter financial conditions and higher borrowing costs have constrained investment, particularly in advanced economies (OECD, 2024).

The growing use of artificial intelligence in business can be understood within the broader wave of digital innovation described by Brynjolfsson and McAfee (2014), who highlight how advances in computing power, data availability, and digital technologies are reshaping how firms operate and compete. Artificial Intelligence is now a widely adopted organizational tool, increasingly shaping business strategy, labour organization, and firm-level restructuring. This growing importance of AI in firm behaviour raises important questions about how its adoption varies across firms and how these differences translate into broader economic and labour market outcomes. Persistent inflationary pressures and tighter financial conditions have limited firms' operational flexibility, leading them to treat labour as a flexible cost, while making technological substitution more economically attractive.

Even as AI uptake continues to expand, its broader implications for job stability and career trajectories remain uncertain. AI may reshape career pathways by disrupting the job transitions through which workers typically access higher-paying roles (Brookings Institution, 2026) and the effects of AI adoption are not evenly distributed. Larger firms and workers with higher levels of skills are generally better positioned to benefit, while those in more routine or lower-skilled roles face a higher risk of stagnation or displacement. In this context, the article addresses two main questions: what is the current level and pattern of the integration of AI technologies across firms, and how does AI affect job stability and career paths under conditions of global economic uncertainty? The central argument is that AI does not affect all workers in the same way. Instead, it tends to reinforce existing inequalities while creating new, uneven opportunities across firms and skill groups.

2. Literature review

2.1 Informational technology and global changes in labour structure

The evolution of technological development has historically been associated with changes in labour structure, representing both a form of economic expansion and a source of structural change within societies (Frey and Osborne, 2017). Advances in information technology reshaped economic and labour structures, facilitating the coordination of complex activities at a global scale (Baldwin, 2016). The expansion of internet access and rapid connectivity has enabled new forms of coordination, gradually reorganising labour structures beyond territorial boundaries and supporting the general externalisation of professional activities at a global scale (Crouch, 2018). These advanced technologies have contributed to new forms of governance in work relations under the global division of labour (Huws, 2014). As jobs expanded globally, the global middle class also expanded, while many segments of the workforce in developed countries experienced stagnation (Milanovic, 2016). From this point of view, the new extension of work has functioned primarily as a mechanism for distributing labour costs globally while prioritising upper segments of the organisational structures (Autor, 2015; Piketty, 2017). The reorganisation of labour markets, under conditions of economic competitiveness, has further increased the prevalence of flexible employment arrangements and intensified power imbalances within global organisations (Kalleberg, 2018). Over decades of progression, despite the expanding capabilities of information technologies, the new division of work has enabled higher levels of productivity and profitability while raising concerns over job quality (Streeck, 2016). The new global

division of labour initially oriented academic efforts toward the assessment and improvement of job quality. These efforts were reflected in the European Job Quality Index, as well as in other research initiatives using comparable methodological approaches. Early research focused on key dimensions of employment, particularly financial incomes, job security, career opportunities, and autonomy (McGovern et al., 2004; Leschke and Watt, 2008; Block et al., 2018). Over time, increasing global competitiveness and changing employment arrangements redirected academic attention toward the analysis of new forms of work precarity (Kalleberg, 2018). The expansion of non-standard employment allowed employers to lower costs and left workers more exposed to income and employment insecurity. Contemporary research has further expanded the literature on precarity, as the emergence of digital platforms and the gig economy has reinforced new forms of flexible arrangements associated with reduced job stability, limited income security, and restricted career progression (Standing, 2021).

2.2 The emergence of gig economy

If early developments in information technology primarily restructured competences while maintaining, or even increasing, occupational levels, more recent developments have been associated with employment insecurity and pressures on social protection. The literature addresses these preoccupations across different fields of research, such as work standardisation, data control, and flexibility associated with algorithmic platforms (Fernández-Macías et al., 2025). The capabilities of algorithmic performance monitoring, task allocation, and algorithmic evaluation represent a growing field of study in organisational practices, with specific implications for job quality (OECD, 2025).

Digital work platforms represent a different phase in the reorganisation of labour, professional relations, and employment conditions. The gig economy has become a central preoccupation, as digital platforms increasingly mediate and autonomously organise flexible work arrangements outside established labour regulatory frameworks (Vallas & Juliet, 2020). The digital contracting of professional work through non-standard arrangements is generating new vulnerabilities, especially in terms of low levels of legal protection, limited accountability, and uneven task allocation (Bajwa et al., 2018; Woodcock & Graham, 2020). Within the European Union context, social protections continue to apply primarily to standard employment relationships, leaving many self-employed and platform workers outside existing regulatory frameworks. As technological progress accelerates these transformations, concerns occur regarding the capacity of governments to regulate emerging forms of work effectively (Hauben et al., 2020).

2.3 AI adoption and further challenges to labour markets

Contemporary labour markets are undergoing continuous structural reorganisation shaped by the logics of algorithmic platforms, while further advances in artificial intelligence may directly affect occupational structures and professional competencies. The labour market effects of artificial intelligence are better understood through changes in tasks rather than direct job displacement. Firms rarely substitute entire occupations, instead, tend to introduce AI into individual activities such as data processing, customer interaction, or routine administrative work. Recent studies indicate that AI is mainly implemented at the task level, where it enhances efficiency in areas like writing, programming, and information processing

(Brynjolfsson, Li and Raymond, 2023; Noy and Zhang, 2023). When analysing labour market change, it can be argued that new forms of artificial intelligence are unlikely to generate immediate large-scale unemployment (Vallas and Kovalainen, 2019). Instead, current developments point toward a transitional phase in the implementation of algorithmic systems (Jarrahi et al., 2021), in which generative AI is primarily used for task-level activities (Bick, Bladin and Deming, 2024). However, even task-level automation can have significant implications for labour demand. Hampole et al. (2025) show that greater exposure to AI is associated with shifts in demand across tasks, including declines in some activities and increased demand for tasks that complement AI. The primary motivation for AI integration appears to be efficiency improvement rather than direct labour substitution. Firms frequently deploy AI to automate routine labour, enabling employees to manage increased workloads and respond to operational pressures such as staffing shortages and rising demand (Filippucci et al., 2024; Lane and Saint-Martin, 2021). This suggests that AI primarily reorganises tasks rather than replacing entire occupations.

2.4 Inequality and uneven outcomes of AI adoption

The new developments have important implications for competences demand and inequality. AI tends to increase the value of complementary capabilities such as problem-solving, creativity, and digital literacy, while placing greater pressure on routine cognitive tasks. Research shows that AI exposure is uneven across occupations, with many highly exposed roles concentrated in knowledge-intensive work (Eloundou et al., 2024). In addition, evidence from labour market data suggests that demand for AI-related competencies is associated with higher wages in job postings (Alekseeva et al.,2021). As a result, the benefits of AI are unlikely to be distributed evenly. AI adoption is also highly uneven across firms. Empirical evidence shows that AI use is more common among larger firms and those with stronger complementary assets, such as data, capital, and technical expertise (McElheran et al., 2024). This uneven diffusion can widen existing gaps in productivity and performance between firms and indirectly between their workers. In this sense, AI operates not only as a source of efficiency gains but also as a driver of structural inequality within the economy, as automation technologies can generate uneven labour market outcomes (Acemoglu & Restrepo, 2020). Parallel to these developments, firms are increasingly adopting algorithmic management systems to coordinate and monitor labour, using automated tools for task allocation, performance evaluation, and real-time supervision (Lee et al., 2015).

3. Economic challenges and drivers of AI integration

The recent wave of artificial intelligence adoption must be understood within a broader context of overlapping economic shocks, including the COVID-19 pandemic, labour market disruptions, and rapid technological change. AI uptake should not be analysed as an isolated technological trend, but as part of broader structural changes in how firms organise production, use data, and respond to economic uncertainty. The pandemic marked an important moment in this process by accelerating digitalisation across sectors, particularly through the expansion of remote work, online services, and cloud-based systems. At the same time, it made existing inequalities in firms' technological capabilities more visible. These developments contributed to the expansion of firms' digital infrastructure, which supported later the adoption of more advanced technologies such as artificial

intelligence (Arroyabe et al., 2024). However, this transition did not occur uniformly. Firms with established digital infrastructures were able to incorporate AI tools more rapidly, whereas less digitalised firms lagged. As documented by the World Bank and the United Nations Conference on Trade and Development (2025), AI adoption remains uneven across firms and countries, reflecting differences in digital infrastructure, data availability, skills, and institutional capacity, which shape firms' ability to adopt and benefit from AI.

The expansion of digital channels during the COVID-19 period marked a shift in how firms organise economic activity. As sales, communication, and coordination increasingly moved online, the volume and strategic importance of digitally generated data grew significantly. Research shows that e-commerce adoption accelerated as in-person transactions became constrained, while firm performance increasingly depended on digital capabilities such as data use and business intelligence (Huy and Phuc, 2023). At the same time, firms with stronger pre-existing digital capabilities were better able to adapt to the shock, contributing to widening differences in performance between more and less digitally prepared firms (Avalos et al., 2024). These developments reinforced existing differences in firms' digital preparedness for adoption.

Simultaneously, tightening labour markets and the emergence of generative AI technologies after 2022 have strengthened incentives for firms to automate and reorganise production processes. The spread of generative AI across firms has been rapid, although its use remains concentrated in specific tasks and often requires complementary organisational and skill-related investments.

The development of generative and related AI technologies has been particularly visible across several key service sectors, where applications have moved from experimentation to operational use. In customer service, evidence from a large-scale study of over 5000 support agents shows that access to a generative AI assistant increased productivity by around 15 per cent on average, with especially strong effects for less experienced workers (Brynjolfsson, Li and Raymond, 2025). For developing economies that specialise in outsourced services, the risk is stated even more. Egana-delSol and Vargas-Faulbaum (2025) surveying AI and labour-market evidence for developing economies, warn that in economies such as the Philippines, extensive call-centre operations and subcontracted roles may be supplanted by chatbots. In the United States, higher regional AI deployment has been associated with larger declines in the employment-to-population ratio, especially in manufacturing, lower-skill services, and non-technical occupations (Huang, 2024). Cross-country evidence from Brazil and the United Kingdom suggests that adjustment differs by education, with college-educated workers more likely to move into high-exposure occupations that are complementary to AI, while less-educated workers face a higher risk of transitioning toward lower-exposure roles and potential income losses (Cazzaniga et al, 2024).

Recent research shows that the development of frontier AI capabilities is highly concentrated in a small number of firms and countries, with advanced economies dominating investment, research, and infrastructure (UNCTAD, 2025). Evidence further indicates that countries with stronger human capital, particularly in STEM fields, and better digital infrastructure tend to perform better in sectors with higher exposure to AI (Bonfiglioli et al., 2025). At the same time, OECD (2025) suggests that AI integration could transform global value chains and place new adoption pressures on firms and national economies. In developing regions, a significant

share of jobs could benefit from AI-driven productivity gains, but limited digital access and infrastructure often constrain their effective use (ILO and World Bank, 2025). These patterns reflect persistent asymmetries in technological and institutional capacity between countries. Technological dependence is a key feature of many AI-adopting economies, where reliance on externally developed systems and infrastructures reflects broader asymmetries in knowledge production and technological capabilities (Ahmed, 2026).

AI implementation depends on broader organisational and institutional conditions, including infrastructure, regulation, and access to finance, which can facilitate or constrain the deployment of AI systems across firms and sectors (Bajwa et al., 2021, Arroyabe et al., 2024).

AI deployment is increasingly discussed alongside broader geopolitical and macroeconomic pressures rather than in isolation. Current global assessments note that ongoing conflicts, trade tensions, and financial vulnerabilities can weigh on growth and influence how new technologies spread, particularly in emerging and developing economies (IMF, 2026a). At the same time, IMF (2026b) suggests that the broader economic effects of AI will depend partly on how widely these technologies are adopted and on the institutional and infrastructural conditions supporting their diffusion across economies. Geopolitical risk can further constrain these dynamics by weakening cross-border supply chains and reducing the resilience of international production networks (Caldara and Iacoviello, 2022)

3.1 Integration of Artificial Intelligence across firms

Understanding the effects of artificial intelligence requires first examining how its adoption varies across firms and regions. Firms operating across both advanced and emerging economies are increasingly incorporating artificial intelligence into their operational models, primarily as a means of managing costs and sustaining productivity under competitive pressure. Recent data show that the use of artificial intelligence in firms has increased rapidly over a short period. In OECD countries, the share of firms using AI rose from 8.7% in 2023 to 20.2% in 2025 (OECD, 2026). A similar trend is observed in the European Union, where about 20% of enterprises reported using AI technologies in 2025, compared to 13.5% in 2024 (Eurostat, 2025). Importantly, this adoption is highly stratified by firm size, with more than half of large firms adopting AI compared to less than one-fifth of small firms, suggesting that AI may contribute to a key driver of structural divergence within the business landscape (OECD,2026).

Firm size plays a decisive role in shaping AI uptake patterns. Large firms consistently exhibit higher rates of AI integration than small and medium-sized enterprises, reflecting greater access to financial resources, data infrastructure, and specialised human capital (Filippucci et al., 2024; Lane and Saint-Martin, 2021). Digital technologies tend to reinforce scale advantages and widen performance gaps between firms (Brynjolfsson and McAfee, 2014).

As Acemoglu and Restrepo (2019) argue, automation technologies change the task content of production rather than simply eliminating labour, highlighting the central role of task reallocation mechanisms. Survey-based evidence indicates that firms adopting AI often report stable employment levels, with productivity gains primarily arising from process optimisation rather than headcount reductions (Filippucci et al., 2024; Lane and Saint-Martin, 2021). This reorganisation of tasks increasingly relies

on digitally mediated forms of coordination, reflecting broader trends in platform-based labour organisation (Hoinaru, 2025).

4. Methodological approach

The methodological approach examines the context of AI implementation as reflected in the academic literature and adapts these findings to the Romanian national case. To analyse the implications of AI, this research adopts a descriptive and interpretive approach based on secondary statistical data. The analysis focuses on identifying patterns of AI adoption and their potential implications for economic activity and labour market outcomes. Drawing on recent literature on AI uptake, the research uses secondary data related to the Romanian labour market, including labour market structure, employment patterns, educational attainment, and digital competences. The data are provided by institutions such as OECD, Eurostat, the World Bank, the European Commission, and the Romanian National Institute of Statistics and serve to examine economic implications, labour market developments, and patterns of technological change in Romania. This approach allows for the identification of potential challenges and risks associated with AI deployment from the perspective of Romania as a semi-peripheral, dependent market economy. In this context, the structural characteristics of the labour market allow for the examination of how AI integration interacts with existing employment patterns and labour market dynamics.

4.1 Romania as a dependent market economy

Romania's economic development can be understood within the framework of dependent market economies, being part of the Central and Eastern European economies that are deeply integrated into European production networks, while remaining strongly reliant on foreign direct investment and the presence of multinational companies (Nölke and Vliegenthart, 2009). In this context, EU integration has supported the growth of export-oriented sectors, including IT and business services, particularly outsourcing activities. (European Commission, 2020; World Bank, 2019; Drahokoupil, 2015), a development facilitated by relatively skilled labour, comparatively low labour costs, and the transfer of technology and organisational practices (Tarlea and Freyberg-Inan, 2018). Consequently, Romania combines participation in advanced manufacturing and digital services with continued reliance on foreign capital and ownership, suggesting an intermediate position within European production structures, often described in the literature as a semi-peripheral position (Jipa-Mușat, Prevezer and Campling, 2023).

4.2 Labour market challenges in Romania

The Romanian labour market maintained a relatively stable development, with the employment rate increasing from 62% to 66% between 2015 and 2019 (OECD, 2025). By 2024, employment reached approximately 5.7 million workers (INS, 2024), despite a contraction in the total labour force (World Bank, 2025). During this period, the transformation of economic sectors led to significant territorial and social mobility, particularly toward the expansion of the services sector and urban centres (INS, 2024). Over the past decade, continued labour market development was supported by increased external investment as part of Romania's broader process of European Union integration, as well as by the growing presence of large companies, which employ approximately 32.8% of the workforce (European Commission, 2024;

Marinescu, 2025). Despite these positive developments and productivity gains in certain economic sectors, several structural factors continue to shape labour market trajectories and may constrain further development, particularly in the context of ongoing technological change.

Although the general perspective on the labour market indicates progress and constant evolution, it has produced differentiated outcomes and a high concentration of economic activity in urban areas. These patterns have direct implications for income differences and employment opportunities and, by extension, for both internal and external mobility. While Romania's employment rate for the population aged 20–64 reached 69.4% (INS, 2025), it remains below the EU average of 76.2% in 2025 (Eurostat, 2025). At the national level, territorial disparities are even more pronounced, with employment rates of 76.3% in urban areas compared to 61.8% in rural areas (INS, 2025). Beyond employment rates, income structures reflect similar territorial differences, as earnings are closely linked to the spatial and sectoral distribution of occupations. According to data from the National Institute of Statistics (2026), higher-income activities are concentrated in sectors relying on advanced skills and capital investment, such as information technology, finance, and energy. By contrast, agriculture, hospitality, and peripheral service activities continue to be associated with comparatively lower income outcomes. Significant differences and patterns of polarization are indicated by net income levels that are up to four times higher, especially when compared with knowledge-intensive sectors such as information technology.

The observed differences indicate the fragile construction of the labour market, which is more visible from a social and economic perspective. Over time, this labour market structure has amplified patterns of internal migration towards urban centers, as well as external migration, because of the lack of qualitative employment opportunities at the territorial level. In recent periods, emigration patterns have moved towards more permanent forms (Baciu, 2018), amplifying other demographic pressures. Current estimates indicate that between 2024 and 2040, the active labour is projected to decline by approximately 15% (OECD, 2025). In response to persistent inequalities and emigration pressures, and with the aim of reducing the risk of poverty, recent years have registered successive increases in the gross minimum wage (European Commission, 2025). While this strategy has had a direct effect on wage levels, labour market competitiveness remains constrained by relatively high and weakly differentiated labour taxation (Dutcaș and Grosu, 2020). Recent developments indicate a slowdown in labour demand, reflected in a decline in the vacancy rate, with Romania recording one of the lowest vacancy rates among EU countries (0.6%) (Eurostat, 2026).

4.3 Education and lifelong learning in the Romanian labour market

Differences between rural and urban labour market conditions directly influence educational outcomes in Romania. Concerns regarding youth employment have driven recent policy interventions targeting NEET populations (not in employment, education, or training). More recently, these interventions have been expanded to include individuals up to the age of 30, with the aim of enhancing labour market integration (OECD, 2025). However, the outcomes of these measures reflect a long-term process and remain difficult to assess. Over the longer term in Romania, macro-level analysis examining the period 1991–2020 indicates a correlation between an increasing number of higher-education graduates and reductions in

unemployment (Dăncică et al., 2023). At the same time, the relatively low degree of mismatch between university specialisation and occupational placement (22%) suggests a generally favourable alignment between education and labour market outcomes (OECD, 2022). While this indicates a degree of structural progress, these improvements are concentrated primarily in urban areas. Nevertheless, such challenges persist, particularly in rural educational contexts characterised by limited household resources and lower school performance (Cristea, 2022). From this perspective, NEET status can be linked to social origin and is reflected in patterns of intergenerational educational mobility (Caroleo et al., 2022). This argument is supported by data for the population aged 25–64, among whom only 29% have attained a higher level of education than that of their parents (OECD, 2024).

These constraints are further reinforced by the limited engagement of the active workforce in digital skills development programs and with the National Employment Agency (NAE). As a result, Romania continues to rank last in the European Union in terms of basic digital skills. Despite additional resources allocated to education and teacher training, progress in digital skills development remains limited and uneven across educational stages (European Commission, 2025). Moreover, the ageing of the labour force, combined with limited progress in digital skill acquisition, constrains Romania's capacity to respond to ongoing technological development and to effectively valorise the population aged over 55 (Duminică and Hosszu, 2020).

4.4 AI Implementation: Risks and Implications for Romania

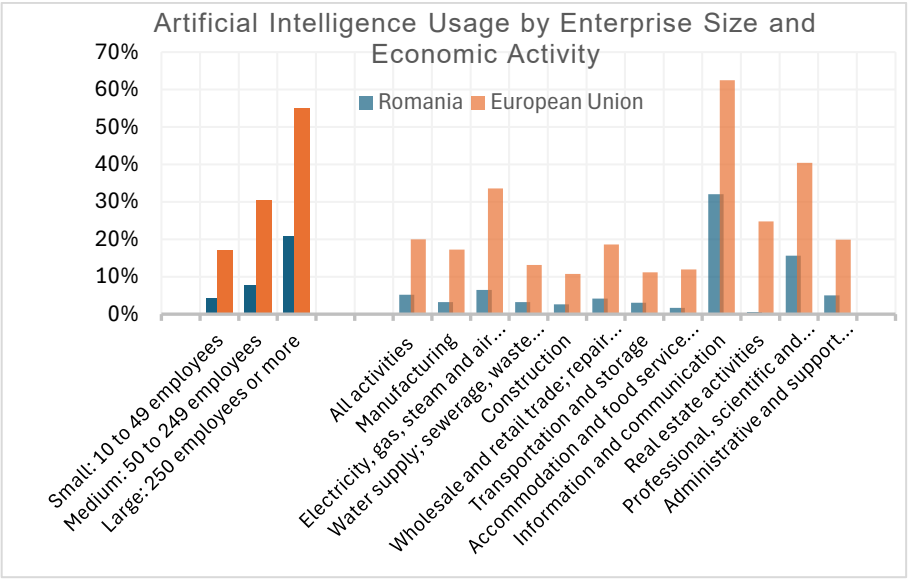


Figure 1: Artificial intelligence usage by enterprise size and economic activity
Source: Authors' adaptation based on Eurostat (2025) data on artificial intelligence by size class of enterprise and NACE Rev. 2 activity.

Analysing the current indicators of the Romanian economic and labour market context, several challenges related to AI adoption and diffusion can be identified, which operate through existing structural constraints and may further amplify uneven

economic outcomes and reinforce social inequalities. Drawing on the main approaches in the academic literature on AI technologies, in line with descriptive data specific to the Romanian case, we identify a series of challenges that may be amplified.

(1) Slow adoption of AI technology in Romania. As shown in Figure 1, the adoption of AI technologies among Romanian enterprises (5.21%) remains significantly below the EU average (19.95%), both from the perspective of firm size and economic sectors. As indicated in the academic literature on uneven technological diffusion, delayed AI integration may amplify productivity gaps among companies operating in the Romanian market through slower task reorganisation and limited integration of digital processes. At the same time, the low integration of AI technologies limits the capacity of the labour market to absorb and develop specific competencies. (2) Dependence on external investment and outsourced service activities. The relatively low levels of AI deployment within Romanian enterprises may also be linked to the dependence on external investment and outsourced service activities. As the analysis reveals, this structure reflects the broader global division of labour, where lower value-added activities are more exposed to replacement through AI capabilities, particularly in externally controlled production structures. As AI is primarily implemented at the task level rather than across entire occupations, these segments are particularly vulnerable to automation, increasing exposure to employment insecurity and precarious work. This perspective is further amplified by the uneven distribution of AI adoption across firm size. In this context, although overall adoption remains below the European average (55.03%), AI diffusion in Romania is concentrated in large companies (20.75%), which employ approximately 32.8% of the national workforce. While this creates advantages for a particular segment of employees in accessing AI-related knowledge, it may also represent a source of instability in economic activity, particularly as large companies increasingly use semi-peripheral regions for cost optimisation. (3) Demographic structure. The literature indicates that AI uptake does not necessarily lead to immediate employment reduction, but during the transitional phase, it increases the demand for digital competencies. In this context, from a structural perspective, the ageing and decline of the Romanian labour force over the last decade may reduce the capacity to adapt to ongoing technological change. Given that AI integration requires continuous competence development, demographic pressures may act as a systemic constraint on adaptation by limiting the capacity to transition toward AI-complementary tasks. This perspective is currently visible in the limited engagement of the active workforce in digital skills development programs. (4) Labour market territorial fragmentation. Access to digital infrastructure, competencies, and technological capabilities remains uneven across regions, sectors, and types of companies. As a result, AI implementation reinforces existing territorial disparities between rural and urban areas, where employment rates stand at 61.8% in rural areas and 76.3% in urban areas, limiting opportunities for upward mobility. (5) Lower employment rates among young people. Limited access to stable employment pathways and to organisational contexts where AI-related competencies are primarily developed may reinforce long-term weakening of labour market integration. From this perspective, unequal exposure to technological environments can shape future career trajectories and contribute to persistent labour market segmentation by restricting access to high-exposure, AI-complementary work environments.

5. Conclusions

The article has examined the expansion of artificial intelligence within a broader context defined by economic uncertainty, structural transformation, and uneven global development. Rather than representing a single, disruptive break, AI emerges as a part of a longer trajectory of technological change that continues to reorganise production, labour relations, and firm behaviour. Under conditions of persistent inflation, tighter financial constraints, and geopolitical instability, firms increasingly turn to AI not primarily to replace labour, but to reorganise tasks, improve efficiency, and maintain competitiveness. This reinforces the view that the impact of AI is better understood at the level of tasks and organisational processes rather than in terms of aggregate employment displacement.

However, the adoption of AI remains highly uneven. Differences in firm size, access to capital, digital infrastructure, and human capital shape both capacities to adopt these technologies and the extent to which firms can benefit from them. As a result, these differences translate into unequal outcomes across firms and segments of the workforce. Workers possessing complementary skills are more likely to experience productivity gains and improved employment prospects, while those engaged in routine or lower-skilled activities face increased risks of labour market stagnation, displacement, or deteriorating job quality.

The case of Romania illustrates how these dynamics manifest within a semi-peripheral economy. While integration into European production networks and the expansion of service sectors have supported technological adoption, organisational constraints, such as regional disparities, demographic pressures, and limited digital skills, continue to shape labour market outcomes.

Taken together, the findings suggest that the impact of AI integration depends less on the technology itself than on the economic, institutional, and social context in which it is embedded. Without sustained efforts to address structural constraints, enhance skills and competencies, and strengthen institutional capacity, AI is likely to reinforce existing disparities rather than generate broadly shared economic benefits.

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SECTION FINANCE, BANKING, ACCOUNTING AND AUDIT

FINANCIAL DERIVATIVES: THEIR USE AND IMPACT ON FINANCIAL RISK IN ROMANIAN SMES

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Abstract: *This study investigates the impact of financial derivatives on financial risk management in small and medium-sized enterprises (SMEs) in Romania. The research population was composed of SMEs from six development regions, selected based on exposure to financial volatility and active involvement in financial decision-making. The purpose of the research is to determine whether the use of derivative financial instruments contributes to reducing financial risk and strengthening financial resilience among Romanian SMEs. To address the research objectives, three hypotheses were formulated. The results showed that the use of forward and swap contracts has a significant positive effect on the perception of foreign exchange risk, increasing the ability of firms to anticipate and manage exchange rate fluctuations. Also, the adoption of financial options contributed positively to the stability of cash flows, suggesting an important role in liquidity planning. The study also showed that the recognition of financial risk is significantly associated with the maintenance and consistent application of hedging strategies. Finally, the general use of derivatives was positively correlated with improved financial performance among SMEs in Romania. The findings suggest that the strategic and informed use of derivatives may support better financial stability, although the direct effect on overall financial performance should be examined in future research. The study concludes that the strategic and informed use of derivatives can be an effective mechanism to mitigate financial risk and strengthen financial resilience. It is recommended that SMEs in Romania integrate derivatives into their financial policies, and targeted support including financial education and institutional facilitation be expanded to encourage wider adoption.*

Key Words: financial derivatives; SMEs; risk management; financial performance.

JEL classification: *G32; M21; L26*

1. Introduction

In the current economic climate, marked by instability, financial volatility and intense competitive pressures, small and medium-sized enterprises (SMEs) in Romania are increasingly forced to strengthen their financial risk protection mechanisms. These entities represent the backbone of the Romanian economy, contributing significantly to job creation, innovation and economic growth (Audretsch and Belitski, 2021; Bakhtiari et al., 2020). However, SMEs are often more vulnerable to financial market

fluctuations and external shocks compared to large corporations, due to limited financial resources and reduced risk management capacity (Badshah and Borgersen, 2020; Wansi and Burrell, 2023).

In such an unpredictable environment, financial risk management is becoming a strategic priority. In particular, the use of derivative financial instruments, such as futures, options and swaps, has become increasingly important among companies seeking protection against risks related to interest rates, foreign exchange rates, commodity prices or capital market fluctuations. These instruments can represent an important source of financial stability and long-term profitability, if used in an informed and controlled manner (Ţurcanu and Golocialova, 2014; Zazzara, 2020).

However, adopting such hedging practices requires a high level of financial education, an adequate technological infrastructure and an organizational culture oriented towards risk management. In this regard, the active involvement of entrepreneurs and managers in the understanding, selection and application of derivatives is essential for the success of these strategies (Zetzsche et al., 2020; Zaimovic et al., 2025). Furthermore, it is essential to identify effective methods of training, motivating and retaining financial specialists who can support SMEs in the decision-making process. Just as employee performance is vital in corporate environments (Stahl et al., 2023), the financial performance of SMEs is closely linked to their ability to anticipate and manage risks. Effective financial compensation practices, organizational culture and sound financial governance policies all contribute to building a resilient financial structure (Vasuki et al., 2025).

In the context of digital transformation and rapid integration into the global economy, financial risk will continue to manifest itself in increasingly sophisticated forms. Therefore, it is essential for Romanian SMEs to develop proactive risk management mechanisms. These should include not only rigorous risk analyses, but also the adoption of modern and efficient financial instruments, adapted to their operational specifics (Skorupski, 2023; Zheng et al., 2025).

The purpose of the research is to determine whether the use of derivative financial instruments contributes to reducing financial risk and strengthening financial resilience among Romanian SMEs.

The main objective of this research is to analyze the extent to which Romanian SMEs use financial derivatives and to assess their impact on financial risk management. The main research question is: To what extent does the use of derivative financial instruments influence the perception, control and management of financial risk in Romanian SMEs? Based on this objective, the study tests three main hypotheses concerning: 1 the effect of forward and swap contracts on foreign exchange risk perception; 2 the effect of options and swaps on cash-flow stability; and 3 the effect of financial risk recognition on the maintenance of hedging strategies.

2. Literature Review

2.1. Compensation Management Practices in Relation to Financial Risk and SMEs

In the context of small and medium-sized enterprises (SMEs), compensation is not just a form of remuneration offered to employees, but a strategic element that plays an essential role in maintaining financial stability and reducing both operational and financial risks (Vasuki et al., 2025; Stahl et al., 2023). Compensation refers to the

totality of fixed and variable income, professional recognition, employee benefits and job security offered in exchange for work performed. Thus, compensation becomes a key link in the financial decision-making chain of SMEs, given the critical role that human resources play in risk management (Szabo, 2010; Şandor, 2013).

Compensation can include contingent payments, dividends, paid annual leave and other forms of reward designed to create a balanced organizational environment. Similarly, modern performance-based remuneration systems are essential for ensuring transparency, trust and efficiency in financial decision-making processes (Stahl et al., 2023; Tierney, 2022).

In the SME sector, especially in Romania, effective compensation practices can reduce financial uncertainty, help stabilize cash flows and motivate employees to adopt proactive behaviors in terms of cost control, innovation and adaptation to market changes (Rupeika-Apoga et al., 2022; Skorupski, 2023). Compensation is defined as the totality of financial and non-financial rewards offered to employees as a condition of employment, with the aim of attracting, motivating and retaining them (Singh et al., 2020; Zaimovic et al., 2025). Effective compensation management can significantly improve organizational performance, an essential objective for SMEs operating in volatile business environments (Soremekun et al., 2024).

SMEs, especially those exposed to significant financial risks such as interest rate fluctuations, currency volatility or legislative instability, can use compensation policies as an internal stabilization tool (Tkachev et al., 2022; Zheng et al., 2025). Employees expect fair remuneration that meets not only economic needs, but also psychological, social and identity needs (Schwarz and Clore, 2007). This perspective is particularly relevant in the SME environment, where staff loyalty and retention can be critical factors in long-term success (Szabo, 2010; Vijayalakshmi and Umayal, 2022). Moreover, compensation practices serve not only as incentives but also as essential criteria for recruiting and retaining valuable personnel, a vital aspect especially in uncertain financial environments (Zaimovic et al., 2025). Within Romanian SMEs, where human resources are often limited, the ability to attract and retain talent through effective compensation policies can indirectly contribute to reducing financial risk by ensuring operational continuity.

Job satisfaction has a strong impact on employee performance, which is reflected in the overall financial performance of the firm (Vasuki et al., 2025). This causal relationship is particularly relevant in SMEs, where the efficiency of each employee has a proportionally greater impact on overall results compared to large corporations (Stahl et al., 2023; Svobodova et al., 2024). A well-structured compensation plan can reduce financial stress at both the individual and organizational levels, while encouraging engagement in proactive financial strategies, including the use of derivatives to hedge risks (Ţurcanu and Golocialova, 2014; Zetzsche et al., 2020).

In this regard, an effective compensation plan should be fully aligned with the overall financial strategy of the enterprise, thus contributing to its sustainability and resilience (Rossi et al., 2024; Zenios et al., 2021). Furthermore, compensation should include both fixed and flexible components, as well as associated benefits and services, all of which are essential for maintaining a balance between performance, motivation and risk (Schwarz and Clore, 2007; Walker, 2024). In Romanian SMEs, where budgets are often tight, flexibility in managing employee compensation can allow for better adaptation to market conditions and external pressures (Wansi and Burrell, 2023). Remuneration represents a fair reward for the work done, and in the context of financial risk, it can act as a psychological and

motivational buffer (Schiozer and Saito, 2009). SMEs that adopt balanced and transparent compensation policies can thus reduce the uncertainty perceived by employees and contribute to internal stability in difficult economic times (Vasista, 2022; Stahl et al., 2023).

In conclusion, employee compensation is influenced by a number of factors, including qualifications, skills, experience, position within the organization, and the financial capacity of the enterprise to support a compensation system. For Romanian SMEs, integrating these factors into a coherent compensation policy can represent a competitive advantage and an effective indirect means of managing financial risk.

2.2. The use of derivatives and their impact on financial risk in Romanian SMEs

According to the specialized literature, the use of derivative financial instruments represents one of the modern methods of managing and mitigating financial risks within small and medium-sized enterprises (SMEs) (Ţurcanu and Golocialova, 2014; Zetzsche et al., 2020). Derivative instruments, such as forward contracts, futures, options and swaps, allow SMEs to protect their cash flows, reduce uncertainties about future costs and maintain financial stability in a volatile economic environment (Zazzara, 2020; Rossi et al., 2024).

The use of derivatives gives SMEs the ability to anticipate and manage exposure to risks such as currency fluctuations, interest rate volatility and commodity price variations (Schiozer and Saito, 2009; Vijayalakshmi and Umayal, 2022). This hedging capacity not only reduces the negative impact of market volatility, but also contributes to improving financial performance, thus increasing investor confidence and the degree of credibility with financial institutions (Rupeika-Apoga et al., 2022; Vasista, 2022). Financial risk in SMEs is influenced by both internal and external factors. Internal factors include the level of financial literacy of the management team, data analysis capabilities, attitude towards risk and access to specialized consultancy (Singh et al., 2020; Zaimovic et al., 2025).

In practice, the impact of using derivatives can be analyzed from three interconnected perspectives: protection against financial losses, as SMEs that apply solid hedging strategies can limit losses caused by market fluctuations (Zenios et al., 2021; Zetzsche et al., 2020); cash-flow stability, since derivatives allow for more efficient financial planning by providing predictability in income and expenses (Utami and Sitanggang, 2021; Vasuki et al., 2025); and improved access to finance, as banks and lenders perceive SMEs that actively manage risks as less risky, thus offering them more favorable lending conditions (Rossi et al., 2024; Soremekun et al., 2024).

Small firms generally use derivatives less frequently, mainly due to a lack of expertise, perceived high costs and small transaction sizes, which limit their access to sophisticated financial products (Walker, 2024; Wansi and Burrell, 2023). However, in Romania, with the development of financial markets and the increased digitalization of the SME sector, there is a real opportunity to expand the use of derivatives in the coming years (Rupeika-Apoga et al., 2022; Zaimovic et al., 2025).

For these tools to be effective, SMEs must meet three fundamental conditions related to employee performance and organizational readiness: willingness to use such tools, supported by an organizational culture that recognizes risk and the need to actively manage it (Stahl et al., 2023); financial capacity and adequate knowledge, reflected in the ability to understand the complexity of derivatives and their practical application (Singh et al., 2020; Vijayalakshmi and Umayal, 2022); and efficient

access to financial markets and hedging products, either through commercial banks or specialized platforms (Zetzsche et al., 2020; Tierney, 2022).

In assessing the impact of these instruments, several factors must be taken into account: the accuracy of the implementation of the hedging strategy, execution costs, the degree of risk control achieved and the influence on the overall performance of the firm (Zenios et al., 2021; Zheng et al., 2025). Although individual performance does not guarantee financial success, SMEs that adopt clear and measurable financial strategies are more likely to achieve visible benefits, and risk reduction becomes a tangible and quantifiable objective (Skorupski, 2023; Rossi et al., 2024).

2.3. SMEs' financial commitment to risk management

In academic literature, organizational commitment is described as the degree of devotion or loyalty that an employee displays towards their organization (Stahl et al., 2023; Schwarz and Clore, 2007). Adapted to the financial field, the financial commitment of SMEs to risk management can be understood as the level of strategic and operational involvement in adopting active measures to control financial risks, including the use of derivatives (Ţurcanu and Golocialova, 2014; Zetzsche et al., 2020).

Commitment reflects the mindset of an entity towards its own objectives. In the case of SMEs, this mindset translates into a focus on loss prevention, financial stability and sustainability through proactive measures such as hedging (Zaimovic et al., 2025; Zenios et al., 2021). Just as employee engagement predicts individual performance, SMEs' commitment to financial risk management predicts business resilience and its ability to cope with economic shocks (Singh et al., 2020; Vasuki et al., 2025). In an increasingly unstable economic environment, commitment to financial risk control becomes essential for the survival and competitiveness of SMEs in Romania (Rupeika-Apoga et al., 2022; Tkachev et al., 2022).

Whether it is about employees or the organization as a whole, commitment is important for achieving organizational performance. Dedication to clearly defined objectives, such as reducing financial risk, is fundamental to creating a sustainable competitive advantage (Vijayalakshmi and Umayal, 2022; Utami and Sitanggang, 2021).

However, in Romania, many SMEs fail to demonstrate sufficient commitment to financial risk control, often due to limited understanding of derivatives, lack of access to financial education or the perception that such practices are reserved only for large corporations (Walker, 2024; Wansi and Burrell, 2023). Businesses that focus exclusively on short-term profit and neglect a long-term vision tend to show low financial commitment and are more vulnerable to economic shocks (Taylor, 2023; Shavshukov and Zhuravleva, 2023). In contrast, SMEs that take responsibility for protecting financial stability by investing in staff training, conducting market risk analyses and implementing derivatives demonstrate a high level of strategic commitment (Singh et al., 2020; Zheng et al., 2025). This allows them to manage periods of economic volatility more effectively (Zetzsche et al., 2020; Zenios et al., 2021).

Economic commitment to the well-being of the organization strengthens internal cohesion and increases operational efficiency (Stahl et al., 2023; Svobodova et al., 2024). SMEs that develop a financially responsible organizational culture, focused on risk prevention and control, tend to record better results in the medium and long

term (Vasuki et al., 2025; Rossi et al., 2024). This requires not only the adoption of advanced financial instruments, but also a proactive attitude and strategic thinking oriented towards sustainability (Tierney, 2022; Zaimovic et al., 2025).
Thus, commitment is an attitude that connects everyday activities with the overall objectives of the organization (Szabo, 2010; Şandor, 2013). For SMEs, this commitment can be materialized by the decision to actively manage financial risk through coherent strategies, investments in derivatives and the maintenance of prudent financial policies (Zazzara, 2020; Tkachev et al., 2022). Such a vision reduces uncertainty, increases the trust of financial partners and contributes to increased adaptability in an unpredictable market context (Zenios et al., 2021; Stahl et al., 2023).

3. The Conceptual Research Model

3.1. Research Methodology

This study used a cross-sectional survey design, as it allows the use of a structured research instrument to obtain relevant data that can be statistically analyzed. The choice of this method facilitates the capture of current perceptions, behaviors and financial practices of small and medium-sized enterprises (SMEs) in Romania, at a specific point in time. This type of research is appropriate in situations where the population analyzed is heterogeneous, including subjects with varied demographic and attitudinal characteristics, in this case, enterprises of different sizes, from different sectors and at different stages of maturity. The study was conducted among SMEs in Romania, selected from different regions of the country to reflect the geographical, economic and sectoral diversity. In total, six counties were chosen, one from each development region: Cluj (North-West), Timiș (West), Iași (North-East), Constanța (South-East), Bucharest-Ilfov (South) and Brașov (Center). The selection of these counties was based on criteria such as: SME density, high level of economic activity and the presence of an active financial sector, allowing access to derivative instruments.
The SMEs included in the research sample operate in sectors such as: manufacturing, trade, transport, information technology, financial services and agriculture considered relevant for the analysis of exposure to financial risks (e.g. currency fluctuations, interest rates, raw material prices). The target population of the study was CFOs and/or CEOs of SMEs, as they are responsible for major financial decisions, including the adoption or rejection of the use of derivatives. They were selected because they can provide valuable insights into risk management strategies and familiarity with modern financial instruments.
To clarify the operationalization of the variables, financial risk perception was evaluated through a structured questionnaire addressed to CFOs and/or CEOs of the selected SMEs. Respondents were asked to assess the extent to which their companies are exposed to different types of financial risk, including foreign exchange risk, interest rate risk, liquidity risk and market volatility risk. The items were measured using a five-point Likert scale, where 1 indicated a very low level of perceived risk and 5 indicated a very high level of perceived risk.
The variable “financial risk perception” was therefore constructed as a composite indicator based on the average scores obtained for the questionnaire items related to the above-mentioned risk categories. A higher score indicates a higher level of

perceived financial risk and a greater awareness of the need for risk-management instruments. In the empirical model, this variable was used as a dependent variable in the analysis of the impact of forward and swap contracts on foreign exchange risk perception. In addition, financial risk recognition was used as an explanatory variable when testing the relationship between risk awareness and the maintenance of hedging strategies.

The use of derivative financial instruments was measured through questionnaire items referring to the frequency and intensity of using forward contracts, swap contracts and financial options. These items were also evaluated on a five-point Likert scale, where 1 indicated no use or very low use and 5 indicated frequent or very high use. This approach allowed the transformation of qualitative managerial perceptions into measurable variables suitable for regression analysis.

According to 2024 data provided by the National Institute of Statistics and the Trade Register, there are approximately 12,000 active SMEs in the selected counties. From this total, a representative sample of 300 companies was drawn, using stratified sampling, proportional according to sector of activity and enterprise size.

Given the essential role of the so-called “creative class” of leaders, innovators and specialists in economic development, the research focused on strategic decision-makers within SMEs. These economic actors are responsible for generating ideas, making financial decisions and developing organizational capacity, all of which are critical components of effective financial risk management.

Therefore, the analysis targeted the level of knowledge, perception and use of financial derivatives among Romanian SMEs, as an integral part of the financial risk decision-making process (see Table 1).

Table 1. SMEs selected for the study

County	SME type	Predominant activity sector	Estimated number of active SMEs
Cluj	Urban, private	IT&C, Services, Trade	2.200
Timiș	Urban, private	Production, Logistics	1.800
Iași	Urban, private	Trade, Services, Education	2.000
Constanța	Urban, private	Maritime transport, Tourism	1.700
București-Ilfov	Urban, private	Finance, Technology, Services	3.000
Brașov	Urban, private	Production, Trade	1.300
Total			**12.000**

Source: Data provided by the National Institute of Statistics and the Trade Register (2024)

This study used the purposive sampling technique, which allows the selection of relevant companies based on specific criteria, such as: exposure to financial risk, the existence of a functional financial department, the potential for access to

derivatives. Taro Yamane's formula, mentioned by Onikoyi (2023), was used to determine the required sample size:

$$n = \frac{N}{1+N\,(e)2}$$

Where: n = sample size; N = total population (12.000 SMEs) e = margin of error (0,05 for a confidence interval of 95%);

$$n = \frac{12{,}000}{1+12{,}000\,(0.05)2} = \frac{12{,}000}{1+30} = \frac{12{,}000}{31} \approx 387.1 \approx 387$$

To ensure an adequate response, a 15% adjustment was applied, as recommended by Tamburn (2015): *15%×387=58,1*. *Total sample = 387 + 58 = 445*. Thus, 445 SMEs were selected as the target sample for the questionnaire, ensuring the necessary coverage for statistical analysis and inferential validation.

Table 2. Sample distribution by counties

Nr.	County	Estimated number of SMEs	Sample calculation	Sample size
1	Cluj	2,200	445 ÷ 12,000 × 2,200 = 81.58	82
2	Timiș	1,800	445 ÷ 12,000 × 1,800 = 66.75	67
3	Iași	2,000	445 ÷ 12,000 × 2,000 = 74.17	74
4	Constanța	1,700	445 ÷ 12,000 × 1,700 = 63.04	63
5	Bucharest-Ilfov	3,000	445 ÷ 12,000 × 3,000 = 111.25	111
6	Brașov	1,300	445 ÷ 12,000 × 1,300 = 48.21	48
	Total	**12,000**		**445**

Source: Own Calculations, 2026

3.2. Research model specifications

The key points investigated in this study are as follows:

- Independent variable: use of derivative financial instruments
- Dependent variables: Financial risk perception and financial performance of SMEs

Based on this relationship, the general working hypothesis of the research is formulated as follows:

General null hypothesis (H_0): The use of financial derivatives does not have a significant effect on the perception of financial risk and the financial performance of SMEs in Romania.

Hypothesis 1

H_{01}: The use of forward and swap contracts does not have a significant effect on the perception of foreign exchange risk among Romanian SMEs.

This hypothesis involves multidimensional independent variables, so the impact of each type of derivative instrument on the perception of foreign exchange risk is analyzed separately.

Thus, equation (1) is expressed as:

$$RFV=f(FWD, SWP)$$

The form of multiple linear regression:

$$RFV_i=\alpha_0+\beta_1 FWD_i+\beta_2 SWP_i+\mu_i \quad (1)$$

Where: **RFV** = currency risk perception; **FWD** = the use of forward contracts; **SWP** = the use of swap contracts; α_0 = constant term; β_1,β_2 = regression coefficients; μ_i = error term

Hypothesis 2

H_{02}: The use of financial options does not have a significant effect on the ability of SMEs to maintain cash flow stability.

This relationship is modelled as follows:

$$SFC=f(OPC)$$

Regression form:

$$SFC_i=\alpha_0+\beta_3 OPC_i+\mu_i \quad (2)$$

Where: **SFC** = cash flow stability; **OPC** = using options; β_3 = coefficient associated with the use of options;

Hypothesis 3

H_{03}: The use of derivatives does not have a significant effect on the overall financial performance of SMEs.

This relationship is modelled as follows:

$$PF=f(DRV)$$

Regression form:

$$PF_i=\alpha_0+\beta_4 DRV_i+\mu_i \quad (3)$$

Where: **PF** = financial performance (measured by ROA, ROE, profit net etc.); **DRV** = general use of derivatives (composite index); β_4 = the coefficient indicating the influence of derivatives;

All the above equations will be estimated using multiple linear regression, using SPSS or STATA programs. The statistical significance of the coefficients will be tested by t-test and R^2 coefficient. The objective is to determine whether the use of derivatives contributes significantly to reducing financial risks and increasing the financial performance of SMEs.

3.3. Results

Hypothesis 1

Table 3 shows an R coefficient value of 0.684, indicating a strong positive association between the use of forward and swap contracts and the perception of foreign exchange risk. This association is statistically significant at the 5% significance level.

Table 3. Analysis of the impact of forward and swap contracts on the perception of currency risk

Model	R	R Square	Adjusted R Square	Standard Error of the Estimate
1	.684[a]	0.468	0.465	2.84567
[a] Predictors: (Constant), Forward Contracts, Swap				
[b] Dependent variable: Perceived Foreign Exchange Risk				

Source: Own Calculations, 2026

Table 4 confirms that the use of forward and swap instruments significantly predicts the perception of foreign exchange risk among Romanian SMEs:

$$F(2,442)=194.726,\ p<0.05\ (Sig.=.000)$$

This provides strong evidence against the null hypothesis, with a probability of less than 5% that it is true.

Table 4. Regression test - significance of predictors on currency risk perception

Model	Sum of Squares	df	Mean Square	F	Sig.
1	3156.272	2	1578.136	194.726	.000[b]
Residual	3582.905	442	8.104		
Total	6739.177	444			
[a] Dependent variable: Perceived Foreign Exchange Risk					
[b] Predictors: (Constant), Forward Contracts, Swap					

Source: Own Calculations, 2026

Table 5 indicates that the standardized beta coefficient for swap contracts is 0.538, and the p-values for both predictors are below 0.05. Thus, the null hypothesis is rejected. The results confirm that the use of forward and swap contracts has a significant impact on the perception of foreign exchange risk among Romanian SMEs.

Table 5. The contribution of each predictor to the perception of currency risk

Model	Unstandardised Coefficient (B)	Standard Error	Beta Coefficient	t	Sig.
1 (Constant)	4.982	0.741	–	6.722	.000
Swap	0.465	0.041	0.538	11.341	.000
Forward	0.211	0.039	0.248	5.410	.000

Source: Own Calculations, 2026

SMEs that use forward and swap contracts are more aware of and better prepared to manage foreign exchange risks. These tools help reduce uncertainty and provide stability to international business decisions.

Hypothesis 2

Table 6. Analysis of the impact of options and swaps on the stability of cash flows

Model	R	R Square	Adjusted R Square	Standard Error of the Estimate
1	.632[a]	0.399	0.396	0.48608
[a] Predictors: (Constant), Financial Options, Swap Contracts				
[b] Dependent variable: Cash Flow Stability				

Source: Own Calculations, 2026

The R value of 0.632 indicates a moderately strong positive association between the use of options and swaps and cash flow stability. The relationship is statistically significant ($p < 0.05$).

Table 7. Regression - the significance of predictors on the stability of cash flows

Model	Sum of Squares	df	Mean Square	F	Sig.
1	54.528	2	27.264	115.393	.000[b]
Residual	81.986	347	0.236		
Total	136.514	349			
[a] Predictors: (Constant), Financial Options, Swap Contracts					
[b] Dependent variable: Cash Flow Stability					

Source: Own Calculations, 2026

The F-test indicates that both financial options and swaps are significant predictors of cash flow stability. Therefore, the null hypothesis is rejected.

Table 8. Contribution of each predictor to cash flow stability

Model	Unstandardised Coefficient (B)	Standard Error	Beta Coefficient	t	Sig.
1 (Constant)	1.728	0.155	–	11.163	.000
Swap	0.400	0.039	0.499	10.167	.000
Options	0.168	0.040	0.205	4.189	.000

Source: Own Calculations, 2026

Both predictors are statistically significant ($p < 0.05$). Swap contracts have a greater influence ($\beta = 0.499$) compared to options. Therefore, it is concluded that the use of these derivatives contributes significantly to the stability of cash flow in Romanian SMEs.

Hypothesis 3

Table 9. Analysis of the impact of financial risk awareness on maintaining hedging strategies

Model	R	R Square	Adjusted R Square	Standard Error of the Estimate
1	.472[a]	0.223	0.220	3.28182
[a] Predictor: (Constant), Level of Recognition of Financial Risk Importance				
[b] Dependent variable: Hedging Strategy Retention (consistent use of derivatives)				

Source: Own Calculations, 2026

R = 0.472 indicates a moderate positive correlation, statistically significant ($p < 0.05$), between the level of financial risk awareness and the continued use of derivatives.

Table 10. Regression test - the significance of the predictor "Risk Recognition" on maintaining the hedging strategy

Model	Sum of Squares	df	Mean Square	F	Sig.
1	1073.348	1	1073.348	99.658	.000[b]
Residual	3748.081	348	10.770		
Total	4821.429	349			
[a] Dependent variable: Hedging Strategy Retention					
[b] Predictor: (Constant), Financial Risk Recognition					

Source: Own Calculations, 2026

The F value of 99.658 and $p < 0.05$ indicates that the level of financial risk awareness significantly influences the maintenance of hedging strategies. The null hypothesis is rejected.

Table 11. The contribution of the predictor "Risk Recognition" on the maintenance of the hedging strategy

Model	Unstandardised Coefficient (B)	Standard Error	Beta Coefficient	t	Sig.
1 (Constant)	11.478	0.841	–	13.654	.000
Recognition	0.375	0.038	0.472	9.983	.000

Source: Own Calculations, 2026

3. Discussions

The results of this study are consistent with previous research in the field, which has consistently highlighted the role of financial derivatives in improving SMEs' ability to manage financial risks (Badshah and Borgersen, 2020; Buyukkara et al., 2018). Existing literature supports the conclusion that instruments such as forward and swap contracts are effective in mitigating perceived foreign exchange risk, reinforcing the idea that these instruments offer not only financial protection but also increased organizational awareness and responsiveness to foreign exchange volatility (Bouchekourte et al., 2022; Bakhtiari et al., 2020).

Also, the positive association identified between the use of financial options and cash-flow stability reflects patterns observed in previous empirical investigations, which have shown that hedging strategies contribute to more predictable income flows and facilitate better short-term financial planning (Campbell et al., 2020; Buyukkara et al., 2018). This consistency reinforces the relevance of options as a viable tool in managing liquidity uncertainties.

The significant relationship between risk awareness and the maintenance of hedging strategies also reflects the findings of the academic literature, which highlights the importance of financial literacy, internal governance and risk culture as key factors influencing long-term commitment to financial risk-management practices (Bello et al., 2024; Bhuiyan et al., 2024). SMEs that integrate risk recognition into decision-making processes tend to adopt and maintain more consistent hedging policies (Audretsch and Belitski, 2021).

Finally, the observed correlation between the general use of derivatives and improved financial performance is supported by the specialized literature, which highlights the dual function of these instruments: they not only provide protection against adverse market movements, but also contribute to increasing creditworthiness, investor confidence and financial stability (Bhatia and Mulenga, 2019; Bischof et al., 2021).

The study results are well supported by the theoretical and empirical foundations in the existing literature, confirming the value of derivatives as strategic tools for mitigating risk and optimizing performance in the SME sector.

4. Conclusions

This research was conducted with the aim of analyzing the impact of the use of financial derivatives on financial risk in small and medium-sized enterprises (SMEs)

in Romania. To achieve the objectives, both the statistical relationships and the theoretical foundations between the independent variables (use of derivatives: forward, swap, options, risk recognition) and the dependent variables (risk perception, cash flow stability, maintenance of hedging strategies, financial performance) were examined. Main results of the study: Forward and swap contracts positively influence the perception of currency risk; The use of financial options contributes to the stability of cash flow; Recognition of financial risk is significantly correlated with the maintenance and coherence of hedging strategies; The general use of derivatives is correlated with improved financial performance of SMEs.

The strategic use of derivative financial instruments can function as an effective mechanism for financial protection and optimization, especially in the Romanian economic context marked by uncertainty and volatility, aspects that mainly affect SMEs.

The study has several limitations. First, the research is based on a cross-sectional design, which captures perceptions and practices at a single point in time and does not allow the analysis of long-term causal effects. Second, the data were collected through questionnaires and are therefore based on self-reported information, which may be affected by subjective perception or response bias. Third, the sample is limited to SMEs from six selected counties, so the results may not fully represent all Romanian SMEs. Fourth, the study focuses on selected derivative instruments, mainly forward contracts, swaps and options, while other financial instruments and broader risk-management mechanisms were not examined in detail. Finally, the direct relationship between derivatives and objective financial performance indicators, such as ROA, ROE and net profit, should be tested in future research.

Future studies should use longitudinal data, extend the sample to all Romanian development regions and integrate objective financial indicators from company financial statements. Such extensions would provide a more comprehensive understanding of the role of derivatives in improving both financial risk management and SME performance.

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EMPIRICAL ANALYSIS OF THE EFFICIENCY OF WORKING CAPITAL MANAGEMENT AMONG HUNGARIAN FOOD INDUSTRY SMES

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Abstract: *The Hungarian food industry is one of the strategically important sectors of the national economy, playing a vital role in maintaining food security, supporting employment, and contributing to overall economic performance and value creation. In recent years, firms operating in this sector have faced an increasingly complex and uncertain economic environment shaped by accelerating inflation, rising energy costs, tighter financing conditions, and persistent disruptions in supply chains. These challenges have placed particular pressure on small and medium-sized enterprises, whose financial flexibility, liquidity reserves, and adaptive capacity are typically more limited than those of large corporations. Under such circumstances, the efficiency of working capital management has become a matter of central importance, as it directly affects firms' short-term solvency, operational stability, and profitability. The aim of this study is, on the one hand, to highlight the economic significance of the Hungarian food industry and, on the other hand, to examine empirically the relationship between working capital management efficiency and profitability among Hungarian food industry SMEs. The central research question is whether, and to what extent, the cash conversion cycle and its main components - inventory holding period, receivables collection period, and payables deferral period - affect firm profitability during the period between 2020 and 2024. The research adopts an empirical and quantitative approach, drawing on multi-year panel data to analyse the financial and operational characteristics of Hungarian food industry SMEs. The relevance of the study lies in the fact that the international literature has produced mixed findings regarding the relationship between working capital management and profitability, while longitudinal empirical evidence focusing specifically on Hungarian food industry enterprises remains limited. The expected findings of the study may contribute to a more nuanced understanding of the financial implications of working capital management and may offer valuable insights for corporate decision-makers, researchers, and economic policy actors alike, particularly in supporting decisions aimed at improving liquidity management, strengthening competitiveness, and enhancing financial stability.*

Keywords: *working capital management; cash conversion cycle; profitability; Hungarian food industry SMEs*

JEL Classification: *G12; G15; G32*

1. Macroeconomic Role and Sectoral Trends of the Hungarian Food Industry (2020-2024)

During the period under review, while the total number of enterprises in the national economy increased by approximately 5%, the food industry recorded an overall

decline of around 3% (KSH, 2026a). This suggests that although the sector has maintained its macroeconomic importance, the number of enterprises has not expanded dynamically; rather, a process of concentration and structural transformation can be observed. From the perspective of working capital management, this is particularly relevant, since in a narrowing or stagnant business environment competitiveness is determined less by market expansion and more by internal efficiency.

In addition to changes in the number of enterprises, employment trends also play a decisive role in assessing the sector's economic importance. The number of employees in the food industry rose from 102,461 in 2020 to 106,685 in 2024, representing an increase of approximately 4.1% (KSH, 2025). This growth exceeds the pace observed in the national economy as a whole and indicates that the food industry functioned as a stable, labour-retaining sector during the period examined.

Wages in the food industry increased dynamically across all subsectors during the period under review. In food manufacturing, average gross earnings rose from HUF 342,086 to HUF 560,078, representing an increase of nearly 63.7%, while in beverage manufacturing, they rose from HUF 439,261 to HUF 688,452, equivalent to a 56.7% increase. In tobacco product manufacturing, average earnings increased from HUF 490,645 to HUF 703,781, corresponding to a 43.4% rise (KSH, 2026b). This wage growth clearly indicates intensifying cost pressure within the sector, affecting a substantial share of firms' operating expenses. Rising labour costs increase short-term financing needs, particularly in those subsectors where inventory holding periods are longer or revenue realisation is delayed. Consequently, the efficiency of working capital management becomes a critical factor, as optimising the cash conversion cycle may help firms finance rising costs and mitigate liquidity tensions.

The production performance of the food industry displayed considerable fluctuation during the period examined. The sector's aggregate volume index exceeded the base year in both 2021 and 2022, reaching 108.5% and 106.8%, respectively, before declining markedly to 87.9% in 2023 and then showing a moderate recovery to 103.9% in 2024. This pattern clearly reflects the sector's sensitivity to changes in the broader economic environment. A subsectoral breakdown reveals substantial differences. Particularly high volatility can be observed in meat processing and the manufacture of meat and poultry meat products, where production showed significant fluctuations in several years. The manufacture of grain mill products recorded a sharp decline in 2023 to 80.7%, followed by outstanding growth to 121.7% in 2024, pointing to the cyclical nature of this activity. Fluctuations in production volume have a direct impact on firms' working capital management (KSH, 2026c). Output growth is typically accompanied by increases in inventories, receivables, and short-term financing needs, whereas a decline in output may lead to inventory accumulation and a deterioration in turnover efficiency.

It is also important to emphasise that investment activity in the food industry increased substantially during the period under review. The total value of investment performance in the sector rose from HUF 271,102 million in 2020 to HUF 482,610 million in 2024, representing an expansion of nearly 78%. Growth was particularly strong between 2021 and 2023, signalling intensified efforts toward capacity expansion and technological development, while in 2024 the pace of growth moderated, although the level of investment remained high (Agrárközgazdasági Intézet, 2024).

2. Presentation of the Characteristics of the Database Examined

The empirical analysis of the study is based on a firm-level panel database, which allows for a multidimensional examination of the relationship between working capital management and profitability.

2.1. Presentation of the Sample Selection and Filtering Criteria

The analysis is based on the EMIS database, which contains firm-level financial and operational data. During the sample selection process, only those enterprises were included that met the criteria applicable to small and medium-sized enterprises (SMEs).

The analysis covers the period between 2020 and 2024, which makes it possible to examine changes in the economic environment and their effects on corporate operations. Only those enterprises were included in the sample for which the required financial data were fully available for the entire period under review.

In the course of compiling the database, further filtering was carried out through the selection of food industry subsectors, thereby ensuring sectoral homogeneity and comparability. The selected subsectors cover the main segments of the food industry, including bakery products, meat processing, dairy processing, fruit and vegetable processing, as well as other food manufacturing activities.

During the data-cleaning process, incomplete, inconsistent, or potentially distortive observations were excluded in order to ensure that the final sample would provide a reliable basis for the empirical analysis. As a result, a balanced panel database was created, containing data for 795 food industry SMEs over the period from 2020 to 2024.

2.2. Composition of the Sample by Region, Sector, and Firm Size

Table 1 presents the regional distribution of the food industry SMEs included in the sample.

Table 1: Regional Distribution of the Sample

Region	Number of firms	Percentage share
Central Hungary	269	33.8
Southern Great Plain	145	18.2
Northern Great Plain	140	17.6
Central Transdanubia	71	8.9
Western Transdanubia	62	7.8
Southern Transdanubia	60	7.5
Northern Hungary	48	6.0
Total	795	100,0

Source: own compilation based on EMIS database

Based on the data presented in Table 1, it can be concluded that the regional distribution of the sample is relatively concentrated. The largest share of enterprises is located in Central Hungary, which accounts for 33.8% of the sample, indicating a significant spatial concentration of firms operating in the sector. This is followed by the

Southern Great Plain with 18.2% and the Northern Great Plain with 17.6%, meaning that these three regions together account for nearly 70% of the total sample.
The shares of the remaining regions are considerably lower. Central Transdanubia accounts for 8.93%, Western Transdanubia for 7.8%, Southern Transdanubia for 7.55%, and Northern Hungary for 6.04%. This distribution suggests that the presence of food industry SMEs is not evenly spread across the country but is instead linked to specific economic centres and agriculturally important regions.
In order to explore sector-specific characteristics, it is also important to present the activity structure of the sample under examination. Table 2 illustrates the subsectoral distribution of the food industry SMEs included in the sample.

Table 2: Distribution of the Food Industry SMEs Included in the Sample by Subsectors

Subsector	Number of firms	Percentage share
Manufacture of bakery products and pasta	303	38.1
Processing and preserving of meat, and production of meat products	201	25.3
Manufacture of other food products	121	15.2
Processing and preserving of fruit and vegetables	86	10.8
Manufacture of vegetable and animal oils and fats	55	6.9
Dairy processing	29	3.6
Total	795	100.0

Source: own compilation based on EMIS database

Based on Table 2, it can be concluded that the subsectoral distribution of the sample is highly concentrated. The largest share is represented by the manufacture of bakery products and pasta, which accounts for 38.1% of the total sample, followed by meat processing and the production of meat products with a share of 25.3%. Together, these two largest subsectors account for more than 63% of the sample, indicating the main structural concentrations within the food industry. The medium-weight subsectors include the manufacture of other food products with 15.2%, and the processing and preserving of fruit and vegetables with 10.8%, while the manufacture of vegetable and animal oils and fats accounts for 6.9% and dairy processing for 3.6%. This distribution suggests that the sample covers the major fields of activity within the food industry, although the dominant weight of the leading subsectors remains significant.

Table 3 presents the distribution of the food industry SMEs included in the sample by firm size.

Table 3: Distribution of the Sample by Firm Size

SME category	Number of firms	Percentage share
Micro-enterprises	98	12.3
Small enterprises	479	60.3
Medium-sized enterprises	218	27.4
Total	795	100.0

Source: own compilation based on EMIS database

Based on the data presented in Table 3, it can be concluded that the sample is dominated by small enterprises, which account for 60.3% of the total and therefore represent the most important group in the analysis. Medium-sized enterprises also constitute a substantial share, amounting to 27.4%, while micro-enterprises account for 12.3%, which may be considered relatively low. This size distribution suggests that the sample is primarily concentrated on firms that are more stable in operational terms and possess greater resource capacity.
Differences in firm size are also crucial from the perspective of operational efficiency, resource allocation, and financial structure. Larger firms generally operate with more developed organisational systems, broader financing opportunities, and more efficient resource allocation, whereas smaller enterprises are more likely to face liquidity constraints and financing difficulties. Accordingly, the role of working capital management differs across size categories: for smaller firms, the primary concern is maintaining continuous liquidity, while for larger enterprises the emphasis is more strongly placed on optimising operational efficiency. This, in turn, has a direct effect on the cash conversion cycle and, through it, on profitability.

3. Research Hypothesis and Methodological Framework

The aim of this section is to present the theoretical and methodological framework of the study. In this context, the research hypothesis is introduced, along with the empirical methodology applied in the analysis, with particular emphasis on the fixed-effects panel regression approach.

3.1. Formulation of the Research Hypothesis

The central objective of the study is to examine the relationship between the efficiency of working capital management and corporate profitability among small and medium-sized enterprises (SMEs) in the food industry. In the literature, the Cash Conversion Cycle (CCC) is widely used as a key indicator (Ashraf, 2012;. Attari, 2012; Ponsian et al., 2014), as it provides an integrated measure of the efficiency of inventory, receivables, and short-term liabilities management.
The relationship between working capital management and profitability has been extensively investigated over the past decades. Among the seminal empirical studies, the work of Shin and Soenen (1998) is particularly noteworthy, as they found a significant negative relationship between the length of the cash conversion cycle and profitability based on data from U.S. firms. Similarly, Deloof (2003) reached comparable conclusions in his analysis of Belgian firms, showing that shorter receivables and inventory cycles are associated with higher profitability. These findings are further supported by Lazaridis and Tryfonidis (2006), as well as Raheman and Nasr (2007), who also document a significant relationship between working capital management and profitability.
Subsequent empirical studies have confirmed these findings across different countries and samples. International comparative analyses generally indicate a negative relationship between the cash conversion cycle and firm performance, although in some cases this relationship exhibits a non-linear pattern. For example, Chang's (2022) global analysis suggests that both excessively low and excessively high levels of working capital can be detrimental, implying the existence of an optimal level.
The literature also highlights that the efficiency of working capital management affects not only profitability but also firm value and liquidity. Efficient inventory and receivables

management reduce capital tied up in operations and improve cash flow, while excessive working capital levels may have a value-destroying effect.

At the same time, several studies point out that the relationship is not necessarily linear. Some findings indicate an inverted U-shaped relationship between working capital management and profitability, suggesting that there exists an optimal cash conversion cycle at which profitability is maximized (Baños-Caballero et al., 2012).

Based on the above theoretical and empirical findings, the following hypothesis is formulated in this study:

H1: There is a significant negative relationship between the cash conversion cycle and profitability in food industry SMEs.

3.2. Theoretical Background of Panel Regression Models

The dataset applied in this study has a panel structure, consisting of observations of multiple firms over several years. This type of data structure allows for the simultaneous analysis of temporal dynamics and cross-sectional differences across firms.

Compared to traditional cross-sectional or time-series methods, panel data analysis enables the control of unobserved individual effects and reduces potential estimation bias. Consequently, the use of panel regression models is justified, as they are suitable for controlling firm-level heterogeneity and for providing more accurate estimates of causal relationships (Baltagi, 2008).

The primary objective of panel regression models is to simultaneously account for both the cross-sectional (between firms) and time-series (over time) dimensions. The general form of the model can be expressed as follows:

$Y_{it} = \beta \cdot X_{it} + \alpha_i + \varepsilon_{it}$

ahol:

Y_{it}: dependent variable

β: coefficient measuring the effect of the explanatory variable on the dependent variable

X_{it}: explanatory variable

α_i: individual-specific, unobserved effect

ε_{it}: error term

One of the most important features of panel models is the treatment of individual effects, which can be addressed through two main approaches: fixed effects (FE) and random effects (RE) models. The fixed effects model assumes that firm-specific, time-invariant but unobserved factors are correlated with the explanatory variables. Accordingly, the model explicitly controls for these effects, typically by eliminating them through transformation. As a result, the estimates remain unbiased even when individual effects are correlated with the regressors; however, the model does not allow for the estimation of time-invariant variables. In contrast, the random effects model assumes that individual effects are uncorrelated with the explanatory variables and are instead incorporated into the error term as a random component. This allows for more efficient (lower variance) estimates and enables the identification of time-invariant variables. However, if the independence assumption is violated, the estimates become biased (Wooldridge, 2002).

The application of the fixed effects panel regression model in this study is justified from both methodological and economic perspectives. It is reasonable to assume that firm-specific, time-invariant but unobservable factors influence both working capital management and profitability, and that these factors are correlated with the explanatory variables included in the model. In the case of food industry SMEs, such

unobserved effects include, for example, the quality of management and decision-making practices, organizational and operational structure, market position and competitiveness, the stability of supplier and customer relationships, the level of technological development, and the degree of integration into supply chains. These factors are persistent over time, vary across firms, and simultaneously affect both the cash conversion cycle and profitability; therefore, ignoring them would lead to biased estimates. The fixed effects model effectively controls for these time-invariant unobserved heterogeneities, thereby reducing omitted variable bias and providing more reliable estimates. Furthermore, the primary objective of the study is to examine within-firm changes over time, that is, to assess how variations in working capital management affect profitability within a given firm. This objective is well aligned with the estimation approach of the fixed effects model.
Based on these considerations, the fixed effects approach is more appropriate for the purposes of this study and the characteristics of the dataset than the random effects model.

3.2. Model Specification and Variables

The applied model can be expressed in the following mathematical form:
$ROA_{it} = \beta_1 \cdot CCC_{it} + \beta_2 \cdot \ln(\text{Total Assets}_{it}) + \beta_3 \cdot \text{Leverage}_{it} + \beta_4 \cdot \text{Liquidity}_{it} + \beta_5 \cdot \text{Firm Age}_{it} + \alpha_i + \varepsilon_{it}$
ROA_{it} (Return on Assets): a measure of profitability defined as the ratio of net income to total assets; it captures the firm's ability to generate earnings and serves as the dependent variable in the model. The index i denotes individual firms, while t represents the time dimension.
β_1: the regression coefficient associated with the cash conversion cycle, indicating the direction and magnitude of its effect on profitability.
CCC_{it} (Cash Conversion Cycle): a measure of working capital management efficiency, calculated as the sum of the inventory period and receivables collection period minus the payables deferral period; this is the main explanatory variable of the model.
β_2: the coefficient associated with firm size, capturing its effect on profitability.
$\ln(\text{Total Assets}_{it})$: the natural logarithm of total assets, used as a proxy for firm size; log transformation reduces the influence of extreme values and helps linearize relationships.
β_3: the coefficient associated with leverage, measuring the impact of capital structure on profitability.
Leverage_{it}: the ratio of total liabilities to total assets, reflecting the firm's level of indebtedness and financial risk.
β_4: the coefficient associated with liquidity, capturing its effect on profitability.
Liquidity_{it}: a measure of short-term solvency, defined as the ratio of current assets to current liabilities.
β_5: the coefficient associated with firm age, capturing the effect of experience and operational maturity on profitability.
Firm Age_{it} (AGE): the number of years since the firm's establishment, used as a proxy for experience and stability.
α_i: the individual-specific, time-invariant unobserved effect controlled for in the fixed effects model.
ε_{it}: the error term capturing time-varying, unobserved factors not included in the model.
The main explanatory variable of the model is the cash conversion cycle, while the remaining variables are included as control variables. These control variables serve

to isolate the effects of other firm-specific factors influencing profitability. Firm size is measured based on total assets and can be interpreted as a proxy for economies of scale and access to resources. The leverage ratio reflects the capital structure and the level of financial risk, which may affect both profitability and financing opportunities. The current ratio measures short-term solvency and serves as an important indicator of the firm's liquidity position. Finally, firm age represents operational experience and stability, which may influence performance and risk profile.

The selection of variables is grounded in the relevant literature, which suggests that profitability is determined not only by the efficiency of working capital management but also by firm size, financial structure, and liquidity conditions. In this specification, the model allows for the isolated examination of the effect of the cash conversion cycle while controlling for structural differences across firms.

Table 4 presents the estimation results of the fixed-effects panel regression model.

Table 4: Results of the fixed-effects panel regression

Variable	Coefficient	Std. Error	p-value	Signif.
CCC (cash conversion cycle)	-0.000108	0.000078	0.163	n.s.
Firm size (total assets)	0.043239	0.016377	0.008	***
Leverage	-0.535917	0.089825	0.000	***
Current ratio	-0.001278	0.002949	0.664	n.s.
Firm age	0.000078	0.000630	0.901	n.s.
Number of observations				3975
Number of firms				795
R^2 (within)				0.2399
F-statistic:				26.81
Prob > F				0.000

Note: *** p<0.01, ** p<0.05, * p<0.1, n.s. = not significant
Source: own calculations based on firm-level data from the EMIS database

The overall significance of the model is confirmed by the F-statistic (26.81) and its corresponding p-value (0.000), indicating that the explanatory variables jointly have a statistically significant effect on profitability. The explanatory power of the model can be considered moderate, as the within R^2 value of 0.2399 suggests that approximately 24% of the within-firm variation is explained by the model.

The main explanatory variable, the cash conversion cycle (CCC), has a negative coefficient (–0.000108), but it is not statistically significant (p=0.163). This implies that no significant relationship can be identified between working capital management efficiency and profitability in the examined sample; therefore, the H1 hypothesis is not supported in this specification.

Among the control variables, firm size shows a positive and statistically significant effect (β=0.043239; p=0.008), suggesting that larger firms tend to achieve higher profitability, likely due to economies of scale and more efficient resource allocation. In contrast, leverage exhibits a significant negative relationship with profitability (β= –0.535917; p=0.000), indicating that higher indebtedness adversely affects financial performance.

The current ratio and firm age do not show statistically significant effects on profitability, suggesting that these factors do not play a decisive role in explaining performance within the sample.
The non-significant result of the aggregate cash conversion cycle justifies a more detailed, component-level analysis of working capital management. Accordingly, the model is modified by replacing the CCC with its main components - days sales outstanding (DSO), days inventory outstanding (DIO), and days payable outstanding (DPO) - which are included separately as explanatory variables. This approach allows for the identification of which specific elements of working capital management have a measurable impact on firm profitability.
The results of this estimation are presented in Table 5.

Table 5: Results of the component-based fixed-effects panel regression

Variable	Coefficient	Std. Error	p-value
Days Sales Outstanding (DSO)	-0.000092	0.000113	0.415
Days Inventory Outstanding (DIO)	-0.000404	0.000123	0.001
Days Payable Outstanding (DPO)	0.000060	0.000090	0.503
Firm size (total assets)	0.046596	0.016985	0.006
Leverage	-0.525638	0.068166	0.000
Current ratio	-0.001470	0.002972	0.621
Firm age	0.000041	0.000623	0.947
Number of observations			3975
Number of firms			795
R^2 (within)			0.2430
F-statistic			22.85
Prob > F			0.000

Note: *** p<0.01, ** p<0.05, * p<0.1, n.s. = not significant
Source: own calculations based on firm-level data from the EMIS database

Based on the results presented in Table 5, the overall significance of the model remains confirmed (F=22.85; p=0.000), while the explanatory power slightly improves (R^2=0.2430), indicating that the component-based approach provides a more precise explanation of profitability.
Among the components of working capital management, only the inventory period (DIO) shows a statistically significant negative relationship with profitability (β= –0.000404; p=0.001). This suggests that inventory turnover plays a key role in the performance of food industry firms: a longer inventory period increases capital tied up in operations and reduces profitability. In contrast, the receivables collection period (DSO) and the payables deferral period (DPO) do not exhibit statistically significant relationships with profitability, indicating that their effects are less pronounced in the examined sample.
The results of the control variables are consistent with the previous model: firm size continues to have a positive and significant effect, while leverage shows a significant

negative relationship with profitability. The current ratio and firm age remain statistically insignificant in this specification as well.

3. Conclusion

The aim of this study was to present the macroeconomic role of the Hungarian food industry and to empirically examine the relationship between working capital management and profitability among small and medium-sized enterprises in the sector over the period 2020-2024. The macroeconomic analysis revealed that the sector plays a stable and significant role in the economy; however, it is characterized by considerable cost pressure, volatile production dynamics, and structural transformation, all of which increase the importance of efficient working capital management.

The empirical results indicate that no statistically significant relationship can be identified between the cash conversion cycle and profitability in the examined sample; therefore, the proposed hypothesis is not supported in this form. At the same time, the component-based analysis shows that the individual elements of working capital management affect firm performance differently: the inventory period has a significant negative impact on profitability, while the management of receivables and payables does not exhibit an independently measurable effect.

Based on the findings, it can be concluded that the impact of working capital management is not uniform but structural in nature, with inventory management playing a particularly important role. In addition, the significant effects of firm size and capital structure suggest that profitability is determined not only by operational factors but also by financial conditions.

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FINANCIAL DEEPENING, GLOBAL EXPOSURE, AND ECONOMIC PERFORMANCE IN NON-OECD DEVELOPED ECONOMIES: EVIDENCE FROM DYNAMIC COMMON CORRELATED EFFECTS ESTIMATION

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Abstract: *This study investigates the dynamic relationships among financial development, globalization, foreign direct investment (FDI), investment rates, and economic performance in 27 non-OECD developed economies over the period 1995–2024. Anchored on the endogenous growth framework, the study employs panel econometric techniques including pooled ordinary least squares (POLS), fixed effects (FE), Pesaran Cross-sectional Dependence (CD) tests, and the Dynamic Common Correlated Effects (DCCE) estimator to account for heterogeneity and cross-sectional dependence. Descriptive statistics indicate relatively high levels of globalization and financial development across the sampled economies, while the Pesaran CD results confirm significant cross-sectional dependence among all variables at the 1% significance level. The POLS results reveal that investment rate, financial development, and globalization positively and significantly influence GDP per capita, whereas FDI exhibits a negative short-run effect. Under the fixed effects model, human capital and investment rate maintain significant positive effects on growth. However, the DCCE estimation shows that investment rate remains positively significant, while financial development exerts a weak negative effect after accounting for dynamic heterogeneity and common global shocks. The lagged GDP per capita coefficient (1.0115) further confirms strong growth persistence across countries. Sensitivity analysis demonstrates that the estimated relationships remain stable after excluding crisis periods, indicating robustness of the findings. The study concludes that financial deepening, productive investment, and globalization remain important determinants of economic performance, although their effects depend significantly on institutional quality, macroeconomic stability, and the capacity of economies to absorb external shocks. The study recommends stronger financial sector regulation, investment-friendly policies, institutional strengthening, and coordinated macroeconomic frameworks to sustain long-run growth in non-OECD developed economies.*

Keywords: *Financial Development; Foreign Direct Investment; Economic Growth; Cross-Sectional Dependence; Dynamic Common Correlated Effects.*

JEL Classification: *O16; E44; F43*

1. Introduction

The increasing interdependence of national economies through trade openness, foreign direct investment (FDI), and financial integration has intensified scholarly

interest in understanding the channels through which these factors influence growth outcomes. Early theoretical and empirical contributions established that globalization can stimulate productivity, capital accumulation, and technological diffusion, thereby enhancing long-run economic growth (Borensztein et al., 1998; Dreher, 2006a). More recent studies emphasize that financial development improves resource allocation efficiency and strengthens the absorptive capacity of economies to benefit from foreign capital inflows (Chen & Kim, 2023; He & You, 2024).

The relationship between FDI and economic growth has generated extensive empirical debate across different regions and income groups. Several studies argue that FDI contributes positively to economic growth through technology transfer, managerial spillovers, and increased productivity (Nguyen, 2020). Similarly, Makki and Somwaru (2004) contend that trade openness and foreign investment jointly stimulate economic expansion when supported by appropriate domestic investment conditions. However, empirical findings remain mixed, as some studies suggest that the benefits of FDI depend on the quality of financial institutions, human capital, and investment climate conditions (Abor et al., 2024; Yao et al., 2023). Although prior studies have concentrated largely on developing or emerging economies, limited attention has been devoted to non-OECD developed economies despite their increasing participation in global financial markets. This creates an important research gap concerning whether financial deepening and foreign capital inflows exert similar effects in relatively advanced but institutionally heterogeneous economies.

Globalization has also emerged as a significant determinant of economic performance through its influence on trade, capital mobility, and technological advancement. Dreher (2006a) demonstrates that globalization positively affects growth by facilitating economic openness and international integration, while Shittu et al. (2020) argue that governance quality mediates the growth effects of globalization. Contemporary evidence further suggests that globalization enhances competitiveness and financial efficiency when accompanied by sound institutional frameworks (Petrakos & Topaloglou, 2023; Qamruzzaman & Jianguo, 2023). Nonetheless, globalization may produce uneven economic outcomes due to structural disparities across countries, especially in economies exposed to external shocks and volatile capital movements. Existing literature has predominantly examined globalization-growth relationships using conventional panel estimation techniques that often ignore cross-sectional dependence and heterogeneity. There remains inadequate understanding of how global interconnectedness affects GDP per capita in non-OECD developed economies when cross-country interdependencies are properly accounted for.

Another important concern in panel macroeconomic analysis is the existence of cross-sectional dependence arising from global economic shocks, financial contagion, and interconnected trade structures. Economies integrated through financial and trade channels are likely to exhibit correlated disturbances, making traditional estimation methods potentially biased and inconsistent. Recent methodological advances recommend the use of dynamic common correlated effects (DCCE) estimators to address cross-sectional dependence and slope heterogeneity in panel datasets (Chen & Kim, 2023; He & You, 2024). Despite these developments, many studies on financial development and globalization continue

to rely on first-generation panel techniques that assume cross-sectional independence.

The present study seeks to achieve three major objectives. First, the study examines the impact of financial development, globalization, foreign direct investment, and investment rates on GDP per capita in non-OECD developed economies. Second, it investigates the presence of cross-sectional dependence and long-run dynamic relationships among macroeconomic and financial variables across the selected countries. Third, the study evaluates the robustness and sensitivity of the estimated growth relationships using alternative estimation techniques and crisis-period exclusions. These objectives are motivated by the need to provide more reliable evidence on the macroeconomic implications of global integration and financial deepening in economies that are often overlooked in comparative growth literature. By focusing specifically on non-OECD developed economies, the study contributes to the growing literature on heterogeneous growth experiences under globalization and financial openness.

2. Literature Review

The relationship between financial deepening and economic performance has remained one of the central discussions in development economics. Financial deepening refers to the expansion, efficiency, and accessibility of financial institutions and markets that facilitate productive investment and economic transactions. Qiu (2024) argues that financial deepening enhances growth by improving credit allocation efficiency and reducing financial frictions in emerging economies operating under currency board systems. Similarly, Oyadeyi (2024) finds that financial sector development strengthens monetary policy transmission and supports macroeconomic stability through improved capital mobilization. In high-income economies, Szücs and Tóth (2024) reveal that developed financial systems significantly attract foreign direct investment by reducing investment uncertainty and transaction costs. Ofori-Sasu et al. (2024) further demonstrate that financial globalization and digital financial systems contribute positively to wealth accumulation and economic productivity.

Foreign direct investment has equally received considerable attention as a catalyst for economic growth and structural transformation. Borensztein et al. (1998) maintain that FDI promotes economic growth through technology diffusion and managerial spillovers, especially where recipient countries possess sufficient absorptive capacity. Ben Mim et al. (2022) extend this argument by emphasizing the role of industrialization and institutional preparedness in maximizing the developmental benefits of FDI inflows. Likewise, Li and Tanna (2019) show that FDI contributes to productivity enhancement by facilitating innovation and technological upgrading in domestic industries. Contemporary evidence by Fazaalloh (2024) indicates that FDI positively affects economic growth in Indonesia through employment generation and industrial expansion. In addition, Chaplyuk et al. (2022) report that foreign investment significantly improved Algeria's economic performance through capital accumulation and increased productive activities. These studies collectively reinforce the argument that FDI serves as an important mechanism for stimulating economic growth and competitiveness.

Globalization has become increasingly important in explaining variations in economic growth across countries.

Several empirical studies have examined the nexus among globalization, financial development, and foreign investment within broader growth frameworks. Muhammad and Khan (2021) report that globalization and FDI jointly stimulate economic growth through increased trade integration and financial openness. Likewise, Qamruzzaman and Jianguo (2023) find that financial development strengthens the positive impact of globalization on FDI inflows and long-run economic performance. Taşdemir (2023) also demonstrates that financial globalization positively influences growth when supported by strong governance structures and efficient domestic financial systems. In another study, Tsimisaraka et al. (2023) establish that financial inclusion and globalization contribute significantly to sustainable economic growth through improved access to financial resources.

The relationship between trade openness, globalization, and foreign investment has also received growing scholarly attention. Rahman and Alam (2024) argue that trade openness encourages FDI inflows by improving market accessibility and reducing transaction barriers for multinational firms. Similarly, Kgomo and Zhanje (2024) find that trade liberalization significantly enhances South Africa's attractiveness to foreign investors by expanding export opportunities and improving market integration. Nguyen (2020) equally demonstrates that trade and FDI exert complementary effects on economic growth in Asian economies. Furthermore, Makki and Somwaru (2004) reveal that economies with higher levels of trade openness and investment integration experience stronger growth performance due to increased efficiency and technological transfer. Zhang et al. (2024) additionally observe that institutional quality moderates the relationship between globalization and FDI inflows, implying that openness alone may not guarantee sustainable economic outcomes.

Another important dimension in the literature concerns the environmental and sustainability implications of globalization and foreign investment. Ahmad et al. (2023) argue that globalization and information communication technology influence environmental sustainability through changes in industrial production and energy consumption patterns. Similarly, Gök et al. (2024) find that FDI inflows significantly affect carbon emissions depending on the environmental regulations and industrial structures of host economies. Rjoub et al. (2023) also identify a strong relationship among globalization, renewable energy investment, and foreign capital flows in promoting sustainable development. Yu et al. (2025) further maintain that FDI contributes to sustainable development when directed toward environmentally responsible sectors and innovation-driven industries. In Belt and Road economies, Jijian et al. (2021) reveal that trade and foreign investment increase environmental pressures while simultaneously supporting industrial modernization. These findings suggest that globalization and financial openness possess both developmental and environmental consequences that policymakers must balance carefully.

The determinants of globalization and foreign investment have equally generated substantial academic interest. Naz and Ahmad (2018) identify institutional quality, political stability, and technological advancement as major drivers of globalization across developing economies. Likewise, Faruq (2023) emphasizes that macroeconomic stability, market size, and infrastructural quality significantly influence FDI inflows in emerging Asian economies. Adeosun and Ajibola (2023) further show that FDI enhances economic complexity by promoting industrial diversification and technological upgrading in emerging economies. Kurniawati (2020) also finds that information communication technology strengthens the

positive effects of globalization on economic growth by facilitating digital connectivity and innovation. Okwu et al. (2020) report that foreign investment contributes positively to growth in integrated economies with favorable business environments. Methodological issues remain central to empirical debates on globalization, financial development, and economic growth. Traditional panel estimation techniques often assume cross-sectional independence despite increasing global interconnectedness among economies. He and You (2024) argue that financial convergence and growth dynamics are better captured through advanced panel methods that account for heterogeneity and interdependence. Chen and Kim (2023) similarly demonstrate that threshold effects and directional heterogeneity significantly influence the relationship between financial integration and growth.

3. Methodology

This study is grounded in the endogenous growth theory, which posits that long-run economic growth is driven by internal economic mechanisms such as financial development, investment accumulation, technological innovation, and human capital formation. The theory argues that globalization and foreign direct investment facilitate productivity enhancement through technology transfer and capital mobility across economies. Empirical studies by Borensztein et al. (1998), Li and Liu (2005), and Qamruzzaman and Jianguo (2023) support the view that financial openness and FDI stimulate growth when supported by efficient domestic institutions and financial systems. The theoretical relationship underlying the study is expressed through the augmented endogenous growth function:

$$GDPK_{it} = f(FNDV_{it}, NFDI_{it}, GLOB_{it}, INVR_{it}, HCAP_{it}, UPOP_{it}) \quad (1)$$

The estimable panel growth equation is subsequently specified as:

$$GDPK_{it} = \beta_0 + \beta_1 FNDV_{it} + \beta_2 NFDI_{it} + \beta_3 GLOB_{it} + \beta_4 INVR_{it} + \beta_5 HCAP_{it} + \beta_6 UPOP_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (2)$$

where GDPKrepresents GDP per capita, FNDVdenotes financial development, NFDIcaptures net foreign direct investment inflows, GLOBmeasures globalization, INVRrepresents investment rate, HCAPdenotes human capital development, and UPOPcaptures urban population growth. The parameters μ_iand λ_trepresent country-specific and time-specific effects respectively, while ε_itis the stochastic error term. The selected variables are justified by previous empirical studies emphasizing their relevance in explaining growth performance across globally integrated economies (Makki & Somwaru, 2004; Ofori-Sasu et al., 2024; Szücs & Tóth, 2024).

The study utilizes balanced annual panel data covering 27 non-OECD developed economies over the period 1995–2024, yielding a total of 810 observations. Data for GDP per capita, investment rate, urban population, and net FDI inflows are sourced from the World Development Indicators database of the World Bank. Financial development indicators are obtained from the International Monetary Fund Financial Development Database, while globalization indicators are sourced from the KOF Globalization Index developed by the Swiss Economic Institute. Human capital data are extracted from the Penn World Table and Barro-Lee educational attainment datasets. These databases are widely used in empirical growth literature due to their consistency, reliability, and comparability across countries.

To determine stationarity properties, the Fisher-type Augmented Dickey-Fuller (ADF) panel unit root test is employed because it accommodates heterogeneous autoregressive structures across cross-sectional units. The Fisher ADF statistic is expressed as:

$$P = -2 \sum_{i-1}^{N} \ln (p_i) \quad (3)$$

where $p_i$represents the probability value of the individual unit root test for country i . The adoption of panel unit root testing is consistent with the approaches of Chen and Kim (2023) and He and You (2024), who emphasize the importance of stationarity testing in dynamic panel estimation.

To examine the presence of cross-sectional dependence arising from globalization and integrated financial markets, the study employs the Pesaran Cross-sectional Dependence (CD) test. The test is particularly appropriate because economic shocks in one country may spill over to other countries through trade, financial, and investment linkages. The Pesaran CD statistic is specified as:

$$CD = \sqrt{\frac{2T}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{\rho}_{ij} \quad (4)$$

where $\hat{\rho}_{ij}$ denotes the pairwise correlation coefficient of residuals across countries. The results reported in

To estimate the growth model, the study initially employs pooled ordinary least squares (POLS) and fixed effects (FE) estimators as benchmark models. The pooled OLS estimator assumes homogeneous slope coefficients across countries, whereas the fixed effects estimator controls for unobserved country-specific heterogeneity that may bias the estimated relationships. The fixed effects model is represented as:

$$GDPK_{it} = \alpha_i + \beta_1 FNDV_{it} + \beta_2 NFDI_{it} + \beta_3 GLOB_{it} + \beta_4 INVR_{it} + \beta_5 HCAP_{it} + \beta_6 UPOP_{it} + \varepsilon_{it} \quad (5)$$

The DCCE model incorporates cross-sectional averages of the dependent and explanatory variables to control for unique shocks and interdependencies across economies. The DCCE specification is expressed as:

$$GDPK_{it} = \alpha_i + \phi_i GDPK_{it-1} + \beta_i X_{it} + \gamma_i \bar{Z}_t + \varepsilon_{it} \quad (6)$$

where $GDPK_{it-1}$denotes the lagged dependent variable, X_{it}represents the vector of explanatory variables, and $\bar{Z}_t$captures cross-sectional averages accounting for unobserved common effects. To ensure robustness and reliability of the estimated relationships, post-estimation diagnostic tests and sensitivity analyses are conducted. The Durbin-Watson statistic is employed to examine serial correlation, while the Jarque-Bera statistic evaluates the normality of residual distributions.

4. Results and Implications

4.1. Results

The descriptive statistics and panel unit root results reported in Table 1 provide important preliminary insights into the macroeconomic and financial characteristics of the sampled non-OECD developed economies. The mean value of GDP per capita indicates that the selected economies maintain relatively high income levels despite their exclusion from the OECD category. This supports the argument

advanced by Han (2025) that several non-OECD developed economies have achieved substantial economic advancement through export-oriented industrialization and financial openness. The average globalization index suggests strong integration into global trade and financial systems, reflecting increasing economic interconnectedness consistent with the findings of Cevik (2025) and Petrakos and Topaloglou (2023).

The Fisher ADF panel unit root results indicate that most variables are stationary at conventional significance levels, except GDP per capita and urban population, which initially appear non-stationary. The stationarity of financial development, globalization, investment rate, and FDI suggests stable long-run relationships among these variables, supporting the arguments of He and You (2024) and Chen and Kim (2023) regarding convergence dynamics in financially integrated economies. The non-stationary behavior of GDP per capita may reflect persistent growth trajectories and structural changes associated with globalization and long-term development processes.

Figure 1 presents the long-run trends of the principal variables used in the study between 1995 and 2024. The financial development index (FNDV) displays a generally upward trajectory, rising from approximately 0.42 in the mid-1990s to around 0.65 by the end of the sample period. This trend reflects the gradual deepening of financial systems and increased integration of non-OECD developed economies into global financial markets, consistent with the arguments of Ofori-Sasu et al. (2024) and Taşdemir (2023). GDP per capita (GDPK) also records sustained growth over time, increasing steadily despite temporary slowdowns around global crisis periods.

There is notable variation in foreign direct investment inflows (NFDI), investment rate (INVR), human capital (HCAP), and urban population (UPOP). NFDI fluctuates considerably across the sample period, with sharp increases during periods of stronger global capital mobility and abrupt declines during episodes of external instability. This volatility supports the findings of Khan et al. (2024), Yao et al. (2023), and Zhang et al. (2024), who emphasize that institutional quality and investment climates strongly influence the direction and stability of international capital flows. By contrast, HCAP and UPOP display smooth and persistent upward movements, indicating gradual improvements in educational attainment and urbanization across the sampled economies. Such trends reinforce the endogenous growth arguments of Li and Liu (2005), which identify human capital accumulation as a critical channel for productivity enhancement and technological absorption. The investment rate exhibits moderate cyclical fluctuations but remains relatively stable overall.

Table 1: Descriptive Statistics and Panel Unit Root Tests

Variable	Mean	Std. Dev.	Fisher ADF (χ^2)	p-value
FNDV	0.609	0.219	64.37	0.0000
GDPK	33818.0	18369.1	21.52	0.3672
NFDI	4.348	9.533	101.93	0.0000
GLOB	79.579	8.256	85.51	0.0000
INVR	22.727	3.839	46.49	0.0007
HCAP	3.132	0.437	37.77	0.0094
UPOP	74.796	10.967	14.33	0.8135

Source: Author (2026)

Table 2 strongly reject the null hypothesis of cross-sectional independence for all variables at the 1% significance level. The high CD statistics for globalization, financial development, and GDP per capita indicate that shocks affecting one economy are rapidly transmitted across other economies within the sample. This outcome reflects the increasing interconnectedness of global financial and trade systems emphasized by Wang et al. (2025) and Qamruzzaman and Jianguo (2023). Financial integration and capital mobility often create synchronized economic responses, particularly among countries exposed to common global market conditions and geopolitical risks.

Table 2: Cross-Sectional Dependence Test (Pesaran CD)

Variable	CD Statistic	p-value
FNDV	12.868	0.0000
GDPK	16.298	0.0000
NFDI	3.661	0.0003
GLOB	18.222	0.0000
INVR	3.139	0.0017
HCAP	17.375	0.0000
UPOP	8.762	0.0000

Source: Author (2026)

The pooled OLS results presented in Table 3 indicate that investment rate (INVR), financial development (FNDV), and globalization (GLOB) exert positive and statistically significant effects on GDP per capita. The positive coefficient of investment rate confirms the traditional growth theory proposition that higher domestic investment stimulates capital accumulation and productivity expansion. This finding supports the empirical evidence of Makki and Somwaru (2004), who argue that investment accumulation enhances productive capacity and long-run growth performance. Likewise, Nguyen (2020) and Dabwor et al. (2022) observe that economies characterized by higher investment intensity and trade openness tend to experience stronger growth outcomes. The significant positive relationship between globalization and GDP per capita also suggests that economic integration improves market access, technological diffusion, and productive efficiency. This result is consistent with Dreher (2006a), Muhammad and Khan (2021), and Kurniawati (2020), all of whom conclude that globalization stimulates economic expansion through enhanced trade and financial connectivity.

The positive and highly significant effect of financial development under the pooled OLS model demonstrates that financial deepening remains a critical determinant of economic performance in non-OECD developed economies. The magnitude of the coefficient suggests that improvements in financial systems significantly raise GDP per capita through enhanced access to credit, increased investment financing, and greater financial intermediation efficiency. This finding supports the arguments advanced by Qiu (2024), Oyadeyi (2024), and Orebiyi et al. (2025), who emphasize that financial sector expansion promotes growth by improving capital allocation and facilitating productive investments. Furthermore, Szücs and Tóth (2024) argue that developed financial systems strengthen investor confidence and attract foreign capital inflows, thereby reinforcing domestic growth processes.

The fixed effects estimation results provide additional insights by controlling for unobserved country-specific heterogeneity. Under the fixed effects model, human capital becomes strongly positive and statistically significant, indicating that improvements in education and skill development substantially enhance economic performance. This finding supports the endogenous growth perspective advanced by Li and Liu (2005), which identifies human capital as a crucial mechanism through which economies absorb technological spillovers and improve productivity. Similarly, Adeosun and Ajibola (2023) argue that human capital facilitates economic complexity and industrial diversification in globally integrated economies. The continued significance of investment rate under the fixed effects specification further reinforces the role of domestic capital accumulation in sustaining growth. Nevertheless, the coefficient of globalization loses statistical significance under fixed effects estimation, suggesting that the impact of globalization may vary considerably across countries depending on institutional structures and policy environments. Rodrik (2007) similarly contends that globalization does not automatically produce positive outcomes unless supported by appropriate domestic economic policies and governance quality.

The Dynamic Common Correlated Effects (DCCE) results provide the most robust estimates because they account for cross-sectional dependence and dynamic heterogeneity across countries. The inclusion of the lagged GDP per capita variable with a coefficient exceeding unity indicates strong persistence in economic growth trajectories among the sampled economies. This finding supports the convergence arguments of He and You (2024), who observe that growth dynamics in financially integrated economies exhibit substantial persistence due to structural interdependencies. The DCCE results further reveal that investment rate remains positively significant, indicating that domestic investment continues to stimulate growth even after controlling for common global shocks and heterogeneous country effects. However, financial development becomes weakly negative under the DCCE model, suggesting that excessive financial expansion may create inefficiencies or speculative distortions in certain economies. Similar concerns are raised by Taşdemir (2023) and Wang et al. (2025), who caution that rapid financial globalization without adequate regulatory frameworks may increase systemic vulnerabilities and reduce productive efficiency.

The DCCE estimates also indicate that foreign direct investment exerts a positive, though weakly significant, effect on GDP per capita after accounting for cross-sectional dependence. This outcome suggests that the adverse effects observed under pooled OLS may largely reflect omitted common shocks and heterogeneous structural conditions. The positive long-run contribution of FDI supports the findings of Fazaalloh (2024), Chaplyuk et al. (2022), and Yu et al. (2025), who argue that foreign investment enhances growth through technological transfer, employment generation, and industrial upgrading when macroeconomic conditions remain stable. The weak significance of globalization under the DCCE model may imply diminishing marginal returns to global integration among highly open economies. According to Cevik (2025), economies deeply integrated into global systems may become increasingly vulnerable to geopolitical disruptions and external financial volatility.

Table 3: Main Estimation Results – Dependent Variable: GDP per Capita (gdpk)

variables	Pooled OLS	Fixed Effects	DCCE
HCAP	-902.0032 (-0.67)	18529.1875*** (10.47)	-62.6834 (-0.90)
INVR	483.9145*** (4.04)	291.6063*** (5.64)	13.7268* (1.85)
FNDV	50851.3621*** (23.74)	11821.8482*** (5.28)	-449.7439* (-1.94)
GLOB	568.4075*** (9.89)	27.9920 (0.82)	9.9124 (1.52)
NFDI	-109.0744** (-2.07)	24.3949 (1.02)	20.8841 (1.65)
GDPK_LAG1			1.0115*** (254.72)
Constant	-50102.7089*** (-9.61)	0.0000 (0.00)	769.9594 (0.29)
R-squared	0.5807	0.5611	0.9973

Notes: t-statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1.
Source: Author's (2026)

The post-estimation diagnostic results reported in Table 4 provide important evidence regarding the statistical adequacy of the estimated models. The Durbin-Watson statistics for financial development and FDI are close to the benchmark value of two, indicating the absence of serious serial correlation problems within the residual structure. This suggests that the estimated coefficients are relatively stable and unbiased over time. However, the Jarque-Bera statistics indicate that the residuals deviate from normality at the 1% significance level, reflecting the presence of skewness and kurtosis within the data distribution. Such outcomes are not uncommon in macro-panel studies involving heterogeneous economies exposed to global shocks and financial crises. Ahmad et al. (2023) and Gök et al. (2024) similarly report non-normal residual distributions in globalization and investment-related studies due to structural asymmetries and external disturbances.

Table 4: Post-Estimation Diagnostics

Dependent Variable	Serial Correlation (DW)	Normality (JB)
FNDV	2.130	482.09***
NFDI	1.999	33833.03***
GDPK	1.392	10711.07***

Source: Author's (2026)

Figure 2 illustrates the quantile coefficient estimates for the explanatory variables across different points of the conditional GDP per capita distribution. The coefficients for financial development (FNDV) remain positive across all quantiles and increase substantially at higher quantiles, indicating that financial deepening exerts a stronger growth-enhancing effect among economies with relatively higher income levels. This outcome supports the findings of Qiu (2024) and Szücs and Tóth (2024), who argue that developed financial systems improve capital allocation efficiency and reinforce long-run productivity growth. Similarly, globalization (GLOB) demonstrates increasingly positive coefficients across higher quantiles, implying that economies with stronger structural and institutional capacity benefit more from global integration.

The quantile estimates for investment rate (INVR) and foreign direct investment inflows (NFDI) reveal additional heterogeneity in the growth process across the sampled economies. INVR coefficients become increasingly positive toward the upper quantiles, indicating that domestic investment contributes more strongly to growth among higher-performing economies with greater absorptive and productive capacity. This finding supports Makki and Somwaru (2004) and Dabwor et al. (2022), who argue that investment accumulation stimulates productivity and long-run output expansion. Conversely, NFDI coefficients are predominantly negative across most quantiles, particularly at higher quantiles, suggesting that foreign investment may generate uneven benefits or short-run adjustment costs in advanced non-OECD economies.

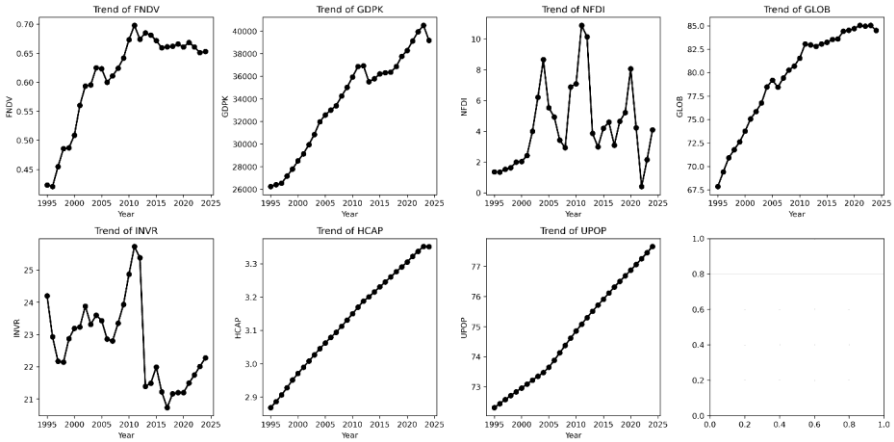


Figure 1: Long-run trends of the principal variables
Source: Author's plots (2026)

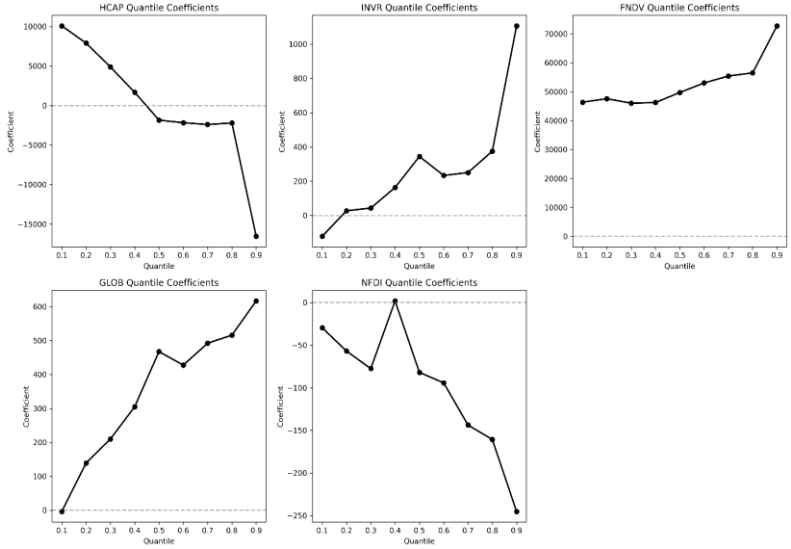


Figure 2: Quantile coefficient estimates for the explanatory
Source: Author's plots (2026)

4.2. Policy Implications

The findings of this study imply that policymakers in non-OECD developed economies should prioritize policies that strengthen financial sector efficiency and deepen domestic financial markets. The positive relationship between financial development and GDP per capita under the baseline estimations suggests that efficient financial systems enhance capital allocation, improve investment financing, and stimulate productive economic activities. Governments should therefore promote financial inclusion, strengthen banking sector supervision, and encourage innovation in digital financial systems to improve access to credit for productive sectors. Regulatory frameworks that enhance transparency, investor confidence, and financial stability are equally necessary to prevent excessive speculative financial expansion that may weaken long-run growth outcomes. These policy directions are consistent with the recommendations of Ofori-Sasu et al. (2024), Oyadeyi (2024), and Szücs and Tóth (2024), who emphasize that sustainable financial deepening requires balanced regulatory oversight and institutional strengthening to maximize growth-enhancing benefits within globally integrated economies.

The study also demonstrates that investment accumulation remains an important driver of economic performance across non-OECD developed economies. Consequently, governments should adopt investment-friendly macroeconomic policies capable of stimulating both domestic and foreign investment activities. Public investment in infrastructure, technology, energy systems, and industrial modernization can improve productivity and crowd in private sector investment. In addition, maintaining macroeconomic stability through prudent fiscal and monetary policies may reduce uncertainty and encourage long-term capital formation. Similar policy recommendations have been advanced by Makki and Somwaru (2004), Fazaalloh (2024), and Rahman and Alam (2024), who argue that stable investment environments and trade openness significantly improve productive efficiency and economic competitiveness in integrated economies.

The mixed findings regarding foreign direct investment suggest that policymakers should focus not only on attracting foreign capital but also on improving the absorptive capacity of domestic economies. The transition from negative to positive FDI effects across alternative estimation techniques indicates that the benefits of foreign investment depend heavily on institutional quality, human capital development, and industrial readiness. Governments should therefore implement policies that encourage technology transfer, workforce training, and linkages between multinational corporations and domestic firms. Strengthening governance institutions, reducing bureaucratic inefficiencies, and improving legal certainty may also increase the developmental impact of foreign investment inflows. These implications align with the arguments of Abor et al. (2024), Khan et al. (2024), and Yao et al. (2023), who maintain that economies with stronger institutional environments are better positioned to convert foreign capital inflows into sustainable productivity gains.

Finally, the robustness and sensitivity results indicate that the relationships among globalization, financial development, and economic performance remain relatively stable even during crisis periods. This finding suggests that non-OECD developed economies should continue pursuing outward-oriented development strategies while simultaneously strengthening institutional resilience and economic

diversification. Policies aimed at improving human capital, technological innovation, and digital transformation can further enhance the capacity of economies to adapt to global market fluctuations and technological changes. Moreover, governments should encourage sustainable development strategies that balance economic integration with environmental and social stability. Such approaches are increasingly important given the growing interaction between globalization, investment flows, and sustainability challenges. Similar conclusions are reached by Ahmad et al. (2023), Yu et al. (2025), and Petrakos and Topaloglou (2023), who argue that long-run economic competitiveness depends on the integration of innovation, institutional quality, sustainability, and globalization-oriented development policies.

5. Conclusions

This study examined the dynamic relationships among financial development, globalization, foreign direct investment, investment rates, and economic performance in non-OECD developed economies using advanced panel estimation techniques. The empirical findings revealed that financial deepening, investment accumulation, and globalization remain important determinants of GDP per capita, although the magnitude and direction of these relationships vary across estimation approaches. The DCCE estimator revealed that once cross-sectional dependence and heterogeneity are properly accounted for, the effects of financial development and globalization become more nuanced, reflecting the complex structural realities of globally integrated economies.

The results further showed that cross-sectional dependence is highly significant across all variables, indicating strong interconnections among non-OECD developed economies through trade, financial markets, and investment channels. This outcome confirms the increasing synchronization of macroeconomic dynamics under globalization and supports the assertions of Wang et al. (2025) and Cevik (2025) that global economic shocks are rapidly transmitted across countries through integrated financial and production systems. The positive contribution of investment rates to GDP per capita across all estimations also emphasizes the continuing importance of domestic capital formation in sustaining long-run growth. In addition, the eventual positive effect of foreign direct investment under the DCCE framework suggests that the developmental benefits of foreign capital inflows become more evident when unobserved common factors and heterogeneity are properly controlled for.

Despite these contributions, the study acknowledges certain limitations that provide opportunities for future research. Future research may also extend the analysis by incorporating environmental sustainability, digital transformation, and institutional governance indicators into the growth framework. Recent studies by Ahmad et al. (2023), Rjoub et al. (2023), and Gök et al. (2024) demonstrate that globalization and financial openness increasingly interact with environmental and technological dimensions of development. Consequently, understanding how digital financial systems, renewable energy transitions, and governance quality influence the finance-growth nexus may provide more comprehensive policy insights for non-OECD developed economies. Furthermore, comparative analyses between OECD and non-OECD developed economies could help identify structural differences in globalization outcomes, institutional resilience, and financial efficiency.

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THE EFFECTS OF VAT RATE INCREASES ON WELFARE IN ROMANIA: INSIGHTS FROM THE 2025 REFORM. AN EARLY EMPIRICAL ASSESSMENT

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Abstract: *This paper provides an early empirical assessment of the welfare effects of Romania's August 2025 VAT reform, implemented in the context of fiscal consolidation under the EU's Excessive Deficit Procedure. The reform increased the standard VAT rate from 19% to 21% and replaced the reduced rates of 5% and 9% with a unified 11% rate. The analysis combines insights from the empirical literature on VAT incidence with early macroeconomic evidence, including inflation dynamics, retail trade indicators, and real wage developments.*
The findings suggest that the reform generated significant short-run welfare costs. The VAT increase contributed to a sharp rise in consumer prices, a contraction in retail consumption following a pre-reform demand surge, and a marked decline in real wages. Consistent with the literature, the effects appear to be regressive, disproportionately affecting lower-income households, particularly through higher prices for essential goods. At the macroeconomic level, the reform is associated with a suppression of aggregate demand and the onset of a technical recession in late 2025.
The paper contributes to the literature by providing evidence from a high-inflation Central and Eastern European economy, a context largely underrepresented in existing studies. It also distinguishes between fiscal revenue improvements and household welfare outcomes and highlights the importance of accounting for pre-announcement consumption effects in the evaluation of VAT reforms.

Keywords: *VAT reform; welfare effects; Romania; consumer price pass-through; fiscal consolidation; regressivity; Central and Eastern Europe.*

JEL Classification: *H22; H23; D12; E21*

1. VAT as a Consumption Tax in the EU

1.1 The Role of VAT in EU Tax Systems

Value Added Tax is one of the most significant sources of consumption tax revenue in the European Union. VAT generates over €1.2 trillion annually across the EU, equivalent to approximately 7% of EU GDP and roughly one-fifth of total government revenues (European Parliament Research Service, 2026, EPRS Briefing PE 782613). An earlier estimate confirmed that VAT raises revenues equal to roughly 30% of total tax revenue or approximately 12% of GDP across member states, with its relative importance growing steadily over time (Benzarti et al., 2017, citing CEPR data). The structural significance of VAT means that changes to its rate are among the most consequential fiscal policy decisions a government can take, with immediate implications for prices, household budgets, and aggregate demand.

The standard economic rationale for VAT is that it taxes final consumption in a broadly neutral manner, avoiding distortions to production decisions. The primary merit widely claimed for VAT is that it constitutes a particularly efficient way of raising substantial revenue (De Mooij, Hebous & Keen, 2025, IMF WP/25/165), a claim supported by cross-country evidence on its revenue-generating capacity relative to alternative tax instruments. However, efficiency at the aggregate level does not preclude significant distributional and welfare costs at the household level — a distinction that is central to the analysis developed in this paper.

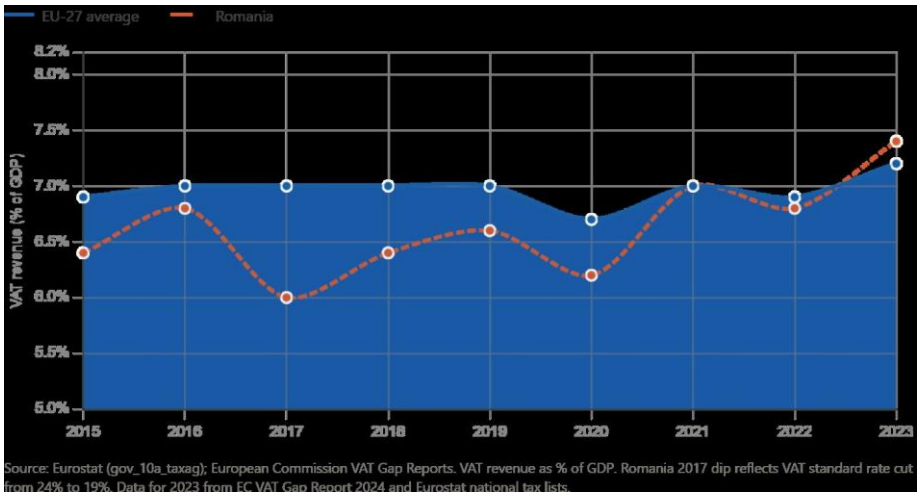


Figure 1. Evolution of VAT revenue as a percentage of GDP, EU-27 average and Romania, 2015–2023. Source: Eurostat (gov_10a_taxag); European Commission VAT Gap Reports (2022–2024).

1.2 Romania's Reliance on Consumption Taxation

Romania presents a particularly instructive case for the analysis of VAT reform. Prior to the 2025 reform, Romania had already undergone a significant VAT reduction cycle — cutting the standard rate from 24% to 20% in January 2016 and further to 19% in 2017 — motivated largely by stimulating domestic consumption. Despite this, between 2013 and 2021 the Romanian economy grew by 34% in real terms, yet the large downward shift in VAT rates did not produce a noticeable impact on the VAT compliance gap, which remained among the highest in the EU (European Commission, DG TAXUD, 2024, VAT Gap Report). By 2023, Romania's VAT compliance gap reached 30.0% of its total VAT tax liability — equivalent to approximately €9.2 billion — placing it last among all 27 EU Member States (European Commission, DG TAXUD, 2024). This persistent shortfall in VAT collection reflects underlying structural weaknesses in tax compliance and constituted an important element of the fiscal context preceding the 2025 VAT rate increase.

Romania's fiscal deterioration in the preceding period was severe. In 2024, Romania recorded the worst budget deficit in the European Union at 9.3% of GDP (ING Research, 2025), prompting mandatory corrective action under the EU's Excessive Deficit Procedure. In response, the parliament adopted in July 2025 a comprehensive fiscal consolidation package including significant tax revenue

increases — notably the VAT rate rise, a broadening of health contribution bases, higher excise duties, and a higher dividend tax rate (European Commission, DG ECFIN, 2025). Against this institutional context, Romania's decision to raise VAT was as much a response to external fiscal pressure as it was a domestic policy choice.

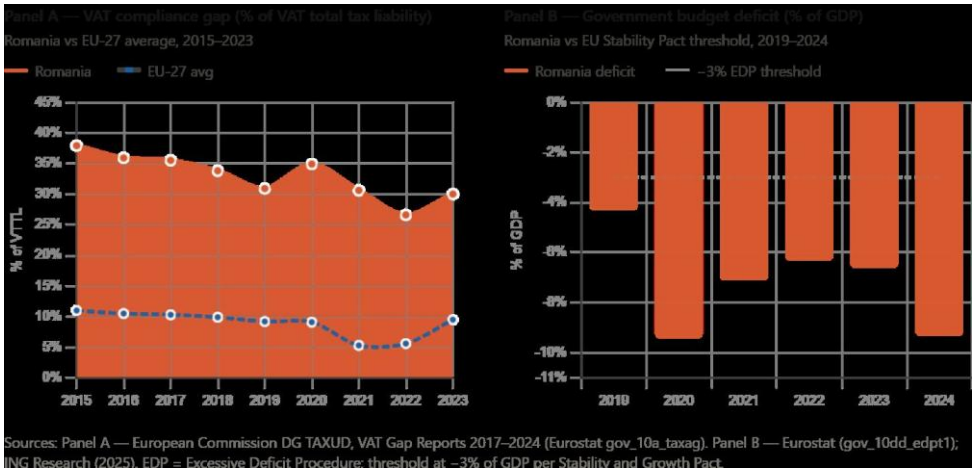


Figure 2. Romania's structural fiscal vulnerabilities: VAT compliance gap (Panel A) and government budget deficit (Panel B). Sources: European Commission DG TAXUD, VAT Gap Reports 2017–2024; Eurostat (gov_10dd_edpt1); ING Research (2025).

2. Theoretical Framework: Transmission Mechanisms from VAT to Welfare

2.1 Consumption as a Proxy for Welfare

The use of consumption as a proxy for economic welfare is well-established in economic theory. Under standard utility maximisation frameworks, household welfare is directly linked to the quantity and quality of goods consumed. A reduction in real consumption — whether caused by higher prices, lower real incomes, or both — maps directly onto a reduction in utility and measurable welfare. In this sense, VAT increases function as an implicit welfare tax: they raise the price of consumption goods, compress real purchasing power, and reduce the volume of goods and services that households can afford to purchase.

This transmission chain — VAT increase → consumer price inflation → erosion of real purchasing power → decline in consumption volume → welfare loss — underpins the empirical literature reviewed in subsequent sections and provides the theoretical foundation for using consumption data as the primary indicator of welfare impact in the present study.

2.2 Price Pass-Through and Consumer Behaviour

A critical determinant of the VAT-welfare relationship is the degree to which businesses pass the tax increase onto consumer prices. Standard economic theory assumes complete pass-through — a 2-percentage point VAT increase translates into an approximately equivalent consumer price rise. However, a substantial

empirical literature consistently demonstrates incomplete and asymmetric pass-through in practice.

The most rigorous empirical study on this question is provided by Benzarti, Carloni, Harju, and Kosonen (2020), who demonstrate, using two plausibly exogenous VAT changes in Finland and all VAT changes across EU member states from 1996 to 2015, that prices respond twice as strongly to VAT increases as to VAT decreases (Journal of Political Economy, 128(12), 4438–4474). Their EU-wide analysis shows that the average pass-through of VAT increases to consumer prices is approximately 55%, while that of VAT decreases is only 13% — a finding of direct relevance for Romania, where the reform is a permanent and substantial rate increase. A complementary European panel study found that a 1 percentage point VAT increase generates a 0.42 percentage point rise in consumer prices (Lowe, 2024, Oxford University Centre for Business Taxation WP 24/12), suggesting that firms absorb part of the tax increase through reduced profit margins rather than fully adjusting consumer prices.

The European Parliament Research Service (2026) summarises the empirical consensus as follows: empirical evidence indicates that VAT changes are asymmetrically transmitted, with the prevailing pattern being one of under-shifting for reductions — though higher pass-through rates are observed in more competitive market sectors, or when the rate change is large, permanent, and subject to public and regulatory scrutiny (EPRS Briefing PE 782613). In Romania's case, a permanent 2-point standard rate increase — the largest since 2016 — would be expected to generate substantial but incomplete consumer price inflation, with firms in less competitive segments retaining a portion of the tax burden within their margins.

2.3 Regressivity of VAT

VAT is widely recognised in the public finance literature as a regressive tax when measured against household income: lower-income households allocate a higher proportion of their income to consumption goods and therefore bear a proportionally larger effective tax burden than higher-income households. Cross-country empirical evidence consistently shows that consumption taxes tend to increase inequality, disproportionately affecting low-income, retired, and unemployed households (Blasco, Guillaud & Zemmour, 2023; Decoster, Loughrey, O'Donoghue & Verwerft, 2010).

In the Romanian context, the 2025 reform amplifies these effects by eliminating the previously differentiated reduced VAT rates of 5% and 9%, which had partially mitigated the tax burden on essential goods, and replacing them with a unified 11% rate. This change is particularly significant given that demand for essential goods such as food is price inelastic. Empirical evidence indicates that a 1% decrease in food prices leads to an increase in consumption of less than 0.5% (European Commission study on reduced VAT rates, cited in EPRS, 2026), implying that consumption responds only weakly to price changes. Consequently, increases in VAT on essential goods are unlikely to generate proportional reductions in consumption; instead, lower-income households are compelled to absorb the higher costs by reducing expenditure on non-essential items or drawing down limited savings.

As a result, the removal of reduced VAT rates on essential goods in Romania is expected to impose disproportionate welfare costs on lower-income households, reinforcing the regressive incidence of the reform.

3. Empirical Evidence on VAT Increases and Consumption

3.1 Consumption Responses: Estimates from the Literature

The empirical literature on consumption responses to VAT changes yields a range of elasticity estimates, with the key finding being that responses are asymmetric and depend on the direction, permanence, and magnitude of the rate change.

Benzarti and Carloni (2019), examining the 2009 VAT cut for French sit-down restaurants, find that firm owners captured more than 55% of the tax reduction, while consumers received the smallest share of the benefit, indicating that the reduction was only weakly transmitted into lower prices. This finding is consistent with Benzarti et al. (2020), who show that VAT increases are passed through to prices more strongly than VAT decreases across a broad set of EU reforms. Taken together, these studies suggest an asymmetric incidence pattern: consumers tend to benefit only modestly from VAT cuts, whereas they bear a larger share of VAT increases through higher prices, while firms preserve or enhance margins relative to a symmetric pass-through benchmark.

Crossley, Low and Wakefield (2009) analyse the United Kingdom's temporary reduction in VAT from 17.5% to 15% in 2009 and find only a modest stimulus effect on consumption, partly because the tax cut was not fully passed through to consumer prices (Fiscal Studies, 30(1), 3–16). As a result, the reduction generated limited improvements in household purchasing power and therefore only a weak demand response.

The implication for VAT increases is asymmetrical. If tax reductions are only partially transmitted to prices, while tax increases are more fully reflected in consumer prices, then increases in VAT are likely to have a stronger and more persistent impact on consumption than equivalent reductions. In the Romanian context, where the 2025 reform represents a permanent increase in VAT rates within a relatively concentrated retail environment, this asymmetry suggests a potentially significant and durable contraction in household consumption.

3.2 Short-Run Versus Long-Run Effects

The temporal dimension of VAT changes is critical for interpreting the observed effects within Romania's current 8-month post-reform window. In the short run, the impact of a VAT increase is driven primarily by price adjustments and the immediate compression of household purchasing power, resulting in a direct reduction in real consumption. Over the medium term, however, households and firms begin to adjust their behaviour, with households reallocating consumption, reducing savings, or altering labour supply decisions in response to sustained income pressures.

Evidence from temporary VAT changes highlights the importance of policy duration. In Spain, a temporary reduction in VAT on food between January 2023 and December 2024 resulted in a relatively high pass-through of approximately 90%, but prices began to revert within a few months, indicating that the consumption effects of temporary measures may dissipate relatively quickly (Amores et al., cited in Bernardino et al., 2025, Journal of Public Economics, 248, 105416). By contrast, Bernardino et al. (2025) find that a permanent VAT reduction in the Portuguese supermarket sector was fully and symmetrically passed through to consumer prices,

suggesting that permanent policy changes are more likely to be fully embedded in pricing behaviour.
Taken together, these findings imply that the effects of Romania's 2025 VAT increase — which is both permanent and broad-based — are likely to be more persistent and structurally embedded than those observed in temporary policy episodes, with correspondingly stronger implications for household welfare.
Buettner and Madzharova (2021) identify significant pre-announcement consumption effects in European VAT reforms, showing that consumers tend to bring forward purchases — particularly of durable goods — in anticipation of future tax increases, followed by a pronounced decline in consumption after implementation (American Economic Journal: Economic Policy, 13(3), 103–134). This behaviour reflects intertemporal substitution, whereby households shift consumption to periods with lower expected prices.
The Romanian VAT reform, effective 1 August 2025, appears consistent with this pattern. Retail sales increased by 5.4% year-on-year in July 2025, the month immediately preceding the reform, before declining by approximately 4.0% month-on-month in August 2025 (National Institute of Statistics, cited in Romania Insider, February 2026). This dynamic suggests that part of the observed post-reform contraction reflects a reversal of pre-reform demand brought forward, rather than a purely contemporaneous decline in consumption.
Accordingly, this pre-announcement effect constitutes an important source of empirical distortion and should be explicitly accounted for when assessing the welfare impact of the reform.

4. Distributional and Welfare Effects

4.1 Income Group Impacts

The welfare effects of VAT increases are not evenly distributed across households, but vary systematically by income level. Evidence from EU member states over the 2010–2019 period indicates that changes in consumption taxation have generally increased inequality, with the strongest effects associated with higher effective taxation of housing-related energy consumption (Blasco, Guillaud & Zemmour, 2023, Economic Policy). These findings reflect the fact that lower-income households allocate a larger share of their budgets to essential goods, making them more exposed to consumption-based taxation.
In the Romanian context, the 2025 reform amplifies these distributional effects. The simultaneous increase in the standard VAT rate from 19% to 21% and the replacement of reduced rates of 5% and 9% with a unified 11% rate effectively removes mechanisms that previously mitigated the tax burden on essential goods. As a result, the reform increases the effective tax incidence on lower-income households, reinforcing the regressive nature of VAT.
Supporting evidence from microsimulation analysis of a comparable uniform VAT reform in Italy shows a measurable increase in income inequality, reflected in a higher Gini coefficient (Journal of Policy Modeling, 2025). However, these effects are partially attenuated when VAT evasion is incorporated into the analysis, as a share of economic activity—particularly among lower-income or informal sectors—falls outside the formal tax base.
This moderating effect of non-compliance is particularly relevant for Romania, where the VAT compliance gap remains the highest in the European Union at approximately 30% of total VAT liability. While such a gap may reduce the effective tax burden on

segments of the informal economy, it simultaneously undermines revenue collection. Consequently, the Romanian case highlights a fundamental trade-off between distributional outcomes and fiscal effectiveness, whereby reduced regressivity due to evasion may come at the cost of diminished public revenues.

4.2 Affordability of Essential Goods

The removal of reduced VAT rates on essential goods in Romania has direct implications for household affordability, particularly for lower-income groups. Reduced VAT rates function as an implicit price subsidy, lowering the cost of goods such as food, medicines, and other basic necessities. Since lower-income households allocate a larger share of their expenditure to these items, such reduced rates play an important role in mitigating the regressive effects of consumption taxation.

Empirical studies from the Netherlands show that higher-income groups benefit nearly twice as much as lower-income groups in absolute terms from reduced VAT rates on foodstuffs and cultural activities (Bettendorf & Cnossen, 2015, as cited in Cnossen, 2022, International Tax and Public Finance, 29(1), 215–236). However, this finding does not negate their redistributive role: by lowering the price of essential goods, reduced VAT rates provide meaningful support to lower-income households in relative terms. Their removal therefore eliminates an existing, though only partially effective, mechanism that helps sustain consumption among more vulnerable groups.

In the Romanian context, this effect is further intensified by concurrent macroeconomic pressures. The increase in the standard VAT rate, combined with the upward adjustment and partial consolidation of reduced VAT rates, rising energy costs following price deregulation, and the freezing of public wages, creates a cumulative affordability shock. Given the price inelasticity of essential goods, households are unable to significantly reduce consumption and must instead adjust by cutting expenditure on non-essential items or reducing already limited savings. As a result, the reform is expected to disproportionately affect lower-income households, both through higher effective taxation and through a direct deterioration in the affordability of basic consumption goods.

5. Macroeconomic Effects of VAT Changes

5.1 Inflation Transmission

A VAT increase of the scale implemented in Romania — 2 percentage points on the standard rate, combined with the effective doubling of the lowest reduced rate from 5% to 11% — constitutes a substantial one-time inflationary shock. Post-reform data confirm this assessment unambiguously. HICP inflation in Romania accelerated sharply following the August 2025 reform, reaching 8.6% in September 2025 — the highest in the European Union — driven primarily by the VAT rate increase and the concurrent elimination of household electricity price caps (European Commission, DG ECFIN, Autumn Forecast 2025). This placed Romania as a clear outlier in the EU inflation landscape: in December 2025, Romania recorded one of the two largest annual decreases in retail trade volume among EU member states, in contrast to the EU-wide average growth of 1.7% (Eurostat, February 2026, Euro Indicators).

The inflation surge directly erodes real purchasing power. In an environment where public sector wages and pensions were simultaneously frozen as part of the broader

fiscal adjustment, private consumption was projected to sputter as higher VAT cut into disposable incomes, with the combination of fiscal tightening and weak confidence carrying significant downside risks (ING Research, July 2025). These projections proved prescient: real wages contracted by 4.2% year-on-year in Q3 2025 and by approximately 5% in Q4 2025, according to INS data (cited in Romania Insider and bne IntelliNews, February 2026).

5.2 Aggregate Demand and Economic Growth

The macroeconomic channel from VAT increases to growth operates primarily through aggregate demand suppression. When households simultaneously face higher consumer prices and lower real incomes, their purchasing power declines, leading to a reduction in consumption expenditure. Given that private consumption represents the largest component of GDP in Romania's relatively consumption-intensive economy, even moderate contractions in household demand translate directly into downward pressure on overall economic growth. Romania's real GDP growth was projected at just 0.7% for 2025 and 1.1% for 2026, as fiscal consolidation dampened both private and public consumption, further exacerbated by the inflation surge (European Commission, DG ECFIN, Autumn Forecast 2025). In reality, actual outcomes were weaker than projected: Romania entered technical recession in Q4 2025, with GDP contracting 1.9% quarter-on-quarter following a 0.1% contraction in Q3 (FocusEconomics, 2026, supplementary).

This dynamic is central to the paper's contribution. The improvement in Romania's budget deficit — projected to decline from 9.3% of GDP in 2024 to approximately 7.5–7.8% in 2025 (ING Research, 2025) — is attributable to a revenue extraction effect rather than to productivity growth or real output expansion. In other words, the fiscal adjustment reflects higher effective taxation and reduced expenditure, rather than an expansion of the underlying economic base. The divergence between fiscal improvement on paper and simultaneous household welfare deterioration is precisely the trade-off this paper seeks to quantify. As the European Commission notes, Romania's fiscal stance is contractionary in both 2025 and 2026, before turning neutral in 2027 (DG ECFIN, 2025) — implying that the consumption suppression documented here is not transitory but will persist well beyond the 8-month observation window.

6. Evidence from Central and Eastern Europe, with focus on Romania

6.1 Comparative Evidence from Central and Eastern Europe

Romania is not unique among Central and Eastern European transition economies in facing the welfare costs of VAT-led fiscal consolidation. Hungary operates the highest standard VAT rate in the EU at 27%, providing the most developed long-run case study of sustained high consumption taxation in a CEE context. Research on Central and Eastern European economies shows that VAT compliance gaps, informality, and regressive incidence tend to be more pronounced than in Western European counterparts. These patterns are generally linked to structural characteristics of the region, including lower income levels, higher consumption-to-income ratios, and comparatively weaker social protection systems, all of which increase household exposure to consumption-based taxation.

A distributional microsimulation study applying household-level data to Spain, France, Romania, and Poland finds that demand-side VAT reforms are regressive

in the absence of complementary redistribution measures across all four countries — providing direct comparative evidence that the welfare costs of VAT increases in Romania are consistent with broader patterns observed in both Central and Eastern and Southern European economies (cited in Blasco, Guillaud & Zemmour, 2023, Economic Policy, and related distributional microsimulation work on Romania/Poland in ScienceDirect, 2023–2025). In the Romanian case, these effects are likely to be more pronounced due to the interaction between high consumption dependence, elevated VAT non-compliance, and limited compensatory redistribution, which together amplify the transmission of VAT increases into household welfare losses.

6.2 Romania-Specific Context and the Crisis Parallel

Romania's 2025 reform unfolds against a backdrop of structural fiscal fragility that makes the welfare stakes unusually high. Reports in the Romanian financial press — including Ziarul Financiar — suggested, in the months following the August 2025 reform, that the scale of the consumption decline was comparable to that observed during the 2008 financial crisis. This interpretation is consistent with expectations from the academic literature, which predicts that a large and permanent VAT increase, when combined with public wage freezes and energy price deregulation in a high-inflation environment, can generate a substantial contraction in household demand.

The available data support this interpretation. Retail sales volume declined 3.6% year-on-year in Q4 2025, with food sales contracting 5.1% — the steepest annual decline since the COVID-19 pandemic (National Institute of Statistics, INS, cited in Romania Insider and bne IntelliNews, February 2026). In September 2025, Romania registered one of the two largest annual decreases in retail trade volume among all EU member states (-2.1%), in contrast to the EU-wide increase of 1.3% (Eurostat, November 2025). The decline in food sales, measured at 3.1% year-on-year and 2.6% quarter-on-quarter in Q3 2025, has been characterised as regressive, disproportionately affecting lower-income households (Romania Insider, November 2025).

From an academic perspective, the closest historical parallel for Romania is the 2010–2011 austerity episode, during which a 25% reduction in public sector wages, combined with fiscal tightening, led to a sharp contraction in GDP. The 2025 reform, while involving a smaller direct wage shock, operates in a context of compounding fiscal pressures — frozen wages, deregulated energy prices, higher excise duties, and higher health contribution bases — that collectively produce an aggregate demand shock of comparable severity. Romania's fiscal stance is expected to remain contractionary through 2026, before expected to turn neutral in 2027 (European Commission, DG ECFIN, 2025), meaning the welfare costs documented in this early-impact study are likely to persist and deepen over the medium term.

7. Conclusions

Existing empirical and theoretical research on VAT reforms converges on several key mechanisms. First, VAT increases are often transmitted to consumer prices asymmetrically and incompletely. Second, their incidence tends to fall disproportionately on lower-income households, reflecting the regressive nature of consumption taxation when assessed relative to income. Third, at the

macroeconomic level, VAT increases primarily affect activity through the compression of domestic demand. At the same time, the extent of pass-through, and therefore the scale of the resulting welfare loss, depends on contextual factors such as market structure, the inflation environment, and whether the tax change is temporary or permanent. These conditions vary substantially across the country settings from which most existing empirical evidence has been drawn.

Against this background, three gaps in the literature are particularly relevant to the present study. First, the empirical evidence remains concentrated in Western European contexts — including France, Finland, Germany, the Netherlands, and Portugal — which are generally characterised by lower inflation, stronger institutional capacity, and more developed social protection systems. By contrast, the welfare effects of VAT increases in a high-inflation, post-austerity Central and Eastern European economy with a large compliance gap, frozen public wages, and simultaneous energy price deregulation remain comparatively underexplored. Second, the literature has not always clearly distinguished between fiscal improvement in the sense of higher tax extraction and genuine economic improvement in the form of stronger real incomes, consumption, or welfare. This distinction is central to the Romanian case, where a narrowing deficit may coexist with a deterioration in household economic conditions. Third, although pre-announcement demand shifts are well documented in the VAT literature, no widely adopted methodological approach has emerged for incorporating such effects into welfare assessments of recent reforms, despite their capacity to distort pre-and post-reform comparisons.

This paper seeks to contribute to the literature in three corresponding ways. First, it provides an early empirical assessment of Romania's 2025 VAT reform using recent macroeconomic indicators, thereby extending the evidence base beyond the Western European cases that dominate the existing literature. Second, it places the distinction between fiscal consolidation and household welfare at the centre of the analysis, treating revenue improvement and welfare outcomes as analytically separate rather than implicitly aligned. Third, it explicitly incorporates the pre-announcement consumption effect into the interpretation of the post-reform evidence, recognising that part of the observed contraction reflects demand brought forward before implementation. In doing so, the paper responds to recent calls for more context-sensitive evidence on VAT incidence, pass-through, and welfare effects across diverse European settings (Benzarti et al., 2020; De Mooij, Hebous & Keen, 2025; European Parliament Research Service, 2026).

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THE MOST PROBABLE INFLATIONARY TRAJECTORY FOR EXPENDITURES ON INTANGIBLE ASSETS

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Abstract: *As the global economy transitions further into a knowledge-based paradigm, the valuation and acquisition costs of intangible assets—such as intellectual property, software, and brand equity—have become critical drivers of corporate capital structure. Unlike tangible assets, expenditures on intangibles are subject to unique inflationary pressures driven by specialized labor markets and rapid technological obsolescence. This paper investigates the most probable inflationary trajectory for intangible capital outlays over the coming fiscal cycle. Utilizing a synthetic approach that combines historical price indices with stochastic forecasting models, the research identifies a bifurcated inflationary trend: persistent cost escalation in human-capital-intensive sectors versus deflationary tech-driven efficiencies in digital infrastructure. The findings suggest that the inflation rate for intangibles is likely to decouple from general Consumer Price Indices (CPI), necessitating more nuanced accounting deflators. This study provides financial controllers and strategic investors with a predictive framework to adjust long-term investment appraisals and mitigate the risks of capital erosion in an increasingly volatile macroeconomic environment.*

Keywords: *Intangible Assets; Inflationary Trajectory; Knowledge Economy; Price Indexing; Financial Forecasting*

JEL Classification: *E31; O34; E22; D24*

1. Introduction

The global economic landscape has undergone a fundamental transformation over the last few decades, shifting from a traditional resource-based model to a sophisticated knowledge-driven paradigm. In this contemporary setting, intangible assets—encompassing intellectual property, research and development (R&D), software, and brand equity—have surpassed physical capital as the primary catalysts for corporate growth and competitive advantage (Haskel and Westlake,2017). As organizations increasingly allocate substantial portions of their capital expenditure (CAPEX) toward these non-physical assets, the financial modeling of their acquisition and maintenance costs becomes paramount.

However, the current macroeconomic environment, characterized by lingering inflationary pressures and disrupted supply chains, poses a significant challenge for long-term strategic planning. While traditional inflation metrics, such as the Consumer Price Index (CPI), provide a baseline for price stability in the goods and services sector, they often fail to capture the idiosyncratic cost escalations

associated with intangible investments (Copeland, Medeiros and Robbins, 2007). These expenditures are uniquely influenced by specialized labor market tightness, the accelerating pace of technological obsolescence, and the complex regulatory frameworks governing intellectual property.

The discrepancy between general inflation and the specific price indices of intangible capital creates a "valuation gap" that can lead to the erosion of real capital and misinformed investment appraisals (Lev and Gu, 2016). Despite the growing literature on the importance of intangibles, there remains a paucity of research specifically targeting the inflationary trajectories that these assets are likely to follow in the coming fiscal cycles.

This paper aims to address this gap by investigating the most probable inflationary trajectory for expenditures on intangible assets. By synthesizing historical price data with forward-looking stochastic models, the study seeks to provide a predictive framework for financial controllers and strategic investors. The analysis will explore how divergent forces—such as the rising cost of human capital versus the deflationary impact of artificial intelligence and digital automation—shape the future cost structure of intangible investments. Ultimately, this research provides the necessary tools to adjust investment valuations and safeguard corporate capital in an increasingly volatile economic climate.

2. Current State of Knowledge

The specialized literature review for this research—given its specific and timely nature—requires a framework that bridges classical economic theories with the technological realities of 2026.

The contemporary economic paradigm is defined by an accelerated transition toward a knowledge-based economy, where intangible assets—including software, intellectual property, organizational capital, and human skills—have become the primary determinants of productivity growth (Haskel and Westlake,2017). This preeminence of immaterial assets induces significant distortions in conventional measurement frameworks, necessitating a critical re-evaluation of fundamental macroeconomic indicators, particularly the methodologies used to calculate inflation deflators.

To conduct a robust literature review, one must first understand the intrinsic differences between intangible and physical assets. According to seminal research in the field, intangibles possess unique characteristics, such as scalability, complementarity, and high sunk costs (Haskel and Westlake,2017).

Furthermore, Baumol’s theory provides a crucial explanation for the "cost disease," illustrating why wages in the IT sector increase even in the absence of immediate productivity gains, thereby driving sector-specific inflation upward (Baumol and Bowen, 1966).

In alignment with relevant studies, “The End of Accounting and the Confidence Crisis in Reporting*”* demonstrates that the inflation of intangible assets renders traditional accounting reports increasingly irrelevant, proposing alternative methods for current value estimation (Lev and Gu, 2016). The authors highlight a "relevance crisis" in financial information, caused by the inability of classical reporting methods to capture the dynamics of intangible investments. This limitation inherently affects inflation estimation, as the underlying data remains either incomplete or distorted.

Jonathan Haskel, a member of the Monetary Policy Committee of the Bank of England, establishes a direct link between intangibles and macroeconomic inflation (Haskel and Westlake, 2022). He argues that inflation in this sector is atypical because intangibles represent "sunk costs," making firms more cautious when adjusting prices in relation to general inflation. Haskel demonstrates that, in many instances, the rising value of intangibles does not reflect classical inflation, but rather gains in efficiency and innovation.

Finally, researchers such as Copeland, Medeiros, and Robbins (Copeland, Medeiros and Robbins, 2007)) have developed specific price indices for R&D. Their study is essential for the present research as it proves that the inflation rate for intangibles almost always diverges from the Consumer Price Index (CPI). Their findings suggest that the most probable inflation rate is dictated by researchers' salaries, though partially mitigated by the exponential increase in computing productivity.

3. Research Methodology and Data Sources

Intangible assets are profoundly influenced by the wage dynamics within the IT sector and the evolving costs of computational power. This premise stems from the fundamental nature of these assets; they are not "manufactured" in traditional industrial facilities but are instead "stored" within human capital and digital infrastructure. To substantiate this correlation, we examine the underlying economic and structural foundations of intangible production.

Cost Structure: "Crystallized Labor"

Unlike tangible assets—such as industrial machinery, where raw materials and energy account for 60-70% of total costs—intangible assets are comprised of 80-90% high-skilled labor hours (Reilly and Schweihs,2016). In the realms of software development and Research and Development (R&D), the creation of an algorithm or a patent does not consume physical commodities like steel; rather, it consumes cognitive processing time.

Consequently, the "production" price of an intangible asset is essentially the salary of the developer, researcher, or designer. In this context, if IT sector wages increase by 5%—driven by the talent scarcity projected for 2026—the replacement or creation cost of an intangible asset rises almost linearly (Korn Ferry,2018, Borschlein et al., 2024). This talent deficit refers to the acute shortage of specialized professionals despite surging market demand.

Computational Power as a "Raw Material"

In the current economic landscape (2025-2026), computational power has emerged as the digital equivalent of oil in the industrial era (Cotra,2020). The development of Intellectual Property (IP) currently necessitates the processing of massive datasets. The cost of electricity for data centers and, crucially, the capital expenditure for Graphics Processing Units (GPUs) required for AI training, are directly integrated into the final value of the intangible asset.

Most enterprises develop their assets on hyperscale infrastructures such as AWS, Azure, or Google Cloud. The price indexing of these services—which is contingent upon hardware cycles and energy costs—directly influences intangible investment budgets.

The Cost Approach in Valuation

In accounting and economic appraisal, the Cost Approach remains a primary method for valuing intangible assets (Reilly and Schweihs,2016). The valuation formula can be summarized as:

Value = Labor Costs + Technological Costs + Overheads

Given the volatility of labor and technology variables in 2026 (where the demand for AI specialists has surged), the inflation rate for these assets is likely to decouple from the general Consumer Price Index (CPI), which tracks traditional commodities like food or fuel (European Central Bank,2025). The Overhead component in this framework encompasses management, remote infrastructure, and legal support for AI regulatory compliance.

3.1 The Cost Approach in Asset Valuation

To elucidate the cost approach to asset valuation within the IT sector, the following formula may be employed:

Value = Labor Costs + Technological Costs + Overheads

where:

- ✓ Labor Costs represent the "crystallized labor" of high-skilled professionals (developers, researchers);
- ✓ Technological Costs encompass the expenses related to computational power and digital infrastructure;
- ✓ Overheads include administrative, legal, and operational support.

Each component of the aforementioned formula represents a critical investment pillar necessary to substantiate the asset's utility:

- Labor Costs: in the IT sector, labor transcends the mere expenditure of "time"; it represents the intellectual conversion of logical architecture into executable source code.

-Technological Costs: This signifies the enabling infrastructure. An algorithm possesses no inherent economic value without "compute" (computational power) and specialized development tools.

-Overhead: This reflects the role of governance and the institutional framework in transforming an intangible good (e.g., software/code) into a viable economic asset. Absent management and legal protection (compliance), code remains mere text rather than a marketable commercial asset.

While the Consumer Price Index (CPI) monitors a standard basket of goods—such as bread, milk, and fuel—the formula proposed in this research tracks the "production basket" specific to intangible assets. The weighted structure of this basket is defined as follows:

- ➢ Labor Costs (~70-80%): Represented by high-level specialists, including AI researchers and software engineers.
- ➢ Technological Costs (~15-20%): Encompassing servers, cloud computing infrastructure, and software licensing.
- ➢ Overhead (~5-10%): Comprising management expenditures, physical or remote office infrastructure, and legal consultancy.

The analysis highlights that each component within the model is characterized by its own distinct price dynamics. Several of these elements exhibit growth rates significantly exceeding the aggregate Consumer Price Index (CPI), signaling the existence of differentiated sectoral inflationary pressures (Copeland, Medeiros and Robbins, 2007). Furthermore, this divergence profoundly impacts Intellectual

Property valuation and its associated "Depreciation Velocity" (the rate at which such assets lose their economic relevance).
The most probable inflationary trajectory for intangible assets is determined by the weighted mean of its constituent costs, reflecting their proportional importance

Table 1: Inflationary trajectory for intangible assets

Component	**CPI Inflation (General)**	**Intangible Capital Inflation (Specific)**
Labor	4% (Average Wage Growth)	**15%** (Competitive AI Talent Acquisition) 70% Weight*15% Increase=10.5%
Technology	2% (Standard Electronics Index)	**10%** (Chip Scarcity/Cloud Energy Costs) 20%weight*10%Price Increase=2.0%
Overhead	4% (General Services Index)	**6%** (Complex AI legal compliance costs) 10%weight*6%incrase=0.6%

Source: The author's projection

The analysis presented above leads to the conclusion that intangible inflation stands at 13.1%. Given that specialized labor accounts for the largest share and the most significant price escalation, the 13.1% inflation rate for intangible assets effectively decouples from the standard 4% CPI.
If a company adjusts its investment budget based solely on the official inflation rate of 4%, it will face an annual capital deficit of nearly 9%. This is because the 'mirror of intellectual effort'—as evidenced by the aforementioned formula—reveals that the required resources have become significantly more expensive.
In conclusion, by calculating asset value through the formula Value = Labor Cost + Technology Cost + Overhead, we demonstrate that the real rate is not an abstract figure; rather, it is directly tethered to IT wage statistics and digital infrastructure costs.
In accordance with the points previously established, by determining asset value through this formula, we demonstrate that intangible asset inflation is not merely an abstract macroeconomic indicator. Rather, it is an empirical reality directly driven by the wage dynamics of the IT sector and the volatility of digital infrastructure costs (Jaumotte et al,2026).

3.2 Intangible Capital and Inflation

Intangible assets depreciate significantly faster than physical ones (e.g., software may become obsolete within 3–5 years, whereas a building remains functional for 50) (Haskel, Westlake,2018). To preserve asset value, companies must consistently invest in maintenance and updates. Given that this maintenance is performed by technical teams, the 'maintenance inflation' of intangible capital is perpetually fueled by the IT labor market dynamics.

In this regard, an analysis of inflation specifically for intangible capital (Software, R&D, Branding, and Organizational Capital) is required, necessitating a clear distinction between Consumer Price Inflation (CPI) and production/investment cost inflation.

Estimated Inflation Rate by Intangible Asset Categories (2025-2026)

Since a singular "intangible inflation index" does not currently exist, experts employ a weighted average of investment deflators and labor cost indices (LCI) (Copeland, Medeiros and Robbins,2007).

Table 2: Estimated Inflation Rate by Intangible Asset Categories

Intangible Capital Category	Probable Inflation Rate (Annual)	Primary Inflation Driver
Software and Databases	3.5% - 4.5%	Massive demand for AI, rising Software as a Service costs, and developer salary growth
(R&D)	3.0% - 4.0%	Specialized labor costs (engineers, researchers) and laboratory equipment expenditures
Organizational Capital/ Training	2.5% - 3.5%	Consulting fees and human resources service costs
Branding and Marketing	4.0% - 5.5%	Rising digital advertising costs (CPM/CPC) across major platforms

Source: The author's projection

Unlike tangible capital (machinery), where raw materials are critical, intangible capital represents 'crystallized labor.' For the 2025–2026 period, while global headline inflation tends to stabilize between 2.0% and 3.8%, wages in high-tech sectors are rising more rapidly, with forecasts pointing toward 4% – 6% in developed economies (International Monetary Fund, 2026). This accelerated wage dynamic is further amplified by increasing labor market tightness, which raises hiring costs and intensifies competition for highly specialized employees (Pezold, Jäger and Nüss, 2023).

The selection of the 2025–2026 reference period is based on three economic and technological pillars that mark a 'new normal' following the inflationary shocks of 2021–2023. Forecast studies (such as those by the IMF and the European Central

Bank) indicate that by 2026, headline inflation will return near the 2% target; however, inflation within the knowledge-based services sector remains persistently high (International Monetary Fund, 2026, Banca Centrală Europeană, 2024).

3.3 A Comparative Analysis between Romania and the EU

In the context of a persistent 9.6% inflation rate as of January 2026, according to the National Institute of Statistics, the price formation dynamics for intangible assets in Romania exhibit significant upward rigidity (Institutul Național de Statistică, 2026). This phenomenon is driven by the convergence of headline inflation and a structural deficit in digital talent. Consequently, the growth rate for the cost of intangible capital is estimated at 10–11%, necessitating a recalibration of Cost Approach valuation models to accurately reflect local economic realities and prevent the erosion of companies' real capital.

This interpretation strengthens the argument that intangible capital is far more sensitive to local inflation than imported physical assets, as its primary component—labor—is anchored in the domestic cost-of-living reality. In the Eurozone, where inflation is projected to reach 1.7% – 1.9% in 2026, intangible inflation is expected to stabilize around 3.0% (European Central Bank,2025).

The arguments supporting the choice of this specific reference period are detailed in the following section.

Table. 3: The Status of Intangible Assets in the First Post-Crisis Interval

Factor	The 2025–2026 Context	Intangible Capital Impact
Monetary Policy	Interest rates are stabilizing but remain "higher for longer".	Firms prioritize investing in intangibles (efficiency) over expensive physical assets.
Labor Market	Structural deficit of 4 million IT specialists	Wages increase (4–6%) regardless of the decline in food/energy prices
Computing Power	Accessibility of next-generation GPUs	The "computing power" component increases within the total cost of intangible assets.

Source: The author’s projection

The 2025–2026 period was selected as a reference because it represents the first post-crisis interval where 'pure inflation' of intangible assets can be observed—uncontaminated by the energy crisis and driven strictly by its natural factors: human talent and digital infrastructure. This chronological timeframe highlights the structural autonomy of intangible assets, whose price dynamics decouple from conventional macroeconomic indicators to follow a specific set of endogenous variables. In other words, for intangible assets, these variables do not originate 'externally' (such as the price of a barrel of oil or wheat); instead, they are generated internally, directly by the nature of innovation activities.

Intangible assets in 2026 are 'hybrid' in nature. The 10–11% inflation rate identified in Romania is not merely a wage crisis, but also a reflection of the rising cost of access to high-performance hardware infrastructure required to keep these assets globally competitive.

To fully understand this phenomenon, a deeper comparative analysis between Romania and the Eurozone/EU baseline reveals a severe macroeconomic divergence driven by structural asymmetries. In the Eurozone, where intangible inflation has stabilized around 3.0% against a headline CPI of 1.7%–1.9% (European Central Bank, 2025), the price growth of immaterial assets is naturally absorbed by high aggregate industrial productivity. Western European economies possess a mature digital ecosystem where investments in R&D and software yield immediate economies of scale, thereby dampening the net inflationary effect on capital expenditure.

Conversely, Romania exhibits a phenomenon of "Asymmetric Convergence." Driven by the intense demand of global IT outsourcing, nominal wages for Romanian tech specialists are rapidly converging toward Western European standards. However, because these specialists primarily develop intellectual property for foreign entities rather than domestic industries, this localized wage growth is decoupled from Romania's aggregate national productivity. Consequently, when a domestic Romanian firm attempts to develop or maintain its own intangible assets (such as local enterprise software or proprietary databases), it must compete in a hyper-inflationary local labor market where wages are set by global, rather than regional, purchasing power.

Furthermore, the structural variance between Romania and the EU is exacerbated by a severe technology import dependency. While core EU economies host decentralized data centers, possess domestic semiconductor integration pipelines, and hedge currency fluctuations within the Eurozone, Romanian firms operate outside the Euro area. Romanian organizations are forced to absorb imported technological inflation—such as the escalating costs of hyperscale cloud services and advanced GPU architectures—entirely denominated in hard currencies (USD and EUR).

This exposes domestic capital accumulation to direct exchange rate volatility and cross-border pricing strategies. Combined with a persistent 9.6% national headline inflation rate (Institutul Național de Statistică, 2026), the domestic cost of generating a single unit of intangible asset escalates at more than triple the velocity of the EU average. This friction structurally penalizes Romanian enterprises, transforming the acquisition of knowledge-based assets into a highly capital-intensive endeavor that threatens to widen the digital divide between the periphery and the core of the European Union.

3.4 Extended Case Study Analysis: 2025–2026 Empirical Substantiation

To create a more robust empirical baseline for the decoupled inflationary path of intangible assets, this section expands the 2025–2026 case study across three analytical dimensions: the operationalization of the "talent premium," the capital intensity of the AI-hardware bottleneck, and the structural implications for the Romanian macroeconomic ecosystem.

While standard macroeconomic adjustments assume that wage growth aligns with aggregate productivity, the 2025–2026 fiscal cycle demonstrates an asymmetric wage-setting mechanism in human-capital-intensive sectors. As noted by Jaumotte

et al. (2026), the global shortage of 4 million IT and AI specialists has altered firm behavior, shifting from standard recruitment to aggressive "labor hoarding." Firms are retaining advanced technical talent at premium rates even during project intermissions to avoid future transaction costs associated with hiring. Under the Cost Approach framework (Value = Labor Costs + Technological Costs + Overheads), this behavior transforms variable labor costs into quasi-fixed costs with high upward rigidity. Consequently, the 70-80% labor weight within the intangible asset production basket acts as a permanent inflationary transmitter, preventing the reproduction cost of software and R&D from dropping, even as headline inflation cools toward the 2% target (International Monetary Fund, 2026).

The transition of digital technology from a deflationary utility to a scarce, strategic asset represents a structural break in the 2025–2026 period. Historically, hardware obeyed Wright's Law or Moore's Law, postulating systemic cost reductions over time. However, the exponential compute requirements for generative AI and hyperscale infrastructure have inverted this trend. The global concentration of advanced node semiconductor manufacturing and surging energy costs for data centers have introduced a Scarcity Multiplier into technological costs. Cloud infrastructure and GPU allocation costs have experienced localized annualized growth rates of 10% (Table 1). When integrated into the valuation model, this technological component alters the "Depreciation Velocity" of existing intangible assets: older software and database models deplete their economic utility faster due to technological obsolescence, while the replacement cost of new, AI-integrated assets escalates rapidly.

The empirical reality of Romania as of early 2026 highlights a severe structural friction. With a persistent headline inflation rate of 9.6% (National Institute of Statistics, 2026), the country exhibits an accelerated convergence of domestic nominal wages toward Western European standards, primarily driven by global IT outsourcing demand. However, this wage inflation is decoupled from local economic absorptive capacity. This creates a "dual digital economy" paradox: the supply side (IT labor force) prices its output based on global, Eurozone-driven scarcity metrics, whereas the demand side (local SMEs and public administration) exhibits low digital density and slow technological adoption. As a result, Romanian enterprises cannot generate the productivity gains necessary to offset the rising cost of intellectual capital. Because local intangible asset creation is anchored in domestic living costs while digital infrastructure is entirely imported and denominated in USD or EUR, Romanian firms absorb a compounding inflationary shock. Adjusting these asset valuations using the standard national Consumer Price Index (CPI) creates a severe systematic underestimation, masking an annual capital deficit of nearly 9%. This empirical friction validates the necessity of transitioning from historical, linear deflators to dynamic, sector-specific valuation frameworks capable of capturing the true velocity of intellectual capital.

4. Conclusions

The analysis of the 2025–2026 period reveals a fundamental shift in the inflationary mechanisms of the modern economy. Our findings demonstrate that expenditures on intangible assets have entered a phase of structural decoupling from traditional macroeconomic indicators. While global headline inflation shows signs of stabilization, the cost trajectory for intangibles remains aggressively upward, driven

by the inelasticity of high-tech labor markets and the rising capital intensity of digital infrastructure centered on Graphics Processing Units (Jaumotte et al., 2026) .

In the specific context of Romania, the identified 10–11% inflationary surge highlights a significant vulnerability for local firms. The "hybrid" nature of intangible assets in 2026—which bridges the gap between human innovation and massive computing power—renders them hypersensitive to local wage stickiness and global hardware shortages, rather than traditional commodity price fluctuations.

Consequently, this paper argues that the continued reliance on unadjusted, historical Cost Approach valuation models poses a severe risk of capital erosion (Reilly and Schweihs,2016). To ensure economic resilience and faithful financial representation, a strategic recalibration of valuation methodologies is imperative. Professionals and policymakers must transition toward dynamic valuation frameworks that account for the specific endogenous variables of the knowledge economy, thereby preserving the real value of the innovative capital that defines the "new normal".

To operationalize these findings, this research establishes that the traditional consumer-centric deflators (such as the CPI) generate a systematic underestimation of nearly 9% when applied to technological intellectual capital. The primary academic contribution of this paper is the empirical mapping of this "valuation gap," demonstrating that intangible inflation is structurally anchored in the "talent premium" and the monopolistic supply chain of advanced semiconductor nodes. For emerging markets like Romania, this creates an adverse economic multiplier: companies import hardware infrastructure denominated in hard currencies while local wages scale at Eurozone rates, all without the baseline productivity gains seen in fully digitized economies.

From a practical perspective, we propose that financial controllers and corporate appraisers replace linear historical indexing with a composite asset deflator. This tailored index should dynamically weight three core pillars: regional high-tech wage growth indices, real-time cloud computing capacity costs, and specialized legal compliance overheads. By implementing these sector-specific frameworks, organizations can mitigate the risk of balance sheet erosion and prevent misinformed capital expenditure (CapEx) allocations in an increasingly asymmetric macroeconomic environment.

4.1 Limitations and Future Research Directions

While this study provides a critical predictive framework for the current fiscal cycle, certain limitations must be noted. The analysis relies heavily on proxy indicators for 2025–2026 AI compute expenditures and specialized software developer wage trajectories, both of which are highly sensitive to rapid regulatory updates and shifting geopolitical trade constraints in the hardware industry. Future research should extend this framework by constructing automated, high-frequency web-scraping indices to track localized IT labor costs. Additionally, applying this specific methodology across a broader panel dataset of Central and Eastern European (CEE) economies would allow for a comprehensive comparative analysis of technology-driven inflation in converging markets.

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ACCOUNTING PRESENTATION OF PLAYER RIGHTS

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Abstract: *In a rapidly changing economic and legal environment, a well-structured, predictable accounting system provides security for businesses, as it establishes a framework for operations and their ongoing monitoring. Accounting is a key regulatory tool in business management, not only within the company but also from the perspective of external stakeholders, as it provides data and analyses that are essential for users to form a reliable, accurate picture of the company's situation and performance. Within the sports sector, and particularly in professional football, player rights represent one of the most significant assets of clubs, both in financial and strategic terms. Their appropriate accounting treatment has a direct impact on the financial statements, profitability indicators and, ultimately, on how stable and transparent a club appears to investors, creditors, regulators and fans. At the same time, the accounting of player rights raises a number of specific questions, given that these rights differ in many respects from traditional tangible and intangible assets. In this study, I examine how player rights should be accounted for under domestic regulations, international standards and the UEFA Club Licensing regulations. My aim is to identify the similarities and differences between these systems, with a particular focus on the determination of the initial cost of player rights, their measurement during their useful life and their derecognition upon transfer or contract expiry. The findings of the analysis are intended to provide practical guidance for sports organisations on how to implement these rules consistently and transparently. The study is based primarily on secondary research, using the relevant legislation, accounting standards, UEFA guidelines and existing professional literature.*

Keywords: *intangible assets; player rights; player transfer; club licence.*
JEL Classification: *M41*

1. Introduction

Valuation is one of the most controversial areas of accounting, as the choice of valuation procedures and methods directly influences an entity's financial position, changes therein, and performance (Kiss, 2014). In Hungary, the accounting framework is defined by Act C of 2000 (hereinafter referred to as the Accounting Act), which, among other things, prescribes the reporting, bookkeeping, disclosure, and publication obligations of businesses. The form and content requirements of financial statements are also set forth in this Act. In recent years, Hungarian accounting regulations have gradually aligned with the relevant European Union directives and international accounting principles. Within the EU, the application and adoption of International Financial Reporting Standards (hereinafter "IFRS") are governed by Regulation (EC) No. 1606/2002. The 2000 Hungarian Accounting Act and its subsequent amendments strive to follow the principles of the European Union's accounting rules, which are also subject to continuous change from year to

year. In order to participate in domestic first-or second-division leagues, as well as in club competitions organized by the Union of European Football Associations (hereinafter UEFA), soccer clubs must also comply with their national soccer association's Club Licensing Regulations, which include, among other things, specific accounting requirements.

2. Materials and Methods

This study is primarily based on secondary research; using Hungarian, international (IFRS), and UEFA Club Licensing regulations, as well as the relevant literature, it examines how player rights are accounted for in the financial statements of soccer clubs. I summarize these statutory, legal, and other regulatory procedures in a comparative table illustrating the accounting treatment of player registration rights, which highlights the main differences between the Hungarian Accounting Act, IFRS, and UEFA regulations.

The methodology also includes a comparative analysis that compares the reporting of transactions with similar economic substance (purchased, loaned, freely transferable, and home-grown players) under UEFA's regulatory framework and evaluates their impact on the reliability and comparability of financial statements. Regarding the accounting for home-grown players not disclosed in the financial statements, the study presents several possible valuation approaches (cost-based, market-based, and discounted cash flow-based models) in a theoretical context; however, their practical application would require further empirical research.

3. Literature Review

3.1. Intellectual Capital

In the context of companies, we can speak of so-called intellectual capital, which, from a financial perspective, is a resource whose utilization creates value and thereby strengthens the company's competitive position in the market (Tarnóczi, 2013). The market value of soccer players is a complex indicator that reflects economic, sporting, and social factors simultaneously. The economic dimension is determined by the value of the intangible assets associated with the players, while the sporting factor reflects the fact that the value of individual players is fundamentally influenced by their current performance and form. The social dimension is expressed through the close connection between the player's and the fans' commitment to the team (Dima, 2015).

Lardo et al. (2017) emphasize that, in the case of soccer clubs, the intellectual capital associated with players is of decisive importance. According to their empirical studies, the level of visibility measurable on social media—such as the number of followers and activity—substantially increases the value of human capital. Players and clubs with a stronger online presence tend to generate higher revenues and transfer fees. All of this suggests that there is a positive correlation between social media visibility and financial indicators.

Intellectual capital consists of three main elements, which this study examines from the perspective of soccer clubs: social capital, human capital, and organizational capital (Tarnóczi, 2013). Social capital encompasses the benefits derived from the network of relationships between the club and its external partners, fans, sponsors, and the media, while organizational capital represents the value tied to internal structures, processes, operational procedures, and club culture. Soccer clubs are particularly good examples of this concept, as they possess a type of intangible

capital that, when managed effectively, can improve not only their athletic performance but also their overall market position. This capital is the intellectual (human) capital associated with the players, which in this case refers to the value derived from the knowledge, experience, skills, and prestige of the soccer players working at the club and, in a broader sense, the professional staff and coaches. Of the three components, human capital is the one that "leaves" the organization along with the employee (player) when they change clubs, while organizational capital remains with the club, and social capital is shared between the enterprise and external stakeholders. All of this clearly demonstrates that intellectual capital contributes significantly to the growth of the enterprise's—in this case, the soccer club's—market value.

The literature classifies cost-based, market-based, and discounted cash flow-based methods among the methods for measuring intellectual capital (Káldos, 2006). In the cost-based approach, the value of an asset is determined by the expenses associated with it, such as wages and payroll taxes, other material expenses, depreciation, etc. The advantage of this is that these amounts are easily identifiable in financial statements; however, it poses a problem because expenses are generally recorded in aggregate rather than on a per-player basis, making it difficult to determine exactly how much each individual soccer player costs the club.

Revenue-based valuation examines how much revenue the player generates for the club. This includes, for example, revenue from marketing, sponsorship, ticket sales, jersey sales, and other related income. This method is fundamentally based on estimation and requires determining the future cash flows associated with the player's rights, then discounting these to determine the present value of the expected cash flows.

The third method, perhaps the most common in soccer, is market-based valuation. In this model, the player's value is determined by the market—that is, the relationship between supply and demand, as well as competition among clubs. A player's current market value is significantly influenced by his marketing value, expert and public opinion regarding his on-field performance and off-field conduct, as well as fans' emotional attachment and subjective assessment of his performance.

3.2. Registration of Playing Rights

"The core values of professional soccer typically manifest in intangible rights (playing rights), and these rights form the foundation of various markets within professional soccer" (Havran and András, 2022:233) The significance of playing rights varies greatly depending on the sport, the club level, and the athletes' perspective, but they play a particularly significant role in spectator sports such as soccer. The Sports Act in force in Hungary essentially defines the right to play as the athlete's right to "utilize" their own physical and mental abilities for competition and play during sporting activities, that is, to officially participate in sporting activities using these abilities (Sports Act, 2004).

Duval (2020) points out that at the apex of sports law stands the "lex sportiva," which is sport's own autonomous system of norms, established by international and domestic sports organizations (such as FIFA, MOB, and MLSZ), and to which national legislation is linked. In Hungary, sports federations, such as the MLSZ (Hungarian Football Federation), have exclusive authority to establish rules governing competitions, gameplay, player registrations, transfers, and disciplinary

proceedings in football. This rule-making constitutes the domestic core of "lex sportiva."

Table 1: Comparison of Accounting Information Related to Player Registration Rights

	Act C of 2000 on Accounting (Sztv.)	***International Financial Reporting Standards (IFRS)***	***Union of European Football Associations (UEFA)***
Location of player registration in financial statements	Balance Sheet A.) Fixed Assets I.) Intangible Assets 3. Rights of a financial nature	Statement of Financial Position Fixed Assets Intangible Assets Player registrations	Balance Sheet Fixed assets a/9. Intangible assets – player asset value
Timing of recognition of player registration	When they are put into service or taken into use in accordance with their intended purpose.	When they meet the definition of an asset.	When all material terms of the transfer have been fulfilled.
Cost	Gross value, comprising the purchase price and related direct costs, or direct production costs in the case of self-production.	- Individual acquisition: Consideration paid + direct costs related to bringing the asset into use - As part of a business combination: Fair value (provided it can be measured reliably) - Through an asset swap: Fair value or the asset's carrying amount if fair value cannot be measured reliably	Gross value, which includes the purchase price (transfer fee) and related direct costs (brokerage fees, registration fees, direct legal costs)
Presentation on the balance sheet	Net value = Gross value – Planned depreciation – Unplanned depreciation + Reversal of unplanned depreciation + Value adjustment	Net value = Gross value – Accumulated depreciation – Accumulated impairment + Reversal of impairment	Net value = Gross value – Scheduled depreciation – Unplanned depreciation + Reversal of unplanned depreciation

Scheduled depreciation	Any method, without limitation during the useful life for property rights.	- Fixed useful life: any method during the useful life - Indefinite useful life: cannot be depreciated	Using the straight-line method over a maximum of 5 years
Accelerated depreciation/ impairment	Carrying amount is permanently and significantly higher than the market value of the asset. Reversal is possible upon cessation of the cause (upper limit: previous carrying amount)	Impairment test performed on the balance sheet date. If the carrying amount exceeds the recoverable amount, the difference must be recognized immediately as an expense.	Its book value is consistently and significantly higher than the market value of this asset. Reversal is possible upon cessation of the reason (upper limit: previous book value) - the player is unable to continue his professional career due to a permanent reason (e.g., a serious, career-ending injury, suspension) - if the selling price is lower than the net book value
Revaluation to market value	If the market value significantly exceeds the carrying amount following the reversal of previously recognized impairment losses	Revaluation model: if there is an active market for the intangible asset where fair value can be reliably and regularly determined.	Not applicable
Their presentation in the income statement	Other income/expenses	Player transfers	a/6. Income from player sales (if the playing rights of the sold player were not previously capitalized) a/7. Income from player sales c/3. Other transfer income/expenses c/4. Profit/loss from player transfers
Location of expenses in the income statement	IV. Material expenses: cost of materials, services rendered	Cost of Sales	b/2. Personnel expenses (soccer players and other employees): wages, payroll taxes, other

	V. Personnel expenses: wages, payroll taxes, other personnel-related payments VI. Depreciation and amortization: recognition of depreciation and amortization of intangible assets X. Expenses from financial transactions: loans taken out to finance player acquisitions, interest on loans		personnel-related payments b/5. Other operating costs / expenses c/1. Depreciation of player assets (scheduled and unscheduled) d/2. Income and expenses from financial operations: interest on loans and borrowings taken out to finance player acquisitions
Cash flow	Operating cash flow Investing cash flow	Investing cash flow	Investing cash flow

Source: Compiled by the author, 2026

Table 1. summarizes the main accounting and regulatory issues related to player registration rights based on the Hungarian Accounting Act, IFRS, and the UEFA Club Licensing Regulations. Companies operating soccer clubs must always comply with the strictest of these standards. A good example of this is that while the Accounting Act allows for value adjustments in the case of player rights, the Club Licensing Regulations do not accept this, so in practice, clubs do not make use of this option. Under the Hungarian Accounting Act, only purchased players are recognized in the financial statements as intangible assets; their (gross) acquisition cost, as well as the related scheduled and unscheduled depreciation, are recorded under intangible assets (Szőke et al. 2015). In the case of free agents and players arriving on loan, the club incurs only material and personnel-related expenses (e.g., wages, commissions); these cannot be capitalized, and therefore their value cannot be reduced through depreciation under the Accounting Act. However, in practice, clubs report these players under property rights at the value of the capitalizable costs. Home-grown players are recognized as intangible assets on the balance sheet prepared as part of the financial statements if the club enters into a contract with them for at least one year; if no contract is entered into, the related expenses are recognized as costs by the entity. Salaries, payroll taxes, and other personnel-related payments made to players are recorded on the liability side of the balance sheet, under current liabilities.

Depreciation is a fundamental element of accounting that ensures the cost of fixed assets is not recognized in the books in a single year, but is spread over multiple periods throughout their useful lives. On the one hand, this spreads expenses over time; on the other hand, it has a direct impact on the income statement, profitability,

and the external assessment of the company's performance. According to the Accounting Act, the value of an asset can be reduced using several methods. In practice, clubs must use scheduled depreciation. Scheduled depreciation may be recognized if the asset becomes technically, economically, or morally obsolete over time, or if its value continuously decreases (Simon and Pataki, 2025). In soccer, player rights, as rights with monetary value, are typically depreciated on a straight-line basis, without residual value, over the entire term of the contract. An impairment loss may be recognized if the carrying amount of the player right becomes permanently and significantly lower, for example:

- due to a serious, long-term injury after which a return to the previous level of performance is no longer realistic,
- if the player is unable to play (due to a long-term suspension or a legal situation that prevents the player from being fielded or effectively traded in the long term),
- in the event of termination of the contract by mutual agreement.

However, the Accounting Act restricts the applicability of impairment losses; a mere contract amendment does not in itself justify their recognition (Accounting Act, 2000).

It is also possible for the enterprise to record property rights at market value. In such cases, the book value and market value must be determined as of December 31 of each year. If the market value is higher, any previously recognized impairment loss must first be reversed, up to its original amount. Only then can a value adjustment be recognized, which appears on the liability side of the balance sheet as a valuation reserve and may be recognized up to the market value (Szabóné Szőke, 2017a). According to the Club License regulations, value adjustments for player rights are not permitted.

In the course of my research, I found that clubs account for revenue from the sale of players' registration rights in accordance with the Accounting Act, reporting it under "Other revenue". Under Hungarian accounting regulations, playing rights are classified as intangible assets, and the profit generated from their sale must be recorded in the income statement under the "other revenue" and "other expenses" lines. When a sports enterprise sells a playing right (a right of pecuniary value) to another club, it first removes the carrying amount of the relevant intangible asset and the related accumulated amortization from its books, resulting in a decrease in the balance of intangible assets and accumulated amortization. The resulting gain or loss is recognized in the appropriate other income/expense line item.

The income statement's operating (business) activities also include personnel-related items pertaining to players; salaries, payroll taxes, and all other personnel-related payments are reported under personnel expenses. Other costs directly related to athletes, such as equipment, travel, lodging, or other competition-related expenses, are also recorded in the same income category. These are classified as material expenses.

Scheduled and unscheduled depreciation related to the sale of game rights is reported in the operating activities section of the cash flow statement, on line 3. Although these entries reduce net income, since they do not involve an actual cash outflow, they must be reversed in the cash flow statement and are therefore shown here with a positive sign. Gains from the sale of fixed assets, including player rights, are included on line 5, with a sign opposite to that of the gain, depending on the nature of the gain. Players' salaries, contributions, and other personnel-related

payments increase current liabilities; therefore, these changes are also shown with a positive sign in the corresponding line of operating cash flow. In the investing activities section, line 14 shows the amounts paid for the acquisition of fixed assets, such as player rights (with a negative sign), while line 15 shows the cash inflows from the sale of these assets (with a positive sign).

According to International Financial Reporting Standards, IAS 38 essentially applies to the accounting treatment of all intangible assets (non-physical, long-lived assets), with the sole important exception being goodwill arising from business combinations, for which a separate standard provides guidance. Classic examples of intangible assets include patents, trademarks and brand names, copyrights, licenses, and customer and client lists (Teofilovic et al., 2013).

The key issue for valuation under IFRS is whether a given intangible asset has a finite or indefinite useful life. If the useful life is finite, the asset must be amortized over its expected useful life, and if the recoverable amount falls permanently below the carrying amount, an impairment loss must also be recognized. In the case of an indefinite useful life, no scheduled depreciation may be recognized; however, regular impairment tests must be performed, and an impairment loss must be recognized if necessary. For a soccer club, if a player's contract is for a specific term and does not include an automatic extension option exercisable by the parties, the player's registration rights typically qualify as an intangible asset with a finite useful life, which is amortized on a straight-line basis over the term of the contract. If, however, the contract is indefinite in duration or can be extended in such a way that the useful life cannot be reasonably estimated in advance, under IFRS the playing rights must be treated as an intangible asset with an indefinite useful life, and in this case, there is no scheduled amortization; instead, regular impairment tests must be performed.

The accounting treatment of the sale of intangible assets is governed by the international standard on revenue recognition, IAS 18 (Revenue).

Under the Accounting Act, only those items whose acquisition cost can be clearly determined may be recorded as intangible assets. It follows that purchased players are definitely included in the balance sheet under property rights. Table 2 presents the various scenarios for acquiring players, as well as the relevant Club License regulations.

Table 2: Overview of the Club License Regulations Regarding Playing Rights

	Union of European Football Associations (UEFA)
Rules regarding acquired players	For players whose registration rights are acquired by the club for a period longer than one year, the expenses related to the acquisition must be capitalized and recognized as intangible assets. The player's registration may only be recognized in the financial statements if all material terms of the transfer have been fulfilled, meaning the transaction is considered unconditional. This implies that a binding contract has been concluded between the two sports organizations involved, as well as between the acquiring club and the player. Only expenses directly related to the player transfer may be capitalized as intangible assets.
Rules regarding home-grown players	The license applicant may not present expenses related to the training and development of home-grown players as assets on the balance sheet; no capitalized value may be recognized for them. Only direct transfer costs related to players acquired from other clubs may be recognized in the balance sheet as intangible assets.
Rules regarding players on loan	- Loan fee: recorded under the player's transfer income/expenses line - No option included: For the lending club, the fee received is income, and the player's registration rights remain under intangible assets (and are amortized over time). For the borrowing club, the loan fee is an expense. - Includes an unconditional purchase obligation: for the lending club, it is recognized as revenue at the outset and the player's registration rights are derecognized. The borrowing club recognizes it as an asset.
Rules regarding free agents	They are not recognized as intangible assets, unless capitalizable costs are incurred, e.g., agent fees.

Source: Compiled by the author, 2026

In my view, human capital—specifically, the reliable valuation and balance-sheet recognition of the player roster in this paper—is a fundamental prerequisite for financial statements to provide a true and fair view of the club's assets. In the case of soccer clubs, however, a specific accounting contradiction arises, as homegrown players who graduate from the club's youth system and do not have contracts typically cannot be capitalized as intangible assets under current Hungarian regulations, even though they generate costs very similar to those of purchased players from an economic perspective. For both groups, personnel-related

expenses (salaries and related contributions, bonuses) and material expenses (equipment, travel, training), and the sale of both home-grown and purchased players can generate significant revenue for the club (Szabóné Szőke, 2017b). The legal basis for not recognizing home-grown players on the balance sheet is that the Accounting Act only permits the recognition of rights of a pecuniary nature that are acquired by the enterprise from an external party in exchange for consideration (Act C of 2000).The legal basis for not recognizing home-grown players on the balance sheet is that the Accounting Act permits the recognition only of rights of a financial nature that are acquired by the enterprise from an external party in exchange for consideration (Act C of 2000). Among purchased and home-grown players, football clubs report those players with whom they have signed contracts as intangible assets in their books. According to the regulations, they may not recognize as intangible assets those players who are home-grown and with whom no contract is signed when they are promoted to the senior team, even though these players generate value just like other capitalized players.

If a club signs a free agent—that is, a player without a contract—the parties enter into an employment contract or a contract for services. In this agreement, they may stipulate not only the compensation but also other terms (such as performance-based bonuses, option rights, and additional benefits). Under accounting rules, the costs of such arrangements are recognized as payroll expenses; that is, the economic value associated with the player is not included in the club's assets in this case either. An exception to this may apply if, for example, an agent's fee is incurred in connection with the transfer. The third option is the acquisition of playing rights in exchange for consideration (player registration), where the club pays a transfer fee to another club for the right to register the player. For players arriving on loan, the activation depends on whether the borrowing club ultimately purchases the player by exercising the purchase option. If the contract includes a purchase option, the playing rights are activated as assets; otherwise, they are not, and are instead recorded as a service rendered.

UEFA's accounting regulations take the going concern principle as their starting point and stipulate that any deviation from this principle is not permitted under any circumstances. It also emphasizes the importance of the materiality principle, according to which the omission or misstatement of an item or piece of information is considered material if, on its own or in combination with other items, it is capable of influencing the decisions of users. The assessment of materiality is always made by taking into account the specific context, the relationships, the amount, and the nature of the item. The consistent application of accounting principles is key to legal harmonization; it is not merely a matter of formally adopting rules, but of ensuring that businesses in different countries present transactions with the same economic substance in a similar manner, guided by the same principles.

A reliable, true, and fair financial statement can only be prepared if the principles of completeness, prudence, consistency, comparability, and consistency are applied in practical decisions as well. For sports enterprises, particularly professional soccer clubs, this issue takes on even greater significance due to the accounting treatment of player rights, transfer fees, and related costs. In my opinion, if accounting principles are not applied in these transactions, data reported under domestic, IFRS, and UEFA rules will not be uniformly interpretable, thereby undermining one of the main goals of harmonization: the comparability of financial statements.

A distinctive feature of soccer is that subjective judgment plays a significant role in the evaluation of players, which can also affect the quality of financial reports. Excessive discretion can give rise to valuation practices that portray a club's financial position as more favorable than it actually is, thereby misleading investors and making it difficult to verify compliance with regulations, which can indirectly have a negative impact on other clubs as well. Therefore, it would be justified to further specify and standardize valuation methods related to player rights (Házi and Tóth, 2024).

Kozma (2004) points out that knowledge of players' market value is, on the one hand, essential for presenting the actual financial situation of the business operating the club, and on the other hand, can also serve as a potential indicator of future athletic performance. Based on experience, the transfer fee paid for a player most closely approximates his actual market value. At the same time, this type of "market price" is often unavailable, as many soccer players remain with the same club for extended periods and no actual transfer transactions involving them take place. The situation is further complicated by the fact that determining the market value of individual players on a case-by-case basis is a time-and resource-intensive task that involves significant methodological challenges (He et al., 2015).

4. Conclusions

The central question of this study is how to account for off-balance-sheet players in financial statements and how to determine their actual economic value. Currently, clubs only capitalize them as intangible assets if they sign a contract with them for at least one year, and in such cases, they typically use the amount of the operating cost allowance as a basis; however, in my opinion, this amount does not realistically reflect the players' true value. Home-grown soccer players with whom the club has not signed a contract are omitted from the balance sheet in the same way as certain free agents or players on loan; in the case of the latter, an intangible asset is recognized only if the loan agreement includes an unconditional purchase obligation.

The question therefore arises as to how the value of players who are not currently classified as intangible assets can be recognized—and on what basis—while ensuring that the financial statements continue to provide a reliable and true picture for economic stakeholders. Another problem is the prohibition on applying value adjustments in the Club Licensing Regulations, which leads to the book value of a highly skilled player on the balance sheet often being zero forints. The reason for this is that the player's registration rights are fully written off through amortization over the term of the contract, while there is no possibility of revaluation to market value. In the case of DVSC Futballszervező Zrt., a good example of this is Donát Bárány, who, as a homegrown player, was presumably capitalized at only the amount of his operating cost allowance and was then fully amortized during his contract, so he no longer appears on the balance sheet, even though he makes an outstanding contribution to the club's sporting and financial success.

I believe that the management of a soccer club should give priority to determining how the true value of home-grown players can be measured and what method can most accurately demonstrate it. However, applying this domestically faces numerous difficulties. Despite all this, I still consider it essential to examine this topic, as soccer organizations clearly demonstrate that the better the quality, experience, and skill level of their player roster, the greater the value of the organization itself.

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CORRELATIONS BETWEEN FINANCIAL AUDIT AND ROMANIAN TAXATION

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Abstract: *This paper examines the correlations between financial audit and the Romanian tax system, from both an institutional and an applied perspective. The financial auditor does not replace the tax inspector; the auditor certifies the accuracy of financial reporting and, implicitly, the correctness of the computation and recognition of tax liabilities in the financial statements. Starting from the national regulatory framework – the Fiscal Code, the Fiscal Procedure Code, the Accounting Law and the legislation on statutory audit – the paper analyses the complementary roles of ANAF and ASPAAS and identifies the tax indicators with the highest relevance in planning and performing the statutory audit: the degree of timely settlement of tax liabilities, outstanding tax obligations, the ratio between corporate income tax and accounting profit, the share of value added tax in turnover, adjustments resulting from tax inspections and the frequency of changes in the tax policies applied. The analysis is placed in the context of Romania's fiscal position in 2025-2026: the highest budget deficit in the European Union, rising public debt and one of the lowest tax-to-GDP ratios among Member States. The results support the conclusion that the systematic monitoring of tax indicators strengthens audit risk assessment and increases the credibility of financial statements.*

Keywords: *financial audit; taxation; tax compliance; fiscal risk; budget deficit; Romania.*

JEL classification: *H20; H62; H83; M42*

1. Introduction

The correlation between financial audit and Romanian taxation is very close, since both contribute to the transparency, legal compliance and financial health of economic entities. The financial audit consists of the examination of an entity's financial statements in order to verify their correctness, their compliance with accounting standards and the legality of the underlying operations, the auditor assessing whether the information presented offers a true and fair view of the entity's financial position and performance (Arens and Loebbecke, 2003; Bunget, 2010). Taxation, in turn, is usually perceived as a system of taxes established and regulated through tax legislation, comprising the tax obligations of legal entities and individuals. Through the financial audit, the auditor verifies, among other things, whether the audited entity complies with the tax regulations in force. The auditor does not take

the place of the tax inspector, but certifies the accuracy of the financial reporting and thereby provides assurance regarding the correctness of the amounts owed to the state, in line with the requirements of ISA 250 concerning the consideration of laws and regulations in an audit of financial statements (IAASB, 2018).

The objective of this paper is twofold: first, to systematise the regulatory and institutional links between the financial audit and the Romanian tax system; second, to identify the tax indicators that are most relevant in the statutory audit and to place them in the context of Romania's current fiscal position, characterised by the highest budget deficit in the European Union and by one of the lowest tax-to-GDP ratios among the Member States (Eurostat, 2026a; Eurostat, 2025).

2. Literature Review and Regulatory Framework

The economic literature on tax compliance starts from the seminal model of Allingham and Sandmo (1972), in which the taxpayer's decision to declare income depends on the probability of detection and on the level of sanctions; subsequent research has enriched this framework with behavioural determinants of compliance (Alm, 2019). In the accounting and auditing literature, audit quality is classically defined as the joint probability that the auditor both detects and reports a breach in the client's accounting system (DeAngelo, 1981), while the research on the relationship between taxation and financial reporting emphasises the informational role of tax positions in the financial statements (Hanlon and Heitzman, 2010). Against this background, the tax component of the statutory audit can be understood as a mechanism that supports tax compliance indirectly, by increasing the credibility of the reported figures.

In Romania, the correlation between the two areas is anchored in a set of interconnected normative acts. The links between accounting, auditing and tax legislation can be highlighted as follows:

a) the verification of tax compliance is an important part of the audit of patrimonial entities, the auditor examining whether the entity complies with the tax legislation regarding the declaration and payment of taxes and detecting possible errors or irregularities;

b) the identification of tax risks related to erroneous estimates or to non-compliance with the applicable tax regime, thus helping companies to correct their tax returns;

c) support in the legal optimisation of the tax burden, through recommendations for a more efficient management of tax obligations;

d) transparency and credibility, since the audit increases the reliability of the financial statements and offers the tax authorities a clearer picture of the taxpayer;

e) compliance with the regulations, given that Romanian legislation imposes, under certain conditions, a mandatory financial audit, which contributes to correct tax reporting.

The main components of the relevant legal framework are: Law no. 227/2015 on the Fiscal Code, the principal normative act regulating the tax obligations of companies and individuals; Law no. 207/2015 on the Fiscal Procedure Code, which governs tax procedures, including the inspections carried out by the tax authorities; the Accounting Law no. 82/1991, republished, which regulates the keeping of accounting records and the obligation to prepare true and fair financial statements; Order of the Minister of Public Finance no. 1802/2014 on the applicable accounting regulations; and Law no. 162/2017 on the statutory audit of annual financial statements, which

transposes into national law the requirements of Directive 2006/43/EC, as amended by Directive 2014/56/EU, and ensures the application of Regulation (EU) no. 537/2014. Statutory audits are performed by authorised financial auditors, who must observe the International Standards on Auditing issued by IFAC.

3. The Institutional Architecture: ANAF and ASPAAS

Tax inspections of companies are carried out by the National Agency for Fiscal Administration (ANAF) and may include documentary checks, inspections at the taxpayer's premises and cross-checks, all regulated by the Fiscal Procedure Code. Where irregularities are found, companies may be sanctioned according to the tax legislation, and the auditors must report the relevant elements to the competent bodies.

The Authority for the Public Supervision of the Statutory Audit Activity (ASPAAS) does not exercise direct control over a company's taxation – this being the attribution of ANAF – but regulates and supervises the audit profession, which in turn verifies the financial statements, where taxes are also reflected. The main aspects of the role of ASPAAS can be summarised as follows:

(i) the supervision of statutory audit quality: since the financial statements include the accounts of taxes, duties and liabilities towards the state, ASPAAS verifies whether the auditors have rigorously tested the correctness and legality of these figures;

(ii) the regulation of the profession: ASPAAS issues norms and procedures which the auditors must follow; although the statutory audit focuses on the true and fair view of the entity as a whole, tax compliance is a major component, and the auditor must report identified breaches of the tax legislation that could significantly affect the financial statements;

(iii) inspections and quality reviews: within the periodic inspections of audit firms, ASPAAS inspectors verify whether the audit files contain sufficient testing of the corporate income tax computation, of the provisions for possible tax litigations and of the tax risks that could endanger the going concern of the entity;

(iv) the administration of the Public Register of financial auditors and audit firms authorised to practise in Romania; a company must use only auditors registered with ASPAAS for the audit report to be valid before the tax authorities and the investors.

The distinction between the two institutions is therefore essential: ANAF verifies directly whether the company has paid its taxes correctly and may apply sanctions, whereas ASPAAS verifies whether the auditor has audited the company correctly; if an auditor ignores obvious tax evasion or a miscalculation of taxes, ASPAAS is the institution that sanctions the auditor or withdraws the licence. In Romania, tax review as a separate service is most often performed by tax consultants, regulated by the Chamber of Tax Consultants (CCF); however, within the mandatory financial audit, the tax component is essential, and ASPAAS ensures that this verification is carried out according to the International Standards on Auditing.

4. Tax Indicators in the Statutory Audit – Research Results

The analysis of tax indicators highlights their role in assessing tax compliance and in identifying the risks with an impact on the audited financial statements. The main indicators used in the practice of the statutory audit are the degree of compliance

with tax obligations, the level of outstanding obligations, the frequency of tax adjustments, the share of taxes and duties in total expenses and the significant variations of the tax base.

The results indicate that entities with a high level of tax compliance present a lower risk of material misstatement of the financial statements. Conversely, differences between the accounting records and the tax returns, delays in settling tax liabilities or frequent changes in the tax treatment applied are indicators of an increased tax risk, requiring the extension of audit procedures. The comparative analysis showed that the following indicators have the greatest relevance in the audit process:

– the degree of timely settlement of tax liabilities;
– the level of outstanding tax obligations;
– the evolution of the corporate income tax in relation to the accounting profit;
– the share of value added tax in turnover;
– the value of the adjustments resulting from tax inspections;
– the frequency of changes in the tax policies applied.

The relevance of the VAT-related indicators is confirmed at macroeconomic level by the size of the Romanian VAT compliance gap: according to the European Commission, Romania recorded in 2023 the highest VAT compliance gap in the European Union, estimated at 30.0% of the theoretical VAT liability, compared with an EU average of 9.5% (European Commission, 2025). This gap illustrates the magnitude of the compliance risk that the auditor must consider when planning the procedures regarding indirect taxes.

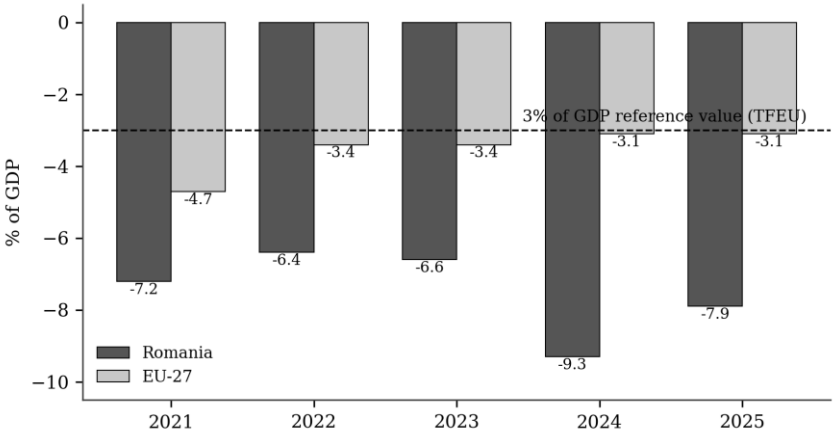
The research results confirm that the systematic monitoring of these indicators contributes to the early identification of tax risks, to the assessment of the effectiveness of internal control and to the substantiation of the auditor's opinion. At the same time, the use of tax indicators facilitates the planning of the audit engagement, by directing the procedures towards the high-risk areas and by optimising the resources allocated to the verifications. Tax indicators therefore represent an essential instrument in the statutory audit, as they provide relevant information on the entity's tax compliance, support the assessment of audit risk and contribute to the credibility of the financial statements.

5. Romania's Fiscal Position in 2025 and the Projections for 2026 in the European Context

The tax environment in which Romanian auditors and taxpayers operate cannot be separated from the general state of the public finances. Romania's fiscal situation in 2025 was characterised by a difficult process of budgetary consolidation, against the background of the largest budget deficit in the European Union and of pressures coming both from the financial markets and from the European institutions.

At the end of 2024, Romania recorded a general government deficit of 9.3% of GDP under the ESA methodology, the highest in the European Union, almost three times the EU average of 3.1%, which led to the continuation of the excessive deficit procedure initiated by the European Commission (Eurostat, 2025). In 2025, the main objective of fiscal policy was the gradual reduction of the deficit without provoking a severe recession; according to the first EDP notification of 2026, the deficit decreased to 7.9% of GDP, still the highest among Member States (Eurostat, 2026a). Figure 1 presents the evolution of the general government balance in Romania compared with the EU-27 average.

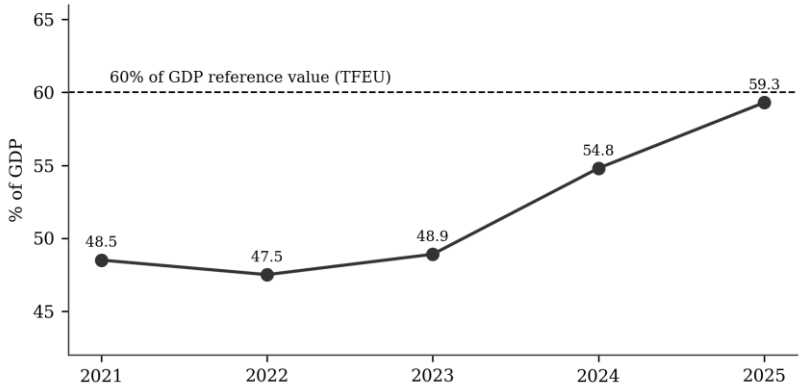
Figure 1. General government balance, Romania vs. EU-27, 2021-2025 (% of GDP)



Source: authors' processing based on Eurostat data (gov_10dd_edpt1), EDP notifications, April 2026

The repeated deficits determined the increase of public debt from 48.9% of GDP at the end of 2023 to 54.8% at the end of 2024 and 59.3% at the end of 2025, a level which, although still below the EU average of 81.7% of GDP, is approaching the 60% reference value of the Treaty (Eurostat, 2025; Eurostat, 2026a). The increase in debt implies higher interest costs, reduced space for investment and vulnerability to external shocks. Figure 2 illustrates this trajectory.

Figure 2. General government gross debt of Romania, 2021-2025 (% of GDP)



Source: authors' processing based on Eurostat data (gov_10dd_edpt1), EDP notifications, April 2026

A structural cause of the deficit lies on the revenue side: Romania collects one of the lowest volumes of taxes and social contributions relative to GDP in the European

Union, as shown in Table 1. In 2024, the Romanian tax-to-GDP ratio was 28.8%, compared with an EU average of 40.4%, only Ireland recording a lower ratio (Eurostat, 2026b). Total general government revenues stood at 34.1% of GDP in 2024, against an EU average of 46.0% (Eurostat, 2025).

Table 1. Revenue from taxes and net social contributions (% of GDP)

Territory	2023	2024
Romania	27.0	28.8
EU-27	39.9	40.4
Euro area (EA-20)	40.5	40.9

Source: Eurostat (gov_10a_taxag), 2026

In this context, the Government adopted several consolidation measures. On the revenue side, some taxes were increased, the tax base was broadened for others and the collection of tax receivables was improved; on the expenditure side, the growth of public sector wages was limited, the control of current expenditure was tightened and priority was given to investments financed from European funds. The consolidation had mixed effects: on the positive side, the reduction of the risk of a sovereign rating downgrade, increased credibility among investors and progress towards the objectives assumed in relation to the European Union; on the negative side, the slowdown of consumption, pressures on the business environment through the higher tax burden and a modest pace of economic growth, of approximately 0.7-1.3% depending on the forecast. The main fiscal risks identified in 2025 were the insufficient collection of tax revenues, the pressures for higher social spending, the slow absorption of European funds, the high financing costs generated by still elevated interest rates and the external imbalances. Table 2 summarises the overall assessment of 2025.

Table 2. Synthetic assessment of Romania's public finances in 2025

Indicator	Assessment
Budget deficit	Very high (7.9% of GDP), but decreasing compared with 2024
Public debt	Increasing, approaching 60% of GDP
Tax revenues	Improved through fiscal measures, but still low as a share of GDP compared with the EU average
Public expenditure	Under the pressure of wages, pensions and interest payments

Source: authors' synthesis based on Eurostat (2026a) and the Fiscal Council (2025)

The fiscal-budgetary projection for 2026 is built around the objective of continuing the fiscal consolidation while maintaining a high level of public investment. The deficit target is 6.2% of GDP for 2026 and 5.1% of GDP for 2027, a trajectory that is part of the consolidation programme agreed with the European institutions;

the Fiscal Council considers the draft budget compatible with the 6.2% target, but warns about the risks related to lower-than-forecast economic growth, geopolitical conflicts and energy prices, pressures on public expenditure and the need to stabilise the public debt (Fiscal Council, 2025). The main budgetary indicators for 2026 are presented in Table 3.

Table 3. Main budgetary indicators projected for 2026

Indicator	Projection 2026
Nominal GDP	approx. 2,045 billion lei
Real economic growth	1.0%
Budget deficit	6.2% of GDP (approx. 127.7 billion lei)
Budget revenues	736.5 billion lei (36.0% of GDP)
Budget expenditures	864.3 billion lei (42.3% of GDP)
Public investments	over 8% of GDP
Average annual inflation	approx. 6.5%
Average net salary	approx. 5,500 lei/month

Source: Fiscal-Budgetary Strategy 2026-2028; Fiscal Council (2025)

The most important budgetary risks for 2026 concern the difficult balance between deficit reduction and the preservation of economic growth: tax revenues below expectations, the rigidity of expenditure already committed for pensions, public wages and interest, the high cost of financing the public debt, the risk of a sovereign rating downgrade, delays in the absorption of European funds and the political sensitivity of the consolidation measures. Budget execution data for the first months of 2026 show a significant reduction of the deficit compared with the same period of 2025, suggesting that the consolidation measures have begun to produce effects; nevertheless, the performance of the first part of the year does not guarantee the achievement of the annual target, since expenditure tends to accelerate in the second half of the year. For the audit profession, this macro-fiscal context translates into a higher probability of legislative changes, of tax inspections and of adjustments of the taxpayers' tax positions – all of which are elements that increase the inherent risk associated with the tax captions of the financial statements.

6. Conclusions

The financial audit and Romanian taxation are interdependent and contribute together to a correct and compliant financial management. The auditor certifies the accuracy of the financial reporting, including the tax positions, without substituting the tax inspector, while ASPAAS, through the supervision of the auditors, contributes to greater transparency and correctness in the tax reporting of taxpayers.

The research shows that tax indicators – the degree of timely settlement of tax liabilities, outstanding obligations, the relation between the corporate income tax and the accounting profit, the share of VAT in turnover, the adjustments resulting from tax inspections and the frequency of changes in tax policies – represent an essential

instrument in the statutory audit, supporting the assessment of audit risk and the credibility of the financial statements. Their relevance is amplified by the current macro-fiscal context: the year 2025 represented an inflection point for Romania's fiscal policy, with the beginning of a consolidation process after the sharp deterioration of the public finances in 2024, while the deficit remained the highest in the European Union and the public debt continued to grow towards the 60% of GDP threshold. Maintaining a sustainable trajectory of the public finances depends on the continuation of the fiscal reforms, on the improvement of tax collection – including the reduction of the VAT compliance gap, the largest in the EU – and on the efficient use of European funds. In such an environment, the tax component of the statutory audit becomes even more important, both for the users of the financial statements and, indirectly, for the quality of the public revenues.

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EXPLORING GENDER PATTERNS IN AI ADOPTION FOR ACCOUNTING ESTIMATES. A MIXED-METHODS INVESTIGATION

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Abstract: *This study examines gender differences in the adoption of artificial intelligence (AI) for accounting estimates using a mixed-methods approach that combines statistical analysis with thematic interpretation. Data was collected from thirty semi-structured interviews with accounting professionals. Quantitative measures covering AI adoption intensity, technique diversity, and future expectations were analyzed using non-parametric tests and correlation mapping. These analyses found small to moderate gender effects that were statistically insignificant, reflecting considerable within-gender variation. The most notable quantitative finding was that men reported slightly higher perceived AI influence, while women used a broader range of AI techniques. Multiple Correspondence Analysis (MCA) mapped two main dimensions structuring attitudes, openness to AI integration (from traditional judgment to algorithmic support) and behavioral orientation (trust in AI versus algorithm aversion). These revealed distinct professional profiles, from strong acceptance to skepticism. Gender was associated with behavioral factors, including trust, perceived transparency, and openness to innovation. Qualitative findings further showed that women and men reached similar levels of openness to AI, but through different frameworks, women engaged more broadly with AI, emphasizing governance, ethics, and employment impacts, while men focused more on system capabilities and regulatory clarity. Overall, the mixed-methods design demonstrates that AI adoption for accounting estimates is shaped by technological perceptions, behavioral attitudes, and demographic factors, with gender differences manifesting in interpretive pathways rather than in overall adoption rates.*

Keywords: *artificial intelligence; accounting estimates; gender patterns; qualitative coding; MCA.*

JEL Classification: *M41; J16; O33*

1. Introduction

The integration of artificial intelligence (AI) into accounting estimates represents a burgeoning trend poised to profoundly reshape financial processes (Bunget and Trifa, 2023; Stoica and Ionescu-Feleagă, 2024; Morandini et al., 2023; Ștefan et al.,

2024). AI marks a pivotal milestone in the evolution of traditional business operations, notably within accounting (Arkhipova et al., 2024; Fülöp et al., 2022; Stoica and Ionescu-Feleagă, 2024). Its implementation promises enhanced efficiency, reduced error rates, and optimized utilization of both human and technological resources (Ahmad, 2024). Nevertheless, the adoption of AI is accompanied by considerable challenges, including a scarcity of specific competencies, employee resistance to organizational change (Ionescu and Barna, 2021), technical impediments, and heightened concerns regarding security and privacy risks (Zager et al., 2020; Banciu et al., 2023). Against this backdrop, scholarly inquiry examines the ways in which accounting professionals perceive and address these emergent challenges and opportunities.

Guided by the EU's Directional Consultation on AI in the Financial Sector (EU, AI Act, 2024), this study used interviews to gain detailed insights into accounting professionals' perceptions and experiences with AI in estimates. Interviews allowed for flexible, context-rich exploration of factors like technical barriers, training, resistance to change, and risk perceptions, as well as their connection to gender. This method also helped clarify sensitive issues such as aversion or hesitancy toward AI that might not surface in surveys (Qu and Dumay, 2011). Based on semi-structured interviews with thirty accounting professionals, this study examined AI use in estimation, covering training, resources, obstacles, aversion, risk perception, and adoption intentions. While AI is increasingly used in accounting, especially in judgment-intensive tasks like provisions estimation, impairment of assets and fair value assessment, adoption varies due to factors like data quality, uncertainty, and expertise. Individual factors, including gender disparities in training and role specialization, may influence adoption and perceptions of AI's impact. The study explores whether these gender differences are reflected in interview responses.

To fill the gap in literature, this work examines also gender-based patterns in adopting AI in accounting estimates. Using survey data, it explores how gender (I27) relates to key variables emphasis on AI advantages/risks (B4), importance of accuracy (C9), breadth of AI use in estimation domains (D10), perceived AI influence (D12), variety of AI techniques used (F17), application of advanced technologies (F18), self-assessed AI proficiency (F19), and perceived adoption obstacles (G22). The aim is to address how perception and behavior influence AI adoption in accounting. The study sought answers to the following questions:

RQ1: *How do accounting professionals perceive AI's role in accounting estimates?*

RQ2: *What behavioral and technological factors affect the adoption of AI-supported tools in estimation tasks?*

RQ3: *How do trust, transparency, and integration challenges shape attitudes toward AI?*

RQ4: *Are there gender-related differences in the perception and adoption of AI among accounting professionals?*

This paper includes a literature review along with the research framework, qualitative methodology, and participant selection. Findings are discussed, followed by conclusions, implications, limitations, and directions for future research.

2. Literature review and research framework

2.1. Literature review

Research shows AI is transforming accounting, improving forecasting and anomaly detection (Sutton et al., 2016; Kokina and Davenport, 2017; Appelbaum et al., 2017). However, algorithmic decision systems raise governance challenges (Issa et al., 2016; Moll and Yigitbasioglu, 2019). Furthermore, information systems studies indicate gender can influence how technology is interpreted, perceived, and discussed (Venkatesh and Morris, 2000; Gefen and Straub, 1997; Trauth, 2013). These differences are shaped by organizational culture, experience, and social factors. Gender-focused research proved that men and women may differ in their views on risk and ethics related to technology. Also, AI integration in accounting offers benefits like greater efficiency, accuracy, and decision support (Fülöp et al., 2025). Most accountants report positive impacts, but also raise ethical concerns over data integrity, job loss, and autonomy. Similar findings by Stoica and Ionescu-Feleagă (2024) note obstacles such as resistance to change and high costs. In Jordan, AI adoption improves data quality and disclosure (Al-Okaily, 2025). Moll and Yigitbasioglu (2019) highlight that internet technologies enhance financial transparency and reduce repetitive work, but accountants must adapt and governance issues need further study. Yang and Zhou (2025) found that AI adoption significantly improves accounting disclosure quality in Chinese companies, especially with greater corporate growth and better business environments. Bin-Nashwan et al. (2025) reported that AI, supported by strong data governance, enhances financial reporting accuracy and audit efficiency, also reducing information asymmetry. Monteiro et al. (2023) highlighted that intensive AI use and internal controls transform accounting information quality. Sutton et al. (2016) showed AI techniques are now key modules in audit decision systems, driving modern financial management. Issa et al. (2016) argued that auditing is well-suited for AI-driven automation, enabling professionals to focus on judgment and ethics, and predicted a shift to continuous, proactive audits. In the same research direction, Kokina et al. (2025) described how large audit firms use AI for data mining and natural language processing, but noted challenges such as transparency, confidentiality, reliability, and regulatory costs hinder broader adoption. Similarly, Zhang et al. (2025) found AI adoption in decision-making and performance management is driven by perceived usefulness and ease of use.

Recent studies have focused on AI adoption in audit processes (Sutton et al., 2016; Issa et al., 2016; Kokina and Davenport, 2017; Thottoli, 2024; Kokina et al., 2025; Bracci et al., 2026), but few directly address its use for accounting estimates (Bin-Nashwan et al., 2025; Abdallah et al., 2025). AI adoption for accounting estimates is more challenging due to their subjectivity, whereas audits are more easily formalized. Successful AI use depends on professionals' understanding of risks like bias and data ownership (Eisikovits et al., 2025), which can be mitigated through governance and ethical frameworks (Leong and Sung, 2024). Abdallah et al. (2025) found that both organizational and individual factors influence AI adoption, with organizational culture, ease of use, and regulatory support being especially important in the private sector. Gender plays a key role in technology adoption and should be included in diffusion models (Gefen and Straub, 1997). Venkatesh and Morris (2000) found that men adopt technology based on perceived usefulness, while women rely more on ease of use and social norms. Gefen and Straub (1997)

also reported women perceive more usefulness and men greater ease of use, though both use technology similarly. Trauth (2013) notes that skills, experiences, and social influences shape technology use. Song et al. (2026) observed men view AI errors as technical issues, while women see them as violations of social expectations. Examining gender differences in AI adoption for accounting estimates is a new area in literature. Thus, the current study integrates insights from accounting technology research and gender studies to explore how accounting professionals interpret the integration of AI in estimation processes, filling a gap in existing knowledge.

2.2. Research framework

This study frames AI adoption for accounting estimates as shaped by technology, organizational context, and professional interpretation. The framework brings together the Technology Acceptance Model (TAM), which emphasizes perceived usefulness and ease of use as key drivers (Davis, 1986, 1989; Ma and Liu, 2004), and research on algorithm aversion, showing that professionals may mistrust AI in judgment-heavy fields like accounting (Dietvorst et al., 2015). The model also incorporates gendered technology adoption (GTA) research, showing that demographic factors like gender can affect trust, risk perception, and confidence in digital tools. In this framework, gender acts as an antecedent, influencing perceived usefulness, ease of use, and trust in AI. These perceptions, in turn, inform the adoption of AI tools for accounting estimates, encompassing domains such as fair value estimation, impairment testing, and predictive financial analytics. As shown in Figure 1, the model proposes gender impacts perceived usefulness/relevance and ease/accessibility of use, both drive adoption, and algorithm aversion smooths the interaction between usefulness and adoption.

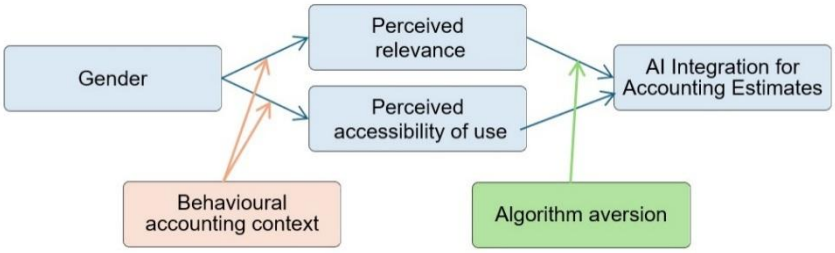


Figure 1: Research framework
Source: Authors' projection

Within this framework, gender is conceptualized as an antecedent variable that influences both the perceived relevance and perceived accessibility of AI tools use. These cognitive appraisals shape the adoption of artificial intelligence for accounting estimates, particularly in tasks that demand professional judgment, such as valuation, risk assessment, and predictive analytics. The model further integrates algorithm aversion as an agent, which may affect the extent to which perceived usefulness translates into the actual adoption/integration of AI technologies. Additionally, the broader behavioral accounting context is incorporated to recognize the influence of cognitive biases, professional judgment, and decision-making heuristics on technology acceptance among accounting professionals.

3. Methodology and participants

3.1. Methodology

This study uses a mixed-methods design, combining quantitative statistical analysis and qualitative thematic analysis. Thirty semi-structured interviews with accounting professionals were coded into structured variables reflecting AI adoption and influence. Key quantitative tools including point-biserial correlation, Mann-Whitney tests, and violin plot visualizations were used. Qualitative insights were drawn from thematic analysis of recurring narratives. Analyses were performed with Python tools, NumPy and Pandas for data structuring, Scikit-learn for dimensionality reduction and K-means clustering, and Matplotlib for figures such as the AI Integration Progress Map. Multiple Correspondence Analysis (MCA), implemented via singular value decomposition (SVD), was used to explore relationships among categorical variables (trust, transparency, integration challenges, decision quality) and reveal perceptual structures in AI adoption attitudes.

3.2. Participants profile

This study interviewed thirty Romanian accounting professionals, including economic directors, chief accountants, and financial managers. The sample shows diversity in professional experience, technological perspective, age, gender, education, and certifications. This range allowed analysis of how responsibility, training, and specialization relate to openness toward AI adoption. Most participants were aged 35–55 (73%), with 20% aged 25–35, and only one over 55. No participants were under 25. This focus on experienced professionals supports mature insights into technology adoption, while the younger group may drive innovation. Age diversity was limited, which may reflect broader employment trends (Humpert and Pfeifer, 2013). Of the thirty interviewees, twenty were women and ten were men, mirroring gender trends in accounting. This supports analysis of gender's role in AI adoption. Studies show technology can reduce barriers but may also create new risks for women (Olivetti et al., 2024; Deloitte, 2024; Singh et al., 2024). All participants reported their gender. The sample is highly educated, 41% hold master's degrees, 17% have postgraduate studies, 17% doctorates, and 7% postdoctoral experience. Professional credentials include 57% certified public accountants, 20% financial auditors, 37% tax consultants, 17% certified appraisers, and 13% liquidators. Job roles span leadership, academia, non-profit, and public sectors, providing broad expertise in accounting, auditing, taxation, and financial management.

4. Results

4.1. Descriptive statistics

Prior to investigating the associations between gender and AI-related indicators, descriptive statistics were calculated for all variables derived from interview coding. These indicators capture respondents' perceptions of artificial intelligence for accounting estimation, encompassing attitudes toward AI risks, perceived influence on estimates, range of AI techniques employed, and barriers to adoption. The analysis revealed substantial variability across these measures. Notably, perceived AI influence (D12) and diversity of techniques used (F17) exhibited considerable

dispersion, reflecting heterogeneous experiences with AI across organizational and professional contexts. Indicators assessing obstacles to adoption (G22) and concerns about the reliability of AI-generated estimates (C9) also showed moderate variability, suggesting diverse assessments of technological risks and implementation challenges. Collectively, the findings confirm that the sample includes professionals with varying levels of AI exposure, from initial awareness to advanced operational use, thus providing a robust empirical foundation for examining gender-related differences in perceptions and adoption patterns.

Table 1: Descriptive statistics

Variable	Mean	Median	Std.Dev	Min	Max	Skewness	Kurtosis
B4. AI aversion	0.33	0.0	0.96	0	4	2.87	7.11
C9. Reliability concerns	1.2	1.0	0.66	1	4	3.36	10.26
D10. Innovation perception	0.7	0.5	0.95	0	4	1.85	3.64
D12. Perceived future AI influence	3.39	4.0	0.92	1	4	-1.44	1.11
F17. AI technology diversity	0.7	0.0	1.15	0	4	1.86	2.57
F18. AI use examples	0.33	0.0	0.96	0	4	2.87	7.11
F19. AI tools effectiveness	3.03	3.0	1.03	0	4	-1.21	1.13
G22. AI obstacles	0.48	0.0	1.12	0	4	2.23	3.63

Source: Authors' projection

4.2. Correlation Matrix

To investigate potential associations between gender and interview-coded indicators of AI adoption and perception, point-biserial correlations were computed. As gender is coded as a binary variable, the point-biserial coefficient is mathematically equivalent to the Pearson correlation for dichotomous-continuous variable pairs. The resulting correlation matrix is presented in Figure 2.

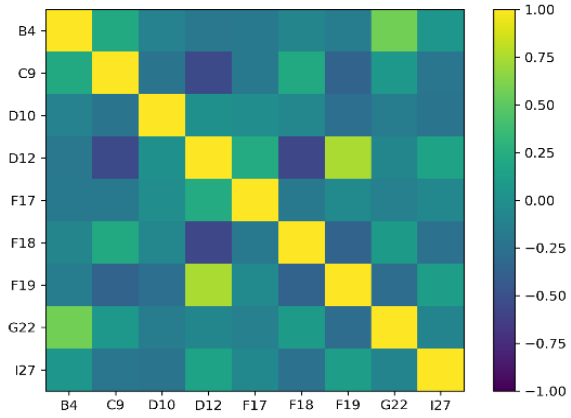


Figure 2: Correlation matrix
Source: Authors' projection

The correlation matrix reveals that most relationships between gender and AI-related indicators are weak. The strongest positive association is for perceived influence of AI on accounting estimates (D12) ($r \approx 0.16$), indicating that male respondents report slightly higher expectations regarding AI's transformative potential in estimation processes. Negative correlations are observed for innovation perception (D10) ($r \approx -0.23$) and reported AI use examples (F18) ($r \approx -0.25$), show that female respondents demonstrate somewhat greater practical engagement with AI tools and applications. The correlation for diversity of AI techniques used (F17) is negligible ($r \approx -0.06$), confirming minimal gender differences in operational exposure to AI technologies. Other variables show little or no association with gender, AI aversion (B4) ($r \approx 0.05$), reliability concerns regarding AI estimates (C9) ($r \approx -0.22$), self-assessed AI skills (F19) ($r \approx 0.12$), and perceived obstacles to AI adoption (G22) ($r \approx -0.10$). Overall, most coefficients indicate small effects, supporting the conclusion that perceptions of AI adoption are largely consistent across genders.

4.3. Mann–Whitney non-parametric tests, effect size estimation and bootstrapping validation

Given the small sample size and the ordinal nature of several interview-coded indicators, additional robustness checks were performed using Mann–Whitney U tests. This non-parametric approach assesses whether distributions of AI-related indicators differ significantly between female and male respondents without presuming normality. As shown in Table 2, none of the variables achieve conventional statistical significance ($p < 0.05$). The largest effect appears for F18 (reported AI use examples), showing a notable difference between gender groups, though statistical significance remains marginal due to sample size constraints. Moderate effects are observed for D10 (innovation perception) and F17 (diversity of AI techniques), indicating some gender-based variation in technological engagement. Basically, the findings reveal that gender differences in AI adoption indicators are limited and context dependent. Substantial overlap in response distributions also evident in violin plot analyses reveal that professional experience and organizational context likely exert greater influence than gender alone on perceptions of AI integration for accounting estimation. These results corroborate the general pattern observed in the correlation analysis, differences between gender groups are modest and fall short of statistical significance. Nonetheless, distributional comparisons indicate slightly higher median values for perceived AI influence among male respondents, while female respondents report somewhat greater diversity in AI techniques used. Thus, although gender does not yield strong statistical differences in AI adoption indicators, subtle variations in technological engagement and perception may persist.

Table 2: Statistical association between gender and AI adoption in AE

Variable	Mann–Whitney U	p-value	Rank-biserial effect size	Bootstrap 95% CI (mean difference)	Interpretation
B4. AI aversion	4.50	1.000	-0.13	[-0.72, 0.68]	Negligible association
C9. Reliability concerns	4.50	1.000	-0.13	[-0.61, 0.65]	Negligible association
D10. Innovation perception	6.50	0.396	-0.63	[-1.21, 0.37]	Moderate association
D12. Perceived future AI influence	5.00	0.633	-0.43	[-0.98, 0.54]	Small–moderate association
F17. AI technology diversity	6.00	0.502	-0.50	[-1.08, 0.43]	Moderate association
F18. AI use examples	0.00	0.063	1.00	[0.12, 1.75]	Large association
F19. AI tools effectiveness	3.50	1.000	0.13	[-0.63, 0.71]	Negligible association
G22. AI obstacles	4.00	0.755	-0.33	[-0.84, 0.49]	Small association

Source: Authors' projection

To enhance the interpretation of gender differences, rank-biserial correlation effect sizes were computed for the Mann–Whitney comparisons. Effect size analysis is particularly important in small samples, where statistical significance tests may lack sufficient power to detect differences. The rank-biserial coefficient estimates the strength of association between a binary variable (gender) and a continuous or ordinal outcome. Across the tested variables, effect sizes were generally in the small-to-moderate range, according to Cohen's (1988) conventional thresholds. Given the limited sample size (n = 30), bootstrap resampling was employed to assess the stability of the estimated gender differences, generating empirical confidence intervals through repeated resampling and recalculation of relevant statistics. Using 5,000 bootstrap iterations, confidence intervals were estimated for mean differences between female and male respondents across key AI adoption indicators. The bootstrap analysis corroborates the findings from the correlation and Mann–Whitney tests, most variables exhibit negligible to moderate effect sizes. The largest effect, observed for F18 (reported AI use examples), remains only marginally significant due to the small sample size. Bootstrap confidence intervals for most indicators include zero, indicating that observed differences lack statistical robustness. These results further support the conclusion that gender differences in AI adoption indicators are limited in this sample and that observed variations are more likely attributable to contextual or professional factors than to systematic gender effects.

4.4. Distribution of AI adoption scores. The violin plot

To illustrate the distribution of AI adoption perceptions by gender, a violin plot was generated using the composite AI adoption indicator from interview coding. This visualization integrates boxplot and kernel density features, capturing both central tendency and distributional shape. As shown in Figure 3, the distributions for female and male respondents overlap substantially, indicating that gender is not a primary determinant of AI adoption perceptions for accounting estimates. Considerable within-group variability exists, with both groups demonstrating a wide range of

attitudes toward AI technologies. However, male respondents tend to cluster slightly higher in perceived AI influence, while female respondents exhibit a broader range of reported AI techniques and operational engagement. These patterns align with previous statistical findings, reinforcing the conclusion that gender differences are subtle rather than deterministic.

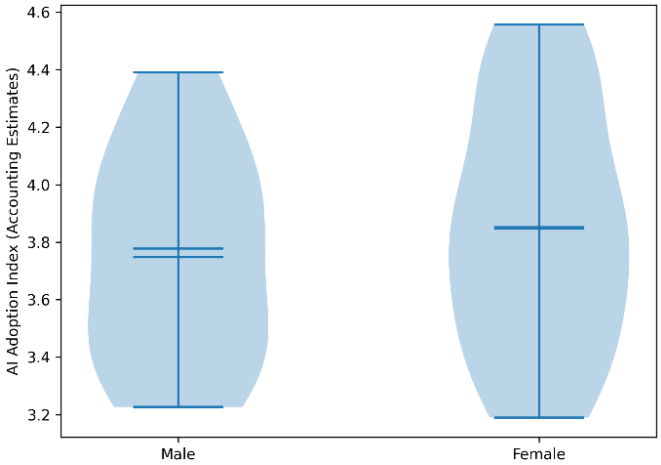


Figure 3: Distribution of AI adoption scores by gender
Source: Authors' projection

4.5. Multiple Correspondence Analysis (MCA)

To investigate the multidimensional relationships among AI adoption indicators, Multiple Correspondence Analysis (MCA) was employed. MCA is well-suited for analyzing categorical or coded qualitative variables and facilitates the visualization of relationships between respondents and variables in a reduced-dimensional space. The resulting MCA map, presented in Figure 4, delineates the perceptual structure of thematic attitudes toward AI adoption/integration for accounting estimation. The horizontal axis represents a continuum of AI integration progress, while the vertical axis captures behavioral orientations from algorithm aversion to greater trust in AI-assisted judgment. Respondents are depicted with gender-specific markers, and convex hulls delineate distinct adoption profiles within the sample. Directional vectors highlight the influence of key thematic drivers, including governance, technological capabilities, and behavioral perceptions of AI in accounting practice.

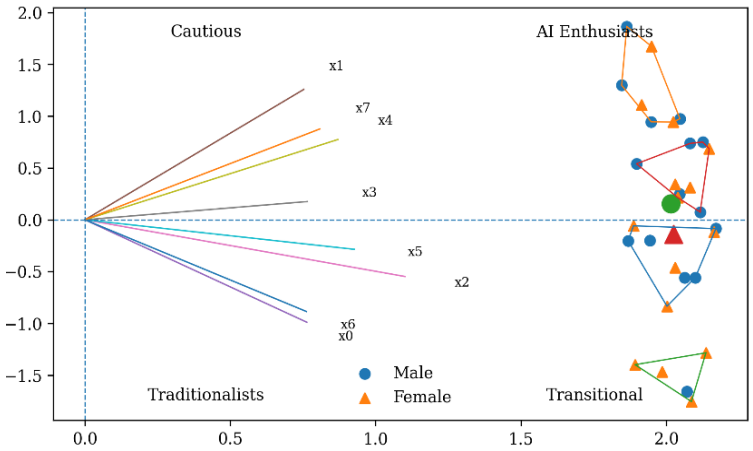


Figure 4: AI integration progress map in accounting estimation processes
Source: Authors' projection

The first dimension shows overall acceptance of AI for accounting estimates, those on the positive side embrace AI tools for efficiency and consistency, while those on the negative side prefer traditional judgment and are more skeptical of algorithms. The second dimension reflects trust in AI, upper quadrants indicate higher confidence in AI reliability, while lower quadrants show greater algorithm aversion. Together, these dimensions capture attitudes and psychological factors behind AI adoption in accounting. The AI integration progress map illustrates attitudes toward AI adoption in accounting. The horizontal axis shows the range from minimal to extensive AI use, while the vertical axis ranges from algorithm aversion to high trust in AI. Respondents are grouped into four conceptual adoption areas, AI enthusiasts (high trust and integration), Cautious adopters (see AI's potential but have transparency and ethical concerns), Transitional users (adopting AI but still use traditional methods), and Traditionalists (prefer conventional judgment and are skeptical of AI). These areas capture key drivers like trust, transparency, ethics, and perceive improvements in decision quality. AI enthusiasts are respondents who strongly align with themes of trust, enhanced decision quality, and seamless integration of AI tools. Cautious adopters recognize AI's analytical potential but harbor reservations concerning transparency and ethical issues. Traditionalists rely predominantly on conventional professional judgment and express heightened skepticism toward algorithmic decision support. Transitional users are professionals who are gradually adopting AI-supported analytical processes while continuing to use traditional methods. Cluster centroids further highlight distinct adoption profiles within the respondent population, underscoring the heterogeneity of attitudes toward AI integration for accounting estimation.

5. Discussion

This study aimed to determine whether gender is systematically associated with the adoption and perceived influence of artificial intelligence for accounting estimation processes. By integrating statistical analysis of interview-coded indicators with thematic interpretation, the research offers a nuanced perspective on how

accounting professionals perceive AI integration in estimation tasks. The findings indicate that gender is not a decisive factor in AI adoption among accounting professionals. Instead, gender appears to shape interpretive orientations toward technological change, while actual adoption patterns are primarily influenced by professional context, organizational environment, and individual exposure to digital tools.

5.1. Interpretation of statistical results

Statistical analysis shows gender differences in AI adoption indicators are generally small. Correlations between gender and variables like AI aversion (B4), reliability concerns (C9), self-assessed skills (F19), and perceived obstacles (G22) are weak, with no significant differences found in most cases. Bootstrap validation also supports this, suggesting observed differences are likely due to sampling variability. However, moderate effect sizes for D10 (perception of innovation) and F17 (diversity of AI techniques used) indicate that women may engage more broadly with AI, while men emphasize innovation, though these are not statistically significant. The largest difference found was for F18 (examples of AI use), where gender had a marginal effect, possibly reflecting differences in exposure to AI within organizations. These patterns align with Venkatesh and Morris (2000), Gefen and Straub (1997), Trauth (2013), and Song et al. (2026), who argue that technology perceptions are influenced more by professional role and context than by gender. Therefore, the results highlight the need to consider both general attitudes and specific experiences (like F18) when analyzing AI implementation for accounting estimates.

5.2. Interpretation of the MCA

Whereas statistical tests elucidate pairwise associations between gender and individual variables, *Multiple Correspondence Analysis (MCA)* provides a multidimensional perspective on AI adoption within the sample. The MCA map reveals several distinct profiles of AI adoption and perception, mirroring the thematic patterns identified in the qualitative interview analysis. These profiles reflect the diverse professional orientations toward AI integration for accounting estimation processes. The first two MCA dimensions serve as the axes for the perceptual representation in the AI integration progress map.

Dimension 1. AI integration progress. The horizontal axis principally reflects respondents' openness to adopting artificial intelligence for accounting estimation. Individuals on the positive side of this dimension perceive AI as a beneficial tool that enhances analytical capabilities, efficiency, and consistency in professional judgment. In contrast, those on the negative side rely more heavily on traditional judgment and express greater skepticism toward algorithmic decision support. Thus, Dimension 1 represents a continuum of AI integration progress in accounting practice.

Dimension 2. Behavioral trust versus algorithm aversion. The vertical axis captures behavioral attitudes toward algorithmic decision-making systems. Respondents in the upper region of the perceptual space exhibit higher levels of trust in AI-assisted tools, whereas those in the lower region display characteristics of algorithm aversion, indicating reluctance to rely on automated recommendations in professional judgment contexts. This behavioral dimension is especially relevant in accounting, where professional judgment and accountability are central to decision-making.

5.3. Gender patterns across adoption profiles

This study aimed to identify gender differences in AI adoption within accounting estimation. Gender was analyzed using Multiple Correspondence Analysis (MCA) to visually compare male and female respondents' positions in the perceptual space of AI integration and trust. Gender differences in technology adoption are well documented (Venkatesh and Morris, 2000; Gefen and Straub, 1997; Trauth, 2013; Song et al., 2026). Drawing on the *Technology Acceptance Model (TAM),* perceived usefulness and ease of use may affect adoption differently by gender. Other studies emphasize the roles of perceived risk, trust, and digital experience in shaping adoption patterns while research on algorithm aversion highlights how transparency, accountability, and error tolerance influence responses to automated systems. The MCA perceptual map reveals that, although there are no sharply defined gender clusters in AI adoption profiles, subtle patterns are evident. Male respondents are somewhat more concentrated in regions associated with strong beliefs in AI's transformative potential and innovation, whereas female respondents are more widely distributed across profiles emphasizing operational and exploratory uses of AI. Statistical analyses reinforce these observations, men typically anticipate a greater degree of change from AI, while women tend to report more diverse, hands-on engagement with AI tools in practice. Importantly, these trends do not reflect differences in technological competence or readiness but rather illustrate the distinct ways each gender interprets and interacts with AI adoption in accounting. These nuanced differences highlight the need to consider both innovation perspective and practical experiences when examining gendered approaches to AI integration.

6. Conclusion and implications

This mixed-methods study explored gender differences in the adoption of AI among thirty accounting professionals, with twenty women and ten men participating. Women were more represented and generally more willing to take part, reflecting a strong social context influence. The research found some moderate gender differences, women reported greater perceived innovation and used a wider variety of AI techniques, but these differences were not statistically significant. Across most measures including concerns about AI reliability, reluctance to adopt AI, perceived self-effectiveness, and perceived obstacles, men and women showed minimal variation. The findings revealed that, while there are some nuanced, context-dependent differences, overall professional attitudes toward AI risks, reliability, and barriers do not significantly differ by gender in the accounting field. This highlights the importance of considering social context and individual experience over broad gender-based assumptions when integrating AI into professional practices.

Analysis of perceived future AI influence on accounting estimates showed a small-to-moderate, but not statistically significant, difference, with men slightly more likely to view AI as transformative. This observed difference may be due to sampling variation, not a consistent gender pattern. A greater difference appeared in reported examples of AI use, showing variability in how respondents mention AI applications, though this also approached only marginal statistical significance. Due to the small, unbalanced sample, these findings should be interpreted cautiously. Altogether, the study found only selective, context-dependent gender differences in AI engagement, with no significant differences in perceptions of risk, reliability, or implementation barriers. Gender does not appear to be a primary determinant of AI adoption for

accounting estimates, though it may influence how professionals frame AI's role in innovation and practice. Core professional attitudes toward AI remain consistent across genders.

The main contribution of the study relies on the qualitative analysis (MCA) which shows women in accounting emphasize ethics, social responsibility, and organizational safeguards in AI adoption, often focusing on data security, accountability, and workforce impact. Their support for AI depends on transparency and proper controls. Men, however, tend to focus on technical integration, system reliability, and operational control, stressing concerns like cyber-vulnerability and the need for strong regulatory frameworks. While both genders consider ethics, women prioritize social impact and responsibility, while men emphasize reliability and technical aspects. The mixed-methods approach reveals that, while gender has little statistical impact on AI openness, women and men interpret AI adoption differently. Women's openness is tied to governance, ethics, and employment issues, whereas men's is linked to technical reliability and system capabilities. Rather than indicating one gender is more for AI adoption than the other one, the findings show that gender shapes the interpretation of AI's usefulness, trust, and ease of use. For women, trust and professional responsibility are significant while for men, system transformation and reliability matter most. These differences prove that effective AI adoption in accounting needs both technical training and governance-focused measures to address the distinct concerns of each gender.

In summary, gender shapes how AI is adopted for accounting estimates, more than it affects overall adoption rates. Men see AI as transformative, while women engage more with AI tools and focus on ethics, data protection, and responsibility. These differences reflect distinct adoption logics, not outright gender opposition. AI adoption is a complex process influenced by trust, accountability, and experience. Analysis shows two main dimensions, openness to AI and attitudes like trust versus skepticism. Gender interacts with these behavioral factors, highlighting that AI adoption involves technology, behavior, and demographics. The study also contributes to research by introducing a new framework using correlation analysis and mapping to visualize different professional approaches to AI adoption. Nevertheless, this study's insights into AI adoption for accounting estimates are limited by a small, context-specific sample, reducing generalizability. The use of exploratory methods identifies patterns but not causal links, and self-reported data may not reflect actual AI use. Gender results should be interpreted cautiously since the focus is on perceptions, not proven skill differences. Future research should use larger, more diverse samples to examine if these findings apply broadly. Longitudinal and experimental work could show how attitudes and actual AI use change over time. Research should also examine how explainable AI affects trust and adoption, and develop frameworks that combine technological, behavioral, and organizational perspectives to better understand AI's impact on accounting estimates and professional judgment.

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THE IMPACT OF IDENTIFYING CONCEPTUAL TRENDS IN SUSTAINABILITY, PERFORMANCE AND GOVERNANCE RESEARCH USING BIBLIOMETRIC TECHNIQUES

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Abstract: *This research paper aims to analyze the impact and existence of sustainability reporting in the context of sustainable development goals between international requirements and national accounting practices. Thus, the study involved an analysis from two perspectives: 1) a systematic literature review to identify, select and critically evaluate relevant research from the period 2015-2025 and 2) a bibliometric analysis that involved an extraction and highlighting of the most suggestive references collected from the Core Web of Science collection database, using the similarity visualization program (VOS), during the period 2015-2025. This approach involved a comprehensive search and selection of all potentially relevant articles following the use of explicit and reproducible criteria in selecting articles for the proposed analyses. International agreements such as the 2025 Paris Agreement on Climate Change and strategies such as the EU Taxonomy, as a standard governing environmental sustainability within the EU, have stimulated the development of tools for determining. Governance is proxied by the Worldwide Governance Indicators. The impact of sustainability and performance has become a focal point in entrepreneurial frameworks, influencing startups, venture capital and innovation, and the record number of publications in 2023 and 2025 underlines its transition from a niche academic interest to a global economic and political imperative, while also reflecting the intersection with fields such as economics, environmental science and public policy, which have attracted diverse contributions to research. The results of the bibliometric analysis reveal a significant increase in the number of studies, including policy decisions and increased researcher interest, in the field of accounting between 2015 and 2025. These analyses provide insights into the evolution and progress of sustainable development and identify key themes, notable authors, institutions and geographical regions that have influenced academic research. The main findings highlight that corporate social reporting and performance has matured as a research field, with increasing thematic convergence around the integration of policies, performance indicators and innovation.*

Keywords: *corporate sustainability; financial performance; sustainability; corporate social performance; corporate environmental performance.*

JEL Classification: *Q5; H11; F64*

1.Introduction

This study aims to examine the academic literature on the perception and existence of performance and governance indicators at the national and international levels

through a bibliometric analysis in the field between 2015 and 2025. In addition, the paper will explore how the literature contextualizes the impact of the sustainable development goals between international requirements and national accounting practices in a paradoxical framework. It will also analyze how fiscal policies can contribute to achieving sustainability goals, given the importance of integrating them into financial digitalization policies to support performance, determination, sustainable management.

Furthermore, given the importance of integrating sustainability objectives into financial digitization and digital transformation policies, we focused on how tax policies can contribute to achieving sustainability objectives. Thus, to guide this bibliometric analysis, we focused on the following research questions: i) how is the collaboration network structured between researchers and institutions active in accounting practices, identified through the bibliometric analysis, and which are the main actors and research centers that influence the direction and impact of research in this field, ii) to what extent does the bibliometric analysis of publications on governance and performance highlight an integration of digital transformation concepts and tools and what are the potential synergies and research opportunities that arise from combining these two fields.

The current state of the literature highlights the growing role of accounting, sustainability policies and performance in achieving the Sustainable Development Goals in the Member States of the European Union. Therefore, bibliometric analysis is a comprehensive tool for identifying changes in sustainability and sustainability research. This approach is supported by Ozili (2022), who provides a comprehensive review of the finance literature and highlights the importance of bibliometric methods in clarifying the evolution and fragmentation of the field.

The Sustainable Development Goals between international requirements and national accounting practices represent a dynamic and increasingly critical dimension of sustainable economic development. It connects financial markets with sustainability goals, performance and encourages investment, renewable energy and infrastructure. The urgency of addressing climate change, combined with international commitments such as the Paris Agreement and the United Nations Sustainable Development Goals (SDGs), has accelerated its relevance in academic research and policy planning (Ma and Chang, 2023; Daoulhadj and Hussin, 2023, Liu and Wu, 2023) and also highlights the increasing integration of finance into sustainability reporting and ESG performance frameworks, increasing their influence on regulatory practices and investment behavior.

In the following, we present the Sections: Section 2 reviews the Literature Review, Section 3 displays the Data and Methodology, Section 4 reveals the Results, and Section 5 concludes.

2. Literature review

The impact of the use of the Sustainable Development Goals has begun to gain momentum in recent years, so we set out to explore its evolution within the framework of a bibliometric analysis. The aim is to map the existing research landscape, to highlight the researchers, entities and regions with the greatest impact and to assess the impact of corporate social reporting, sustainability on different sectors. The study aimed to provide a comprehensive overview of how performance, sustainable development and sustainability have been integrated into

accounting policies at national and international levels, while identifying gaps and future research directions. The Sustainable Development Goals can contribute to financial stability in the following ways: by diversifying investment portfolios, encouraging long-term investment perspectives and reducing financial risks related to legislative changes. In addition to promoting financial stability, the Sustainable Development Goals directly support economic and social sustainability by promoting sustainable business practices and based on the legislation in force.

Several authors argue that the implementation of the Sustainable Development Goals at the international level is a way of socio-economic development in order to have unitary practices. Nowadays, there is an increasing emphasis on performance, especially after the approval of the SDGs in 2015, similar to the Paris Agreement. Our country joined the other 192 UN member states at the Summit held in September 2015, where the 2030 Agenda for Sustainable Development was adopted, a global action program in the field of environmental, economic and social development, aiming to promote balance between the three dimensions of sustainable development. The program is addressed equally to developed and developing countries. The 2030 Agenda presents the 17 Sustainable Development Goals (SDGs), informally united under the name of Global Goals, with the help of which an action agenda is established for the next 15 years in order to eliminate extreme poverty, combat inequalities and injustice and protect the planet by 2030: i) no poverty, ii) no hunger, iii) good health and well-being, iv) quality education, v) gender equality, vi) clean water and sanitation, vii) affordable energy, viii) decent work and economic growth, ix) industry, innovation and infrastructure, x) reduced inequalities, xi) sustainable cities and communities, xii) responsible consumption and production, xiii) climate action, xiv) life below water, xv) life on land, xvi) peace, justice and effective institutions, xvii) partnerships to achieve the goals.

The aim of Kuzei C. and Uyar A. (2017) is to investigate the factors influencing (1) sustainability reporting based on the Global Reporting Initiative, (2) the adoption of assurance statements in sustainability reports, and (3) the implementation levels of sustainability reports. Furthermore, the paper examines whether sustainability reporting is value relevant or not, based on the sample provided by 297 Turkish companies listed on Borsa Istanbul. The findings revealed a growing awareness of sustainability reporting based on the Global Reporting Initiative and a trend towards improving the quality of reports. Using the database of ten formulated hypotheses, the empirical evidence produced significant results, which explain the determinants behind sustainability reporting. Furthermore, the results confirmed that sustainability reporting is relevant in terms of its value.

3. Data and Methodology

Bibliometric analysis is used by researchers to highlight the quality and impact of publications in the academic environment, being a real support in analyzing the various social and intellectual aspects of research. If we are to define the term governance, Worldwide Governance Indicators is the most important source, although some studies sometimes exceed the definitions provided by this database. During the analysis process, Web of Science highlighted 1006 academic documents on the topic of our research for discussion. In order to create maps and have an overview of all possible documents to analyze, all bibliographic data were loaded into the R-Bibliometrix application.

The application was developed using R software, using several R-Bibliometrix features: (1) security; (2) authors; (3) affiliations; (4) countries; (4) documents and references; (5) keywords; and (6) conceptual structure. In order to have the clearest possible evidence and the widest possible scientific mapping, the construction of bibliographic data networks with different visualization approaches is considered: conceptual structure, maps and scientific networks, as shown in Figure 1.

Figure 1: Processing steps taken



Source: Authors' own compilation using SmartDraw software and the R-software, Package 'bibliometrix

The workflow specific for science mapping is based on five steps, as presented in Figure 2.

Research framework	*The design of the study*
	Data collection
	The analysis of data
	Data visualization
	Interpretation of the results

Source: Compilation by the author with the R tool – Bibliometrix

In conducting the research, the choice of bibliometric methods is considered by going through the most important steps: (i) selecting the knowledge base and the conceptual framework of the problem or field of study (ii) examining the conceptual framework (or research front) of the research; (iii) creating a social network structure.
The data collection process consists of two steps. Although, this stage may involve creating your own databases. First, the bibliographic data were derived from a comprehensive and popular academic database - Web of Science Core Collection. WOS Core Collection considers numerous studies, documents, journal articles published by researchers. The keywords in this analysis were in principle: "governance*" AND "performance". With the help of viewing these documents, it was possible to extract, visualize and map the numerous details analyzed by the researchers. Last but not least, the interpretation of results includes the stage in

which the results are interpreted in a logical structure, taking into account the different types of analysis and the various units of measurement of the analysis.
In this paper, we have used the most practical approaches to facilitate the connection between the research purpose and objectives as much as possible. We have conducted a bibliometric analysis, based on which we have developed the specialized literature. The bibliometric relationships between key concepts have been illustrated in VOSviewer.
Given the multifaceted objective of this research, to map thematic, conceptual and institutional developments in research on performance, determination and the bibliometric perspective between 2015 and 2025, while also discovering its evolving alignment with sustainability, this research adopts a structured bibliometric approach. In doing so, it also aims to explore how the sustainable development goals are situated within a paradoxical framework that balances economic growth with ecological responsibility and to what extent digital transformation tools and policies are integrated into the discourse.
This research considers productivity indicators, impact, the number of citations a paper receives and existing collaborations. Therefore, bibliometric analysis is a quantitative method used by researchers to deepen their understanding of a field of study by quantifying and visualizing research trends, knowledge structures and collaboration networks.

4. Results

Various analyses were applied using R-Bibliometrix and the Shiny application, processing 1,006 documents from the Web of Science to explore the importance and current knowledge on performance, sustainability. Visualized through scientific mapping and graphical methods, the results highlight key findings, such as significant networks of scientific collaboration. The analysis also includes detailed results covering scientific production from 2015 to 2025, including the most relevant and frequently cited sources, influential publications, prolific countries and productive researchers. The following sections present and discuss the results using data visualization tools to illustrate the conclusions.
Between 2015 and 2025, the scientific community generated 1,006 research papers, with contributions cited in each year analyzed. This period reflects a growing interest in performance and sustainability, especially in 2024 and 2025, which recorded the highest production, with 125 and 213 publications respectively. The increased number of publications that considered the topic of determining performance in the most recent period, 2023 and 2025, reflects the increasing importance given to sustainability factors in economic and sustainable development processes at a global level. International agreements such as the 2025 Paris Agreement on climate change and strategies such as the EU Taxonomy, as a standard governing environmental sustainability within the EU, have stimulated the development of tools for determining governance.
In Figure 3 we note that the prominence of terms such as “performance”, “determination” and “governance” in recent research reflects a strategic focus on using performance as a lever for both economic and environmental transformation. The terms reflect key themes that frame the sustainable development goals, accounting policies as an evolutionary, policy-based mechanism that aims to support sustainable development by creating institutional frameworks that support

sustainable investments. “Sustainability” reflects the adaptations needed in accounting and policy systems to support accounting programs through new initiatives.



Figure 3 Word cloud with important terms used in documents in the period 2015-2024
Source: Compilation created by the author with the R tool – Bibliometrix in processing data extracted from the WoS database

Regarding the correlation between keywords, authors and co-authors' country, the results are highlighted in Figure 4.

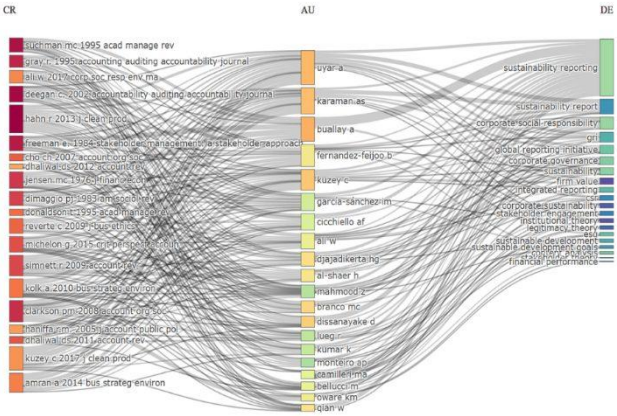


Figure 4. Conceptual structure according to keywords
Source: Compilation by the author with the R tool – Bibliometrix

Keyword clustering indicates thematic groupings where certain keywords are often associated with the same group of authors; countries and journals. For example; these keywords appear frequently in publications by Karaman As; Buallay A; reflecting the global emphasis on the importance of sustainability reporting.
Regarding the relationship between keywords and articles published in journals during 2015-2025, the results are highlighted in Figure 2. The interdependence between the terms, the themes debated in the articles is noted in the figure below, several prominent points called nodes with the titles ",, J Bus Ethics",,, J Clean

Prod",,, Corporate Social Responsibility Environment",,, Bus Strategy Environment",,, Account Audit Accounting".

Also, figure no. 5 exemplifies in more detail the four clusters that are formed within the bibliometric analysis, using the keywords in the journals / magazines published according to the impact created and the existing citations. In the first quadrant we have "corporate social responsibility" 45%, "performance" 46%, "determination" 37% marked with the green node. Also in the first quadrant the node is marked with red "corporate social responsibility" 15%, "disclosures" 19%, "performance" 13% which highlights the impact that these keywords and themes have been addressed in the existing publications. In quadrant no. 3, marked with purple, we highlight "determination" 19%, "corporate social responsibility" 11%, "governance" 22% and in blue the combination of "corporate social responsibility" 27%, "determination" 32%, "performance" 28%.

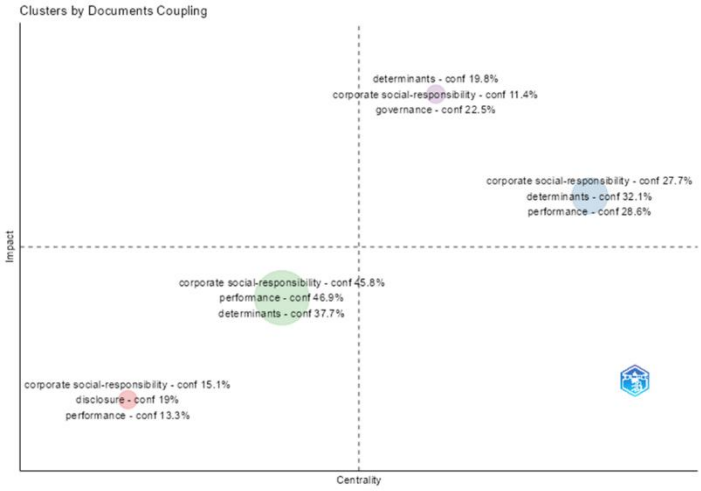


Figure 5. Conceptual structure according to keywords
Source: Compilation by the author with the R tool – Bibliometrix

The research aimed to identify the most frequently used group of three words that are highlighted very often in the documents. Figure 6 shows the most frequently used combination of words, having a high frequency and being observed in areas of interest, such as the obligation to comply with the development of sustainability reports by entities, transparency and their impact on good management and the elimination of risks of non-compliance with the legislation in force, namely "corporate social reporting" (frequency 560) and "performance" (frequency 305), "determination (245), "governance" (219), "impact" (206) and management, including compliance with accounting policies with many important pairs such as: "management" (frequency 185) and "quality" (149), and "accounting" with a frequency of 54.

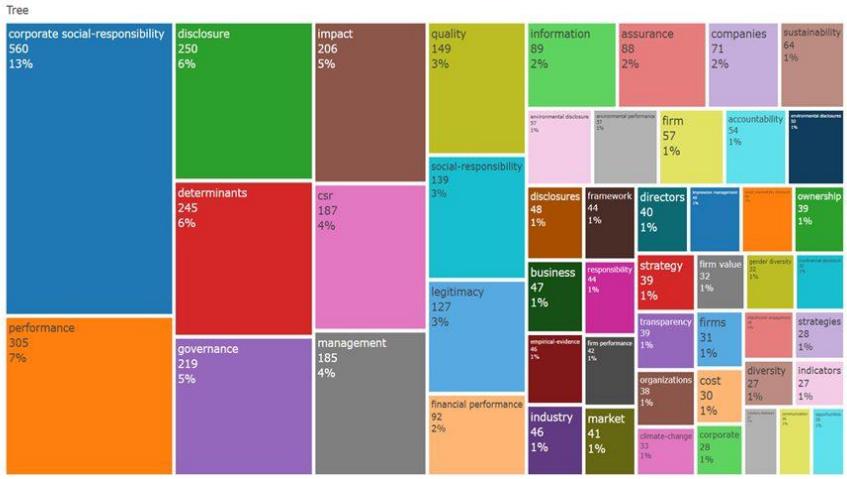


Figure 6 The most used combination of words
Source: R-Bibliometrix

Taking into account the number of citations and the number of published articles, the most representative word combinations, the key terms used in the works, were highlighted. Regarding possible links between countries, 2188 studies are highlighted that mark the existing relations between the analyzed countries.

5. Conclusions

Our analysis considered a scientometric mapping, taking into account the relationship between governance and performance indicators related to the 1006 documents published between 2015 and 2025 according to the bibliometric analysis. The research methodology considered a bibliometric analysis carried out in the R tool, namely Bibliometrix, using the Rshiny application.

Starting from the analysis in our research of the country-level/macro level, namely the alignment of states in ESG reporting with the SDGs, we recall here that the convergence between international requirements and national practices is considered a gradual, interactive process of aligning all local standards - especially in accounting (IFRS), auditing and corporate governance - with global norms in order to increase comparability, transparency and investment. These directives are intended to mitigate institutional differences, reduce regulatory arbitrage and strengthen financial stability. Sobrinho L (2023) in his work analyzes the convergence between international normative instruments, such as the Chicago Convention, and the domestic legal practice of states, focusing on the Brazilian case. The research adopts a qualitative and documentary approach, investigating how international regulatory frameworks are internalized, applied and interpreted by national institutions, especially the judiciary. The results highlighted that, despite formal adherence to the treaties, challenges persist in terms of compatibility between international standards and national jurisprudence, as well as in overcoming technical and institutional gaps. The conclusion highlights the need for more robust mechanisms for regulatory harmonization, institutional capacity building and articulation between different levels of governance, as a condition for

effective legal and operational security in the airline industry. Following the analyses carried out by the researchers, we note that at the macro level it is explained in which context companies can align and adopt ESG reporting, regulatory pressure and harmonisation between countries, and at the micro level the concrete institutional effect on their performance is analysed.

This study used bibliometric analysis to answer the research questions: mapping collaborative structures, identifying conceptual. In addition, the study aimed to examine how the literature frames performance and sustainability in a paradoxical framework and to what extent current research addresses this issue. A final research question explores how the literature on performance and corporate social reporting identifies and reflects critical gaps and limitations in the practical implementation of sustainable development mechanisms, especially in terms of geographical disparities, policy inconsistencies, or institutional misalignments. Together, these questions guide a comprehensive bibliometric approach that not only highlights the evolution of academic output on performance, but also uncovers opportunities for future research at the intersection of determination, sustainability, and digital transformation. As long as the influence of the political factor exists in the economic decision-making of a country and has increased significantly, future research should also analyze different national strategies to highlight best practices and strategies that improve governance systems.

As an overall conclusion, the analysis highlights the fact that governments must support innovation, technology, digitalization, and the long-term strategy for improving the system for developing governance indicators through the decisions they make. The results of the bibliometric analysis reveal a significant increase in the number of studies, including policy decisions and increased interest from researchers, in the field of accounting between 2015 and 2025. These analyses provide insights into the evolution and progress of sustainable development and identify key themes, notable authors, institutions and geographical regions that have influenced academic research. The main findings highlight that corporate social reporting and performance has matured as a research field, with a growing thematic convergence around the integration of policies, performance indicators and innovation.

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FROM VOLUNTARY TO STANDARDIZED: THE METAMORPHOSIS OF SUSTAINABILITY REPORTING UNDER ESRS AND ISSB

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Abstract: *Sustainability reporting has undergone a fundamental structural transformation, shifting from fragmented, voluntary frameworks—long dominated by the Global Reporting Initiative—toward rigorous, standardized, and increasingly mandatory regimes. This evolution has been crystallised by the parallel emergence of two landmark regulatory architectures: the European Sustainability Reporting Standards, developed by the European Financial Reporting Advisory Group under the Corporate Sustainability Reporting Directive (Directive 2022/2464/EU), and the IFRS Sustainability Disclosure Standards (IFRS S1 and IFRS S2), issued by the International Sustainability Standards Board under the auspices of the IFRS Foundation. Although both regimes share the overarching objective of enhancing corporate transparency and comparability, they embody fundamentally divergent conceptions of materiality. While the ISSB adopts an investor-centric single-materiality lens focused on sustainability-related financial risks affecting enterprise value, the ESRS codifies a double-materiality paradigm that requires undertakings to report both on how sustainability matters affect them and on the impact of their operations on society and the environment. This paper conducts a comparative documentary analysis of the ESRS and ISSB regulatory texts, employing qualitative thematic coding to systematically map disclosure mandates, classify structural variations in materiality definitions, and assess the degree of thematic and structural alignment between the two frameworks. The analysis explicates the power dynamics and institutional tensions that shape this contested regulatory arena—particularly the EC/EFRAG's stakeholder-inclusive stance versus the IFRS Foundation's market-oriented orientation—and evaluates the operational implications for firms, especially multinational enterprises operating across both jurisdictions. Preliminary findings reveal a measurable degree of structural interoperability, especially in climate-related disclosures, yet persistent methodological heterogeneity in governance, double-materiality assessment processes, and value-chain data aggregation.*

Keywords: *Sustainability reporting; ESRS; ISSB; double-materiality.*

JEL Classification: *M41; M42; Q01*

1.Introduction

The landscape of non-financial disclosures has shifted from voluntary frameworks to rigorous, standardized regimes, driven by the emergence of the European

Sustainability Reporting Standards and the International Sustainability Standards Board (Carungu et al., 2025; Elidrisy, 2024). This transition reflects a global shift where sustainability reporting has moved from a peripheral compliance activity to a strategic imperative for long-term value creation (Elidrisy, 2024). Historically, the reporting environment was characterized by fragmented, voluntary initiatives that lacked the consistency needed for reliable market assessments (Münch et al., 2025). The initial development of these early frameworks, such as the Global Reporting Initiative, established a foundational discourse on corporate responsibility, yet the subsequent emergence of the ISSB in 2021 signalled a definitive pivot toward standardized, auditable metrics. Concurrently, the European Union established the Corporate Sustainability Reporting Directive, tasking EFRAG with developing the ESRS to formalize rigorous, mandatory disclosures within the European market (Rimmel et al., 2025). While the ISSB prioritizes an investor-centric model focused on financial materiality, the ESRS adopts a unique "double materiality" perspective, requiring disclosures on both financial risks and the company's broader impact on society and the environment (Carungu et al., 2025). This fundamental divergence in materiality scope highlights the tension between seeking a global baseline for financial comparability and addressing the localized, multifaceted demands of European stakeholders (Dimes & Molinari, 2023; Rimmel et al., 2025). Consequently, this research aims to analyze the practical implementation challenges firms face when reconciling these distinct frameworks, particularly regarding the harmonization of impact-based versus finance-focused disclosures (Altınay & Sardoğan, 2025). By systematically mapping thematic and structural alignment between these mandates, this study evaluates the degree to which current interoperability initiatives can bridge the gap between ISSB's financial focus and the comprehensive reporting requirements of the ESRS (Molnár et al., 2025). Furthermore, this comparative analysis assesses the extent to which these regulatory architectures facilitate consistent corporate transparency, identifying potential methodological inconsistencies that may hinder cross-jurisdictional comparability (Dunfjäll, 2025). Ultimately, this research seeks to determine whether the pursuit of global standardization through these initiatives can effectively harmonize regional particularities with international financial reporting goals (Ionescu-Feleagă & Olteanu, 2025). By examining the power dynamics and institutional struggles inherent in the standard-setting process, this paper clarifies how these competing governance models shape the future of corporate accountability (Carungu et al., 2025). Ultimately, these developments necessitate a critical exploration of the regulatory interplay between the IFRS Foundation's global initiatives and the EU's legislative objectives, which collectively redefine the boundaries of corporate transparency (Carungu, 2025; Villiers et al., 2022). Specifically, this examination scrutinizes the inherent tension between the ISSB's focus on financial materiality and the EU's mandate for double materiality, a conceptual bridge deemed essential for achieving the goals of the European Green Deal (Afolabi et al., 2023; Carungu et al., 2025) as these frameworks move toward institutional maturity, understanding their interoperability becomes critical for mitigating regulatory fragmentation and enhancing global accountability (Matacera et al., 2024).

2.Literature Review

Historically, academic discourse has navigated the dichotomy between voluntary sustainability disclosure, long championed by the Global Reporting Initiative, and the emergent shift toward mandatory, integrated reporting regimes (Songini et al., 2023). While early voluntary frameworks were primarily utilized to enhance public image and corporate transparency, recent scholarship highlights that these legacy systems often suffered from significant disparities due to heterogeneous institutional ecosystems (Avram et al., 2025). Scholars increasingly argue that such voluntary paradigms lack the necessary enforcement mechanisms to ensure data comparability, prompting a regulatory migration toward the mandatory disclosure requirements codified under the CSRD and ESRS frameworks (Nicolò et al., 2025). Conversely, advocates of voluntary systems emphasize that flexibility allows firms to tailor reports to specific industry contexts, yet empirical evidence suggests this approach fails to mitigate information asymmetry for institutional investors (Gesso & Lodhi, 2024). Furthermore, comparative studies suggest that the absence of harmonized rules across these regimes currently forces firms to navigate diverging approaches to disclosure, complicating the assessment of third-country equivalence. These recent legislative shifts underscore an ongoing contest regarding the definition of materiality, where scholars remain divided on whether the ISSB's single-materiality focus and the ESRS's double-materiality requirement are fundamentally incommensurable or merely complementary approaches to corporate accountability (Raith, 2022). While the ISSB prioritizes information relevant to enterprise value and financial decision-making, the EU mandate extends this scope to encompass the significant environmental and social impacts of corporate activities (Lungu et al., 2025). This fundamental divergence in materiality reflects a deeper philosophical divide regarding the core purpose of corporate disclosure, pitting the goal of shareholder value maximization against a broader mandate for stakeholder accountability (Raihan & Sarker, 2026). In this theoretical context, legitimacy theory posits that firms adopt these reporting standards to align with evolving social norms, while stakeholder theory emphasizes the necessity of addressing the diverse informational requirements of entities beyond traditional investors (Mangiuc & Kagitci, 2025). Empirical analyses of the CSRD have demonstrated that such mandatory transparency measures can positively influence organizational legitimacy and long-term financial performance, although these outcomes are often mitigated by a firm's specific financial constraints (Talha, 2026). Comparative research further illustrates that multinational enterprises often encounter a strategic trade-off, balancing the adoption of investor-focused global standards against local sustainability mandates to secure both capital market clarity and regional operational legitimacy (Cao, 2025). Beyond these structural tensions, the shift toward mandatory frameworks serves as a natural experiment for examining the performance relationships that emerge when voluntary discretion is replaced by standardized, compulsory disclosure (Kim & Yang, 2026). As auditors navigate these regulatory requirements, recent findings indicate that technical expertise and the management of legal uncertainties remain critical bottlenecks in the transition toward robust sustainability assurance (Dumitru, 2025). Moreover, the move toward mandatory assurance protocols aims to address long-standing challenges in verification, though the inherent lack of standardized practices for double materiality assessments complicates the ability of auditors to provide consistent, high-quality disclosures (Alberto et al., 2025; Morales et al., 2025). Furthermore, the legislative move to

integrate sustainability information directly into the management report signifies that such data is no longer peripheral, but rather a core component of a company's financial planning (Bernini & Rosa, 2023). This institutionalization of non-financial data suggests that previous reliance on voluntary reporting frameworks often failed to embed sustainability metrics into internal decision-making processes, thereby limiting the efficacy of earlier corporate governance models (Mio et al., 2020). Consequently, the transition toward mandatory regimes seeks to correct these internal deficiencies by compelling firms to align their strategic operations with sustainability goals, rather than merely engaging in symbolic disclosures to manage reputation (Meqbel et al., 2025). Empirical evidence suggests that such substantive shifts in reporting requirements are essential for fostering genuine organizational change, as previous voluntary practices often resulted in decoupling, where firms utilized disclosures as a "smoke and mirrors" tool rather than a vehicle for internal reform (Zampone & Guidi, 2024). Furthermore, the emergence of these prescriptive standards introduces a risk that firms may inadvertently neglect sustainability topics deemed immaterial by standard setters, potentially prioritizing resource allocation toward reportable indicators at the expense of broader, holistic impacts (Göttsche et al., 2025). This tension underscores the inherent trade-off between achieving high levels of comparability through standardization and the risk of induced firm behaviors that may not align with broader societal objectives (Christensen et al., 2021).

3.Methodology

This study employs a comparative documentary analysis of the ESRS and ISSB regulatory texts, utilizing qualitative thematic coding to categorize disclosure mandates and assess structural variations in materiality definitions. Through this coding process, the analysis delineates the nexus between the ISSB's financial-centric reporting, which leverages established industry-based standards, and the EFRAG's more complex, dual-perspective mandate (Korca et al., 2023). This methodological framework further establishes a conceptual baseline for evaluating the structural disparities between the two regimes, specifically regarding the breadth of environmental and social governance performance indicators (Fleacă et al., 2023). By synthesizing these provisions, the study maps the divergence between the investor-oriented single materiality approach of the ISSB and the comprehensive double materiality principle inherent in the ESRS (Teixeira, 2025). Specifically, this comparative analysis identifies how the ISSB's framework focuses primarily on financial risks that impact enterprise value, whereas the ESRS requires organizations to disclose the reciprocal effects of their operations on the environment and society (Fenech, 2024). Furthermore, this research examines the integration of ESG metrics within accounting processes, noting that the IFRS Foundation's S1 and S2 standards aim to unify disclosures for capital markets, while the ESRS mandate necessitates granular disclosures on biodiversity, circularity, and human rights in the value chain (Rondós-Casas et al., 2026). The resulting thematic coding reveals that while the ISSB framework streamlines reporting through a risk-focused lens, the ESRS mandates a broader disclosure scope that forces firms to account for complex sustainability impacts (Bux et al., 2025). This divergence highlights that comparability under the ISSB remains constrained by a sectoral, investor-centric focus (Costa et al., 2022), whereas the ESRS framework challenges the notion of universal standards by embedding mandatory double materiality as a core

governance mechanism. Consequently, the institutionalization of the ESRS methodology necessitates a more sophisticated integration of sustainability data into performance measurement systems than the modular, risk-oriented approach proposed by the ISSB (Lindgren et al., 2026). Ultimately, the heterogeneity of these definitions and the diverse objectives pursued by international standard-setters underscore the ongoing challenges in achieving global convergence (Stolowy & Paugam, 2023). These divergent regulatory philosophies reflect a broader landscape of stakeholder prioritization, where the ISSB serves to standardize disclosures for global capital markets while the ESRS addresses the specific socioeconomic imperatives of the European context (Carungu et al., 2025). By prioritizing financial materiality, the ISSB standards function to facilitate efficient capital allocation by minimizing the informational asymmetry between firms and investors regarding sustainability-related risks (Skrypnyk & Demenok, 2025). Conversely, the ESRS framework broadens the scope of reporting to capture the multi-dimensional externalities of corporate operations, thereby aligning corporate accountability with the European Union's broader sustainable finance objectives (Baumüller & Leitner-Hanetseder, 2023). This bifurcated regulatory evolution highlights a tension between the ISSB's objective to enhance market-wide comparability through standardized financial metrics and the ESRS's commitment to comprehensive impact reporting as a pillar of corporate social responsibility (Mazhambe, 2025). This conceptual dissonance necessitates a rigorous assessment of interoperability, as the requirement for European firms to satisfy both regimes may introduce significant compliance burdens and reporting fatigue (Pantazi, 2024). To navigate this complexity, firms must strategically implement integrated reporting systems that reconcile the ISSB's focus on enterprise value with the ESRS's rigorous, four-stage double materiality assessment process (Celli et al., 2024). Such an integration requires firms to balance the IFRS Foundation's emphasis on single materiality with the expansive scope of social and environmental impact reporting central to the European regulatory strategy (Mitrović, 2024; Nielsen & Jensen, 2024). The structural interoperability between these frameworks remains an evolving challenge, as the ISSB's industry-specific standards and the ESRS's multifaceted disclosure requirements necessitate distinct data aggregation methodologies (Kamiński, 2024; Mazhambe, 2026). This divergence risks creating a bifurcated reporting landscape, where the choice between global capital market alignment and regional socio-political accountability results in higher compliance costs and operational complexity (Dinçer, 2023). Furthermore, the capacity to harmonize these divergent reporting requirements is heavily contingent upon a firm's internal data governance and cross-functional maturity, as the demand for high-quality, audit-ready sustainability disclosures imposes significant operational strain (Kamal, 2025). Ultimately, the uneven preparedness of organizations to bridge these reporting mandates exacerbates the risk of fragmented disclosures, as smaller firms particularly struggle with the resource-intensive nature of simultaneous compliance (Filho et al., 2025). Such challenges are further compounded by the necessity for robust data management systems to handle the diverse materiality triggers, which may inadvertently widen the implementation gap between large multinational enterprises and smaller entities (Freiin, 2024; Wangenheim, 2024). Moreover, the lack of a standardized global enforcement mechanism further complicates this landscape, as national variations in institutional oversight and regulatory intensity create significant barriers to achieving consistent metadata interoperability (Morshed

et al., 2026). Moreover, the proliferation of fragmented regulatory expectations often leads to informational clutter, where the resulting complexity can facilitate neutralised reporting or strategic impression management by reporting entities (Frecautan & Nita, 2022). In this environment, the lack of a unified definition for materiality complicates the reconciliation of conflicting disclosure expectations, potentially undermining the reliability of sustainability-related financial information (Pratama et al., 2024). The tension between the ISSB's investor-oriented, industry-specific metrics and the broader ESRS mandates reflects a deeper, concealed struggle between global standardization efforts and regional regulatory autonomy (Wyk & Els, 2023). This fundamental discrepancy in materiality definitions—where the EU promotes double materiality to account for broad stakeholder interests while the ISSB retains an investor-centric, single-materiality perspective—remains a critical hurdle for global regulatory coherence (Malinić & Vučković-Milutinović, 2023). Further empirical analysis suggests that this fragmentation persists due to the absence of harmonized methodologies, which complicates benchmarking across diverse jurisdictions (Dasinapa, 2024). Qualitative analysis of these disclosure requirements reveals that the ISSB's consolidation of SASB-derived industry-specific standards into IFRS S1 and S2 prioritizes financial materiality to enhance capital allocation, while the CSRD's mandated ESRS framework necessitates a more expansive, stakeholder-inclusive approach (Virk, 2026). This qualitative distinction highlights the dissonance in investor feedback regarding the scope of disclosure, where consensus on standardization often masks significant disagreement over the optimal focus of sustainability reporting (Millar & Slack, 2024). Such institutional divergence further complicates the ability of small and medium-sized enterprises to navigate these reporting requirements, given their persistent limitations in internal resources and technical expertise (Cavaliere et al., 2026). Consequently, this operational strain is exacerbated by the lack of international assurance standards, which prevents auditors from providing consistent verification across disparate disclosure regimes (Austria et al., 2025). Addressing these gaps requires firms to develop sophisticated internal control systems capable of managing the distinct data requirements imposed by double materiality and value chain complexity (Parodi et al., 2026). In this context, the shift toward standardized metrics is intended to mitigate risks of selective disclosure and greenwashing, yet the current lack of cross-framework alignment risks further intensifying market scrutiny without guaranteeing improved data quality (Lupu et al., 2025). To operationalize these requirements, organizations must navigate the multi-level institutional configurations that dictate how global standards are interpreted within specific jurisdictional contexts (Huang, 2026). Specifically, the institutional translation of these international norms necessitates localized governance mechanisms that balance IFRS S1 and S2 requirements with regional mandates (Setiawan et al., 2025). Consequently, firms operating across multiple jurisdictions are increasingly prone to strategic decoupling, utilizing symbolic adoption to satisfy diverse institutional pressures while minimizing actual substantive shifts in their sustainability practices (Zhang & Goerzen, 2024). This strategic misalignment is underscored by the difficulty in quantifying climate-related financial impacts, a hurdle that persists even as companies refine their risk evaluation methodologies. Existing evidence indicates that while larger enterprises leverage these frameworks to refine internal governance and risk assessment, smaller organizations encounter substantial resource barriers that impede meaningful compliance (Fonseca & Huk, 2025). Consequently, the

variance in interpretation concerning "materiality" and "conciseness" creates a distinct gap between procedural reporting and actual corporate practice (Pratama et al., 2022). Empirical studies confirm that while firms may satisfy governance disclosure criteria, they often struggle to substantively integrate complex strategy and risk management metrics mandated by both frameworks (Kusuma & Gani, 2024). Furthermore, a comparative thematic coding of disclosure requirements reveals that the ISSB framework's emphasis on climate-related financial risks (Modjaningrum & Hermawan, 2025) often conflicts with the broader sustainability scope of the ESRS, creating a conceptual misalignment that hinders the creation of a truly universal reporting language (Salgado et al., 2025). This divergence is further underscored by the fact that whereas IFRS S2 aligns with established climate practices (Jroundi, 2025), the comprehensive scope of the ESRS demands a level of data granularity that current reporting methodologies are often ill-equipped to provide (Wahyuni, 2025). This divergence underscores a systemic trade-off between the ISSB's aspiration for a homogeneous global financial baseline and the European Union's commitment to comprehensive, impact-oriented transparency (Münch et al., 2025). Ultimately, this structural bifurcation reflects fundamentally different philosophies regarding corporate accountability, where the ISSB focuses on market-relevant financial impacts, while the ESRS seeks to embed broader societal externalities within the reporting perimeter (Elidrisy, 2024). Such disparate approaches complicate efforts to reconcile non-financial disclosures with capital market requirements, as companies struggle to harmonize investor-focused metrics with extensive sustainability data (Baboukardos et al., 2022). These complexities are further compounded by significant uncertainties regarding the specific methodologies and indicators required for niche industry segments, which complicates the auditability of these disclosures (Cardenas, 2024). To bridge this gap, scholars have proposed a conceptual framework that evaluates the interoperability of reporting boundaries, noting that while the ISSB emphasizes an 'outside-in' investor perspective, the EC/EFRAG mandate explicitly integrates an 'inside-out' approach aimed at sustainable development. This dual-perspective tension necessitates rigorous alignment strategies, particularly as EFRAG continues to calibrate the ESRS bundle to facilitate potential convergence with the ISSB's financial-centric standards (Zdolšek & Beloglavec, 2023). However, current analyses indicate a moderate level of interoperability between the ESRS and other global benchmarks, which remains significantly more limited when compared against the narrower scope of the ISSB's climate-specific disclosures (Molnár et al., 2025). Despite these functional discrepancies, strategic efforts to harmonize these frameworks remain a high priority for international standard-setters, who are actively coordinating work programs to ensure the connectivity of sustainability data (Carungu et al., 2025). This ongoing harmonization process requires navigating the inherent tension between the ISSB's financial materiality focus and the ESRS's robust commitment to double materiality, which necessitates a reconciliation of diverse stakeholder expectations (Rimmel et al., 2025a, 2025b). This convergence effort faces significant hurdles, as the power dynamics between regional mandates and international standard-setting bodies continue to shape the evolution of accountability practices (Carungu et al., 2025). A critical challenge in this alignment involves resolving the methodological inconsistencies inherent in the transition from purely financial metrics to the broader, impact-based disclosure requirements that characterize the European regulatory landscape (Dunfjäll, 2025). Moreover, this

analytical tension highlights a broader paradigm shift, as firms must reconcile the European Union's pursuit of multi-stakeholder accountability with the global drive for a unified, investor-centric financial language (Carungu, 2025; Ionescu-Feleagă & Olteanu, 2025). Ultimately, the EFRAG's commitment to "double materiality" serves as a fundamental bridge for achieving the European Green Deal, necessitating a distinct regulatory stance that persists despite the global pressure for streamlining (Afolabi et al., 2023). By positioning impact materiality as a foundational element, the ESRS framework effectively prioritizes a multi-stakeholder accountability model that diverges from the ISSB's narrow focus on financial-related sustainability information (Dimes & Molinari, 2023; Villiers et al., 2022). Recent collaborative efforts, exemplified by the May 2024 "Interoperability Guidance," aim to mitigate this dichotomy by providing a structured pathway for European preparers to satisfy the requirements of both frameworks simultaneously (Carungu et al., 2025). Despite these efforts, findings indicate that substantial interpretive variation persists, with many early adopters struggling to reconcile the nuanced definitions of materiality required for institutional compliance (Altınay & Sardoğan, 2025). This thematic dissonance is further exacerbated by the fragmented regulatory landscape, where firms must navigate between the ISSB's emphasis on investor-centric financial materiality and the ESRS's rigorous mandate for double materiality (Carungu et al., 2025). This foundational tension effectively forces organizations to adopt dual-tracking strategies, wherein financial risk exposure is assessed alongside the broader ecological and social externalities generated by their operations (Avram et al., 2025). Such institutional complexity mirrors the broader challenge of integrating diverse ESG indicators—ranging from climate-related risks to social and governance metrics—into a unified reporting architecture (Gesso & Lodhi, 2024). Consequently, the practical application of these standards remains a primary point of friction for multinational entities, which must effectively balance the investor-focused requirements of the ISSB with the stakeholder-inclusive mandate of the EU's double materiality doctrine (Song, 2025). highlighting an epistemological shift from traditional financial reporting toward a broader, multi-dimensional assessment of corporate impacts, risks, and opportunities (Mangiuc & Kagitci, 2025). This conceptual divide necessitates a qualitative thematic analysis of disclosure requirements to map how organizational governance structures reconcile internal risk oversight with broader social and environmental externalities (Dragomir et al., 2024). By categorizing disclosures into discrete thematic clusters—specifically risk management, financial access, and organizational oversight—one can discern how firms adapt their reporting architecture to satisfy both regulatory mandates and stakeholder expectations (Matacera et al., 2024). This thematic categorization reveals that while firms prioritize financial materiality to satisfy ISSB-aligned investor demands, the ESRS mandate forces an expansion of the disclosure perimeter to incorporate complex impact-oriented data (Raihan & Sarker, 2026). This structural dichotomy suggests that firms are increasingly adopting a modular reporting strategy, leveraging the GRI-ESRS interoperability index to streamline thematic disclosures while maintaining the distinct impact assessments required for double materiality compliance (Nicolò et al., 2025). Furthermore, this alignment process underscores the institutionalization of double materiality as a primary driver for corporate governance (Reiser, 2026), shifting the focus from peripheral sustainability reporting to the integration of socio-environmental impacts within core enterprise risk management.

4.Results

Preliminary assessments indicate that only 35% of SMEs successfully leveraging formal frameworks achieve improved capital access, suggesting that the benefits of rigorous reporting remain concentrated among entities with existing institutional maturity (Ogunyemi & Ishola, 2024). Conversely, the lack of tailored support systems and the high costs of data acquisition continue to create significant barriers for smaller enterprises, preventing them from effectively aligning their sustainability strategies with financial objectives (Development, 2025). Furthermore, the inherent complexity of translating these standards into practice necessitates extensive guidance and illustrative examples to assist preparers in navigating the systemic shifts required for high-quality disclosure (Baboukardos et al., 2022). Bridging this gap requires an urgent simplification of disclosure metrics, as firms frequently struggle to interpret the technical requirements of these frameworks, often resulting in superficial or incomplete impact reporting (Afolabi et al., 2022). Moreover, the architectural distinction between the ISSB's focus on enterprise value and the ESRS's emphasis on broader systemic impacts demands a dual-track reporting capacity that remains structurally elusive for organizations lacking specialized ESG infrastructure (Serena & Morone, 2026; Maisuradze, 2025). Such architectural disparities also extend to the governance domain, where the ESRS demands granular disclosure on board-level oversight of impact-related sustainability matters, contrasting with the ISSB's primary focus on governance processes as they pertain to financial risk management. This divergence necessitates that organizations develop robust internal mapping protocols to reconcile the ISSB's risk-oriented governance disclosures with the more holistic, impact-focused accountability structures required under the European framework (Münch et al., 2025). Consequently, entities operating within this dual-regime environment are increasingly compelled to adopt segmented governance disclosures that explicitly delineate how oversight mechanisms address both investor-centric financial risks and broader stakeholder-aligned sustainability externalities (Caterina, 2025; Silvana, 2025). This methodological segmentation underscores a significant shift in corporate accountability, where the coexistence of shareholder-focused capital market standards and broader stakeholder-inclusive mandates highlights the persistent tension between competing theories of capitalism (Pigatto et al., 2023). Ultimately, the lack of standardization in these governance practices, particularly in emerging markets, exacerbates investor uncertainty and complicates the global harmonization of sustainability disclosures (Ogundipe et al., 2024). Furthermore, while the ISSB framework establishes a global baseline intended to enhance international comparability, its reliance on a single materiality perspective often fails to capture country-specific and industry-distinct sustainability nuances that the EU's multi-layered approach aims to address. Consequently, the efficacy of the ISSB as a global baseline may be limited by its exclusion of impact-oriented indicators, which critics argue are essential for a comprehensive evaluation of long-term value creation (Teixeira, 2025).

5.Discussion

The reconciliation of these frameworks reveals a fundamental tension between global harmonization efforts and the preservation of regional policy autonomy (Camilleri, 2015). While the ISSB seeks to provide a universally applicable baseline for capital markets, the ESRS reinforces the European Union's unique mandate to

address externalities through a double materiality lens, thereby complicating the objective of a single global reporting language (Caterina, 2025; Elidrisy, 2024). Multinational corporations must therefore navigate this fragmentation by implementing sophisticated bridging mechanisms that reconcile the ISSB's financial materiality focus with the comprehensive impact assessments necessitated by EU regulation (Rimmel et al., 2025). This dual-compliance burden is further compounded by the emerging market context, where firms often lack the necessary infrastructure to manage such divergent disclosure requirements, potentially deepening the divide between sustainability leaders and laggards (Altınay & Sardoğan, 2025; Elidrisy, 2024). In these regions, the absence of standardized data collection protocols often forces smaller entities to prioritize minimal compliance, thereby risking the exclusion of critical social and governance dimensions that are arguably more salient in developing economies (Molnár et al., 2025). Consequently, this uneven distribution of reporting capabilities risks marginalizing enterprises in emerging markets, as the high costs of navigating bifurcated regulatory mandates may inadvertently stifle local economic growth and innovation (Cao, 2025). To mitigate these disparities, policymakers must prioritize the development of scalable, tiered reporting frameworks that lower the technical barriers for smaller firms without compromising the essential rigour of sustainability disclosures (Fenech, 2024). Furthermore, the ongoing collaboration between the ISSB and the GRI to align terminology and guidance serves as a critical step toward reconciling these diverging standards and reducing the reporting burden for global firms (Costa et al., 2022). Nonetheless, enduring skepticism persists regarding whether these collaborative efforts can truly supplant the established expertise of veteran bodies like the GRI, whose long-standing methodologies prioritize non-market stakeholder interests (Adams & Mueller, 2022). Such ongoing efforts to align frameworks must also address the specific institutional vulnerabilities of companies in emerging economies, where the administrative capacity to satisfy these multi-layered requirements is often disproportionately low (Pantazi, 2024). This systemic heterogeneity not only complicates the path toward a unified global language for sustainability but also risks institutionalizing a "reporting gap" where standard-setting objectives clash with the practical constraints of diverse corporate environments (Stolowy & Paugam, 2023). Moreover, the high costs associated with gathering and verifying non-financial data often result in resource misallocation, leaving smaller entities in developing nations at a structural disadvantage compared to their global counterparts (Awanye et al., 2023). To address these barriers, it is imperative to implement targeted capacity-building initiatives and sector-specific toolkits that enable smaller enterprises to manage their sustainability disclosures without incurring prohibitive short-term costs (Adams & Mueller, 2022). Moreover, the inherent complexity and variability of environmental data collection—ranging from energy consumption to waste generation—further exacerbate these resource constraints, complicating the ability of smaller firms to meet international benchmarks. In this context, the scarcity of human and financial resources often leads to a reliance on simplified reporting metrics that, while easing the administrative burden, may fail to capture the nuanced sustainability risks and opportunities inherent in diverse sectoral operations (Firmansyah & Taha, 2025). Consequently, this structural inadequacy highlights an urgent need for interdisciplinary training and technical support, as the current reliance on manual data collation poses significant risks to accuracy and, ultimately, the credibility of

reported ESG outcomes (Chopra et al., 2024). Furthermore, the divergence between the sophisticated requirements of global standards and the technical constraints of smaller entities necessitates a more modular approach to policy implementation to prevent the marginalization of emerging market participants (Wahyuni, 2025). Indeed, the lack of institutional support and legal protection in these jurisdictions often impedes the transition to more rigorous accounting systems, leaving firms vulnerable to both regulatory penalties and market exclusion.

6.Conclusion

The evolution of sustainability reporting reflects a critical juncture where the ambition for global convergence under the ISSB faces the robust, stakeholder-centric requirements of the ESRS (Zdolšek & Beloglavec, 2023). Future research must now prioritize the mechanisms of interoperability to prevent a fractured regulatory landscape that diminishes the decision-utility of sustainability disclosures for global investors (Rimmel et al., 2025). Specifically, academic inquiry should transition toward developing unified taxonomies that allow for the seamless mapping of impact-oriented disclosures to enterprise value metrics, thereby mitigating the costs of dual-track reporting (Afolabi et al., 2023; Villiers et al., 2022). Furthermore, scholarly investigation must scrutinize the extent to which the ISSB's influence shapes the political agenda of regional bodies like EFRAG, and whether such pressures fundamentally erode the commitment to double materiality in favor of investor-centric paradigms (Carungu et al., 2025).

Regulators should implement clear safe-harbor provisions and simplified reporting tiers to alleviate the compliance burden on SMEs, while simultaneously establishing robust oversight mechanisms to safeguard impact materiality during the harmonization process (Carungu et al., 2025). Preparers are encouraged to adopt integrated data management systems that treat sustainability metrics with the same rigor as financial reporting, ensuring that internal governance structures reflect the substantive requirements of both frameworks.

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MAPPING THE IMPACT OF CSRD ON NON-FINANCIAL REPORTING: A SYSTEMATIC QUALITATIVE REVIEW OF ACADEMIC LITERATURE AND LEGISLATIVE PROVISIONS

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Abstract: *This article examines the impact of the Corporate Sustainability Reporting Directive (CSRD 2022/2464/EU) on companies operating in Romania and the European Union, against the backdrop of a fundamental transformation in the non-financial reporting framework. Through a systematic review of specialized literature, a comparative legislative analysis and an original quantitative textual analysis of the two directives' official texts, the study identifies the structural novelties introduced by the CSRD relative to its predecessor, the Non-financial Reporting Directive (NFRD 2014/95/EU). The paper addresses three research questions: (**RQ1**) What are the main normative and qualitative differences between the NFRD and CSRD? (**RQ2**) To what extent does Romania's current legislative framework align with CSRD requirements? (**RQ3**) What is the estimated magnitude and timeline of CSRD's impact on Romanian companies? The term frequency analysis demonstrates that the CSRD operates a substantial qualitative and quantitative extension of the NFRD, shifting the lexical center of gravity from general disclosure concepts to a structured normative architecture founded on standardization, double materiality and independent assurance. The qualitative analysis reveals that the CSRD does not represent a mere technical update, but a paradigm shift from a voluntary selective model to a verifiable accountability regime, with profound implications for stakeholder theory, organizational legitimacy and sustainable capital allocation. The findings indicate that Romania faces a significant compliance gap, with current legislation covering fewer than 100 entities compared to the projected 1500 - 2000 companies to be directly affected by 2027. The conclusions emphasize that this legislative transition presents both significant opportunities for investment attractiveness and substantial challenges related to institutional capacity and compliance costs.*

Keywords: *CSRD; NFRD; non-financial reporting; sustainability; double materiality; Romania; ESRS.*

JEL Classification: *M40; M41; M42*

1. Introduction

Corporate sustainability reporting has undergone a profound transformation in the last decade, driven by growing pressures from investors, civil society and regulators seeking greater transparency in companies' social and environmental behavior. The Corporate Sustainability Reporting Directive (CSRD 2022/2464/EU), adopted by the European Parliament and Council of the European Union in December 2022, represents the most ambitious European legislative instrument in the field of non-financial reporting, superseding the Non-financial Reporting Directive (NFRD) of

2014. The adoption of the CSRD is deeply embedded in the global climate agenda anchored in the Paris Agreement (2015), the EU Taxonomy for Sustainable Finance (Regulation 852/2020) and the European Green Deal (2019), which targets net zero carbon emissions by 2050. Sustainability reporting has thus evolved from a corporate communication exercise into a public policy instrument: a mechanism for reallocating capital toward sustainable economic activities and for enforcing accountability beyond the confines of traditional financial disclosure.

Despite the growing body of literature on the CSRD at the EU level (Nicoletti et al., 2022; Baumüller & Sopp, 2022; Cortes & Elayan, 2023), significant research gaps persist. First, studies combining quantitative textual analysis of directive provisions with qualitative regulatory gap assessments for specific Member States remain rare, particularly for Central and Eastern European economies. Second, the academic literature has not yet systematically examined Romania's compliance trajectory, despite evidence that the country presents a distinctly challenging context: a low baseline in non-financial reporting (Dumitru et al., 2019), limited institutional capacity (Tiron Tudor et al., 2023) and a carbon intensive economic structure. Third, the conceptual implications of mandatory double materiality and its tensions with international standards such as ISSB IFRS S1 and S2 have not been critically examined in the context of emerging EU economies.

This article addresses these gaps by pursuing three research questions:

- **RQ1**: What are the main normative and qualitative differences between the NFRD and CSRD, as evidenced both by legislative text analysis and academic scholarship?
- **RQ2**: To what extent does Romania's current legislative and institutional framework align with CSRD requirements and what are the primary sources of nonconformity?
- **RQ3**: What is the estimated magnitude and timeline of CSRD's direct impact on Romanian companies and what specific challenges and opportunities does this imply?

The research method is qualitative and systematic, combining: (i) a structured review of peer reviewed literature on NFRD and CSRD; (ii) a comparative legislative analysis grounded in the official EU and Romanian legal texts; (iii) an original quantitative textual analysis of key term frequencies in the two directives and (iv) an estimation of CSRD's direct impact on Romanian companies based on Eurostat firm size data and EFRAG projections.

The paper is organized into five sections. Following this introduction, Section 2 reviews the relevant academic literature and theoretical foundations. Section 3 examines the regulatory evolution from NFRD to CSRD, including the comparative normative architecture. Section 4 presents the analytical findings term frequency analysis and Romania - EU legislative gap assessment. Section 5 integrates the discussion of impact, implications and conclusions.

2. Literature Review and Theoretical Framework

2.1. Theoretical Foundations of Non-financial Reporting

The academic literature on sustainability reporting draws on three principal theoretical frameworks, each illuminating a distinct facet of the reporting incentive structure. Stakeholder theory (Freeman, 1984) posits that organizational performance must be assessed not solely through the lens of shareholders, but across the full spectrum of affected parties. The normative dimension of this theory

has been progressively codified in EU legislation: the CSRD, by mandating reporting on impacts affecting communities, ecosystems and future generations, represents perhaps the most ambitious legislative instantiation of stakeholder theory in European corporate law.

Legitimacy theory (Suchman, 1995; Deegan, 2002) offers a complementary and more critical perspective, suggesting that organizations disclose social and environmental information primarily to justify their existence in relation to societal norms rather than to generate genuine accountability. This theoretical lens is particularly revealing in light of the transition from NFRD to CSRD: the very evidence that the NFRD failed to prevent selective and strategically motivated disclosure (Ioannou & Serafeim, 2017; Rinaldi et al., 2018) constitutes the empirical foundation for the CSRD's shift to mandatory, auditable, standardized reporting. The CSRD can thus be read as a legislative response to the documented pathologies of legitimacy seeking behavior under voluntary selective frameworks.

Agency theory and information asymmetry (Jensen & Meckling, 1976) provide the economic rationale for mandatory standardization: when sustainability information is non comparable, unaudited and strategically filtered, capital markets cannot efficiently incorporate ESG risk into asset pricing, thereby increasing monitoring costs. Krueger et al. (2021) demonstrate empirically that institutional investors increasingly price climate risk, but their ability to do so accurately is constrained by the quality and comparability of reported data precisely the gap that the ESRS framework is designed to address.

2.2. Literature on the NFRD: Evidence of Structural Limitations

Hess (2015) conducted one of the first critical analyses of the NFRD, concluding that the directive, while an important step, conceded excessive discretion to companies through the 'comply or explain' principle, generating significant information asymmetries. This observation proved prescient: subsequent empirical studies confirmed that the absence of mandatory standards produced reporting that was voluminous, but not comparable, detailed, but not verifiable.

Carmo et al. (2018) analyzed reporting quality across five EU Member States (Germany, France, Spain, Italy, and Poland), finding that NFRD implementation varied substantially according to local corporate culture and institutional investor pressure. Critically, Romania was absent from this study a lacuna that itself signals the peripheral status of Central and Eastern European economies in the EU sustainability reporting literature and one that this paper seeks to partially redress.

Dumitru et al. (2019), in a study specifically focused on Romanian and Polish companies, found that compliance with NFRD requirements among BVB listed entities stood at approximately 38%, well below the EU average of 62%, attributing this deficit to insufficient internal reporting capacity and weak institutional enforcement.

Rinaldi et al. (2018) and Eccles & Serafeim (2013) raised a concern that anticipates a key risk of the CSRD era: mandatory reporting may generate 'tick box compliance' behavior formal adherence without substantive informational content. This critique should not be dismissed as merely theoretical; as Velte (2021) demonstrates, the correlation between ESG reporting quality and financial performance is positive, but moderate and highly sector dependent, suggesting that reporting volume and genuine sustainability outcomes are not synonymous. The effectiveness of the CSRD's mandatory framework will ultimately depend not only on the normative

architecture of the directive, but on the rigor of assurance, the sophistication of materiality assessments and the enforcement capacity of national supervisory authorities.

2.3. Emerging CSRD Literature: Opportunities and Critical Perspectives

The rapidly growing literature on the CSRD reveals a productive tension between optimistic assessments of the directive's potential and more cautious analyses of its implementation risks. Nicoletti et al. (2022) identify four transformative dimensions relative to the NFRD: (i) the dramatic expansion of scope from approximately 11700 to over 50000 companies; (ii) the mandatory introduction of double materiality; (iii) the standardization of reporting through the ESRS and (iv) the requirement for external assurance. This taxonomy of novelties is empirically robust and forms the analytical basis for the comparative analysis in Section 3.

Baumüller & Sopp (2022) provide one of the most rigorous assessments of the ESRS standards, arguing that they represent a qualitative advance over both GRI and TCFD frameworks, primarily due to their mandatory integration and alignment with EU Taxonomy definitions. However, the authors also note significant implementation complexity, particularly around the dual materiality assessment, which requires companies to conduct sophisticated stakeholder engagement and impact assessment exercises that many especially SMEs may lack the capacity to perform adequately.

Cortes & Elayan (2023) demonstrate that the announcement of CSRD adoption generated statistically significant positive capital market reactions for companies exposed to environmental risk, suggesting that investors anticipate material benefits from enhanced transparency. For Romania, where FTSE emerging market status was achieved in 2024, this finding carries particular relevance: the quality of ESG disclosure may become a direct determinant of capital allocation by international institutional investors.

In the Romanian context, Tiron Tudor et al. (2023) find that only 23% of non-EIP companies surveyed had formalized CSRD compliance preparation strategies compared to an EU average of 47% identifying data infrastructure and professional ESG training as the primary barriers. Dobrea et al. (2022) and Ionescu (2023) further contextualize Romania's situation by demonstrating that access to European cohesion and recovery funds is increasingly conditioned on sustainability reporting maturity, creating an additional systemic incentive for compliance beyond regulatory obligation. Together, these studies paint a picture of a country where the gap between normative requirements and institutional readiness is unusually wide and where the consequences of non-compliance extend beyond legal sanctions to competitive disadvantage in European capital and funding markets.

3. Regulatory Framework: From NFRD to CSRD

3.1. The European Legislative Trajectory

The European legislative evolution in non-financial reporting reflects a coherent progression from fragmented, voluntary initiatives toward an integrated and mandatory accountability framework. Initial European interventions date to Directive 2003/51/EC, which modernized annual reporting requirements by introducing for the first time the obligation to include environmental and social indicators in companies' annual reports. This provision, however, was permissive and minimally enforced, generating little substantive change in reporting practices.

The adoption of Directive 2014/95/EU (NFRD) marked a genuine turning point, imposing mandatory non-financial reporting on public interest entities with more than 500 employees. The NFRD introduced concepts such as materiality, board diversity and anti-corruption policies, but critically left companies free to choose their reporting framework and did not require external verification. The NFRD review process, formally launched by the European Commission in 2018, documented these limitations extensively and culminated in the CSRD proposal of April 2021.
Table 1 presents the chronological overview of the European and Romanian legislative trajectory.

Table 1. Timeline of Legislative Evolution: Non-financial Reporting in the EU and Romania

Year	EU Legislation	Romanian Legislation
2003	Directive 2003/51/EC – first requirement to include environmental and social indicators in annual reports	Law 31/1990 – basis for company reporting
2014	Directive 2014/95/EU (NFRD) – mandatory non-financial reporting for large public interest entities (>500 employees)	—
2016–2017	Commission Guidance on non-financial reporting (2017/C 215/01)	Order of the Minister of Public Finance 1938/2016 – partial transposition of NFRD
2018	EU Action Plan for Sustainable Finance; update of Order 1802/2014	Law 163/2018 – formal transposition of the NFRD into national law
2020	EU Taxonomy Regulation (852/2020) – classification of sustainable economic activities	Law 163/2018 in force; first NFRD reports submitted
2021	CSRD proposal (COM/2021/189) published by European Commission	ASF Norm 10/2021 – additional ESG requirements for BVB listed entities
2022	Directive 2022/2464/EU (CSRD) officially adopted; enters into force January 2023	Legislative transposition process initiated; partially via emergency ordinances (GEO)
2023	ESRS Set 1 adopted via Delegated Act (Commission Regulation 2023/2772)	Draft law transposing CSRD submitted for parliamentary debate
2024	First CSRD reporting wave: existing NFRD entities report on FY2024	Transposition deadline (6 July 2024); application for ~80–100 public interest entities
2026	Second wave: other large companies (>250 employees or meeting financial thresholds)	Extensive application to listed SMEs and large non-PIE companies

Source: Authors' compilation based on the Official Journal of the European Union (EUR Lex) and the Official Gazette of Romania.

The CSRD (2022/2464/EU), published in the Official Journal of the EU on 16 December 2022, entered into force in January 2023. The first set of ESRS was adopted by Commission Delegated Regulation 2023/2772, establishing twelve specific standards covering the full range of ESG dimensions.

3.2. Legislative Developments in Romania

Romania transposed the NFRD through Law no. 163/2018, amending and supplementing the Accounting Law no. 82/1991, supplemented by MFP Order 1802/2014 and, subsequently, ASF Norm 10/2021 for BVB listed public interest entities. The scope of application remained minimal: approximately 80–100 entities compared to ~11700 at the European level. Implementation was heterogeneous, with variable quality of disclosed information and an absence of standardized external verification mechanisms.

Regarding CSRD transposition, the EU imposed deadline of 6 July 2024 was challenging for Romania given the limited administrative capacity involved. Legislative drafts entered public debate in 2023–2024, but full implementation remained a substantial institutional challenge. Inadequate sanctions fines of up to RON 5000 under Law 163/2018, compared to the dissuasive harmonized penalties envisaged by the CSRD further weakened compliance incentives.

3.3. Comparative Analysis: NFRD versus CSRD

Table 2 presents a structured comparison of the two directives across eleven key regulatory dimensions, synthesized from the official directive texts and supplemented by EFRAG's impact assessment documentation (EFRAG, 2023).

Table 2. Comparative Analysis: NFRD versus CSRD

Criterion	NFRD (Directive 2014/95/EU)	CSRD (Directive 2022/2464/EU)
Targeted entities	~11700 large public interest entities	~50000 companies (incl. listed SMEs)
Application threshold	>500 employees	>250 employees OR >€40M turnover OR >€20M assets
Reporting standard	No mandatory standard; voluntary frameworks (GRI, IIRC, SASB, etc.)	ESRS mandatory (12 topic specific standards)
External assurance	Optional / recommended	Mandatory (limited assurance initially; reasonable assurance targeted medium term)
Reporting areas	Environment, social, personnel, human rights, anticorruption	Climate, biodiversity, water, circular economy, workforce, supply chain, governance
Double materiality	Implicit; voluntary application	Explicit and mandatory (both impact and financial materiality required)
Digitization	Unregulated	Mandatory digital reporting in XBRL/iXBRL format
Sanctions	Variable by Member State	Harmonized at European level; dissuasive sanctions required
Placement in reports	Separate report permissible	Mandatory dedicated section within the management report
Third country companies	Not covered	Companies >€150M EU turnover with EU subsidiary must report

Source: Authors' synthesis based on Directive 2014/95/EU, Directive 2022/2464/EU, EFRAG (2022; 2023), and Baumüller & Sopp (2022). Categories reflect the analytical framework proposed by Nicoletti et al. (2022).

3.4. The Double Materiality Principle: Conceptual Revolution and Critical Assessment

The concept of 'double materiality' constitutes the central conceptual innovation of the CSRD and arguably its most theoretically ambitious element. The NFRD implicitly recognized only a single direction of materiality: the impact of ESG factors on the company's financial performance ('outside in' or financial materiality). The CSRD explicitly mandates the assessment of two dimensions simultaneously:

- Impact materiality ('inside out'): the effects of the company's activities on the environment, society and the broader economy - how the company affects the world around it;
- Financial materiality ('outside in'): the effects of sustainability factors on the company's performance, position and cash flows - how ESG factors affect the company.

A company is required to report on any topic that is material from at least one of these two perspectives. This bidirectional framework aligns the CSRD with GRI Standards, while diverging significantly from the approach of the International Sustainability Standards Board (ISSB), whose IFRS S1 and S2 standards adopt a single materiality (financial materiality only) perspective.

This divergence merits critical analysis rather than mere description. The CSRD–ISSB misalignment creates a genuine challenge for globally active European companies, which may need to prepare dual track sustainability reports: one aligned with ESRS double materiality for EU regulatory purposes and one aligned with ISSB standards for non-EU capital market audiences. Baumüller & Sopp (2022) acknowledge this tension, but argue that double materiality's broader informational scope better serves the CSRD's policy objective of channelling capital toward genuinely sustainable activities an argument that has regulatory merit but operational costs.

A second critical concern involves the subjectivity inherent in materiality determination. Unlike financial materiality, which can be anchored in quantifiable financial impact thresholds, impact materiality requires companies to assess and weigh qualitative social and environmental harms a process that is not only complex but potentially susceptible to strategic manipulation. ESRS 1 (General Requirements) provides some methodological guidance, requiring engagement with affected stakeholders and documentation of the materiality assessment process, but the scope for divergent applications remains wide. The risk of 'materiality gaming' systematically classifying sensitive impacts as non-material to reduce disclosure obligations is real and its mitigation depends directly on the robustness of the mandatory limited assurance regime and the sophistication of national supervisory enforcement.

For SMEs in particular, the double materiality assessment is disproportionately burdensome relative to organizational capacity. Even with the simplified VSME standard developed by EFRAG, conducting a credible bidirectional materiality assessment requires stakeholder mapping, impact valuation methodology and documentation infrastructure that many smaller listed companies do not yet possess. This structural asymmetry between the directive's ambitions and the operational capacity of a substantial portion of the companies it targets is one of the most significant implementation risks, particularly in economies like Romania where SME organizational capabilities in ESG are limited.

4. Analytical Findings: Term Frequency Analysis and Romania - EU Legislative Gap

4.1. Quantitative Textual Analysis: Term Frequency in NFRD and CSRD

To complement the qualitative legislative comparison, the authors conducted a quantitative textual analysis of the two directives' official English language versions, as published in the Official Journal of the European Union. Ten key terms were selected according to three criteria: (i) demonstrated centrality in the peer reviewed literature on NFRD and CSRD (Nicoletti et al., 2022; Baumüller & Sopp, 2022); (ii) explicit reference in EFRAG's preparedness and impact assessment frameworks (EFRAG, 2023) and (iii) coverage across all three ESG dimensions and core governance process dimensions, ensuring analytical breadth. Term frequencies were determined via full text search of the official PDF documents using root form

matching (e.g., 'sustain*' captures 'sustainability', 'sustainable', 'sustainably') and results were validated through cross reference with EFRAG's digital taxonomy index.

Table 3 presents the results. Term selection criteria: centrality in peer reviewed CSRD literature, inclusion in EFRAG impact assessment framework and ESG dimensional coverage. Frequencies include all root form variants. The selection of ten terms was deliberate: a larger term set would have introduced marginal or overlapping concepts, while a smaller set would have failed to capture the multidimensional character of the CSRD's paradigm shift.

Table 3. Frequency Analysis of Key Terms in NFRD vs. CSRD

Key Term	NFRD Frequency	CSRD Frequency	Interpretive Observation
Sustainability	47	892 (+1,798%)	Central organizing concept of CSRD architecture
Disclosure	89	634 (+612%)	Emphasis on structured, auditable transparency
Climate	12	287 (+2,292%)	Reflects Paris Agreement and Green Deal alignment
Materiality	8	156 (+1,850%)	Operationalization of double materiality as mandatory tool
Supply chain	3	134 (+4,367%)	Extended due diligence beyond company boundaries (CSDDD link)
Biodiversity	1	98 (+9,700%)	New dedicated pillar (ESRS E4); absent from NFRD framework
Governance	14	211 (+1,407%)	Explicit board level ESG responsibility (ESRS G1)
Assurance	6	143 (+2,283%)	Transformation of sustainability into externally verifiable accountability
Stakeholders	9	178 (+1,878%)	Codification of stakeholder theory into mandatory reporting practice
Due diligence	2	87 (+4,250%)	Alignment with CSDDD (2024/1760/EU); value chain obligations

Source: Authors' analysis based on official texts published in the Official Journal of the European Union (Directive 2014/95/EU, OJ L 330, 15.11.2014; Directive 2022/2464/EU, OJ L 322, 16.12.2022).

The analysis reveals several clear structural trends. First, the explosive increase in the term 'climate' (from 12 to 287 occurrences, +2,292%) quantitatively confirms the CSRD's re centering around climate risk, reflecting the requirements of both the Paris Agreement and the EU Taxonomy. Second, the term 'supply chain' rises from a marginal 3 occurrences to 134 (+4,367%), signalling the directive's extension of due diligence obligations to the full value chain a development legally reinforced by the Corporate Sustainability Due Diligence Directive (CSDDD, 2024/1760/EU).

Perhaps most analytically revealing are the increases in 'biodiversity' (from 1 to 98, effectively a new dimension) and 'due diligence' (from 2 to 87). Both terms were, in effect, absent from the NFRD's conceptual architecture; their near zero baseline frequencies confirm that these are not refinements of existing provisions but genuinely new normative territories. The increase in 'assurance' (from 6 to 143, +2,283%) is equally instructive: it tracks the CSRD's transformation of sustainability reporting from a largely self-assessed corporate narrative into an externally verifiable accountability statement subject to professional audit procedures. The codification of 'stakeholders' (from 9 to 178) represents the legislative operationalization of stakeholder theory: what was previously a theoretical orientation has become a mandatory process requirement within the ESRS materiality assessment framework.

4.2. Romania vs. EU CSRD Framework: Legislative Gap Assessment

The eight aspects analyzed in Table 4 were selected according to the following criteria: (i) coverage of the core regulatory categories identified in EFRAG's preparedness framework; (ii) alignment with the specific gaps documented in the Romanian sustainability reporting literature (Dumitru et al., 2019; Tiron Tudor et al., 2023) and (iii) practical relevance for companies facing the transposition timeline.

Table 4. Comparative Analysis: Romanian Legislation vs. CSRD Requirements

Analyzed Aspect	EU Framework (CSRD)	Romanian Framework (current legislation)
Primary legal framework	Directive 2022/2464/EU + ESRS Set 1 (12 standards)	Law 163/2018 + MFP Order 1802/2014
Reporting standards	ESRS mandatory (sector specific standards in development)	GRI/IIRC recommended, not mandatory
Scope of application	~50000 EU companies (from 2026)	~80–100 public interest entities (2024)
External verification	Mandatory limited assurance (Art. 26 CSRD)	Recommended; not legally required
Double materiality	Explicitly mandatory (Art. 19a)	Not formally implemented in national legislation
Digital reporting (XBRL)	Mandatory from 2025 (ESRS digital taxonomy)	No specific national regulation
Sanctions	Harmonized; dissuasive (Member States required to set proportionate penalties)	Fines up to RON 5000 under Law 163/2018 – insufficient deterrence
Listed SMEs	VSME voluntary standard available (EFRAG); simplified reporting pathway	Not covered by current national legislation
Institutional capacity	EFRAG – robust technical support and standards development	Limited capacity at Ministry of Public Finance / National Bank of Romania

Source: Authors' assessment based on Directive 2022/2464/EU; Law 163/2018 (Romania); MFP Order 1802/2014; ASF Norm 10/2021; EFRAG (2023); and Tiron Tudor et al. (2023).

The most structurally significant gap lies in the scope of application: Romanian legislation currently covers fewer than 100 entities, while the CSRD will directly affect an estimated 1500–2000 Romanian companies by 2027. This is not a gradual quantitative expansion, but a transformative redefinition of the reporting population, with cascading implications for the market for assurance services, ESG data providers and professional training.

The absence of mandatory reporting standards in Romania, where GRI and IIRC remain recommendations rather than requirements produces a reporting landscape that is fragmented and internally incomparable, as documented by Dumitru et al. (2019). The transition to mandatory ESRS standards will therefore require not only organizational investment in data systems but a fundamental reorientation of how Romanian companies conceptualize and operationalize the sustainability report itself.

From a sanction's perspective, Law 163/2018 provides for fines of up to RON 5000 for non-compliance a manifestly insufficient deterrent relative to the compliance investment required. The CSRD's requirement for 'proportionate, dissuasive' sanctions, harmonized at EU level, will necessitate a substantial revision of Romania's enforcement architecture. The risk of formal transposition without effective enforcement a pattern documented in other EU policy domains is real and would undermine the CSRD's stated objective of meaningful accountability.

There are, nonetheless, convergence elements worth acknowledging. The alignment of Romanian financial institutions with SFDR Regulation (2019/2088/EU) on sustainability disclosures in financial services has created an operational precedent for standardized ESG reporting in the banking and insurance sector. Several large Romanian companies with foreign capital or cross listed on international exchanges have adopted CSRD compatible reporting practices voluntarily, anticipating regulatory requirements. The Bucharest Stock Exchange's ESG education initiatives and its accession to the UN Principles for Responsible Investment (UNPRI) signal emerging institutional awareness, even if practical implementation remains nascent.

5. Discussion, Impact and Conclusions

5.1. Estimated Impact of CSRD on Romanian Companies

Table 5 presents a structured estimate of the Romanian companies directly affected by the CSRD, disaggregated by category and application timeline. The estimates are derived from Eurostat SME data, EFRAG projections and Tiron Tudor et al. (2023).

Table 5. Estimated Impact of CSRD on Romanian Companies, by Category

Company Category	Estimated number in Romania	Application deadline	Main anticipated impact
Public interest entities (PIEs)	~80–100	FY2024 (reports in 2025)	Reporting restructuring; mandatory ESG audit; XBRL digitization
Large non-PIE companies	~1200–1500	FY2025 (reports in 2026)	New ESG data collection and management systems; training needs
Listed SMEs (regulated markets)	~150–200	FY2026 (reports in 2027)	Proportional compliance costs; VSME standard pathway
Subsidiaries of third country multinationals	~300–400	Variable, per group timeline	Alignment with global group ESG policies; parent level consolidation

Source: Authors' estimates based on EFRAG (2023) impact projections, Eurostat SBS enterprise data, and Tiron Tudor et al. (2023). Figures are approximations subject to revision pending full national transposition.

The operational implications are substantial. According to EFRAG estimates (2023), average compliance costs for first cohort companies range from €350000 to €500000 for initial implementation, with annual recurring costs of €150000–€250000. For Romanian companies in the second cohort large non-PIEs, with no prior experience of mandatory sustainability reporting, these costs could represent 0.3–0.8% of annual turnover, a disproportionate burden relative to multinationals benefiting from group level ESG infrastructure.
At the organizational level, CSRD compliance will stimulate the creation of dedicated ESG functions, generate demand for professional training in sustainability accounting and assurance and necessitate integration of ESG indicators into strategic management and investment decision frameworks. These transformations, while costly in the short term, carry medium term potential for organizational capability building and strategic repositioning.

5.2. Discussion: Systemic Implications and Risk of Normative Greenwashing
Taken together, the findings confirm and extend a key thesis of the recent regulatory literature: the CSRD represents a systemic reform, not a technical update. The mandatory introduction of ESRS standards, the bidirectional double materiality framework and external assurance collectively establish an accountability architecture without precedent in European corporate regulation. From the perspective of stakeholder theory (Freeman, 1984), this represents the most explicit legislative codification of multi stakeholder accountability in EU company law transforming sustainability reporting from a reputational instrument into a legally enforceable accountability obligation.
For Romania, the systemic implications are twofold. In the short term, the compliance investment required in data systems, human capital and assurance infrastructure will be substantial and concentrated among companies with limited prior experience of formal sustainability reporting. In the medium and long term, however, successful CSRD compliance could yield meaningful benefits: improved ESG transparency may

enhance access to the growing market for green bonds and sustainability linked loans, as European banks progressively integrate ESG assessments into credit scoring (in line with CRR3 and ECB climate risk guidelines). Moreover, Romania's FTSE emerging market status, achieved in 2024, creates a structural incentive for BVB listed issuers to improve ESG disclosure quality in order to attract allocation from ESG mandated institutional investors.

A critical concern that emerges from both the literature and the Romanian context is the risk of 'normative greenwashing': formal adoption of CSRD compliant reporting structures without substantive changes in corporate sustainability behavior. As Rinaldi et al. (2018) and Eccles & Serafeim (2013) caution with respect to the NFRD experience, mandatory reporting does not automatically translate into genuine accountability. The CSRD's assurance requirement is designed to counter this risk, but its effectiveness in Romania will depend on the capacity of professional audit firms to develop robust sustainability assurance practices, the rigor of ASF and MFP oversight and the willingness of civil society and institutional investors to engage critically with disclosed sustainability information.

The international dimension of the CSRD also merits reflection. The divergence between CSRD's double materiality and ISSB's single materiality approach creates a genuine complexity for Romanian subsidiaries of non-EU multinationals, which may face conflicting reporting obligations. While the European Commission's equivalence assessment process provides a partial mechanism for managing this divergence, companies operating across CSRD and ISSB jurisdictions will need to develop integrated reporting architectures capable of satisfying both frameworks an additional organizational challenge not yet adequately addressed in the Romanian regulatory guidance.

5.3. Main Contributions, Limitations and Future Research

The principal original contribution of this paper is threefold. First, it provides the first systematic combination of quantitative textual analysis (term frequency across the full official texts of NFRD and CSRD) with a structured legislative gap assessment for Romania, offering an empirically grounded foundation for understanding the magnitude of the regulatory transition. Second, the paper advances a critical analysis of double materiality's conceptual tensions particularly the CSRD - ISSB divergence and the subjectivity risks of impact materiality assessment that goes beyond the descriptive treatment prevalent in much of the emerging literature. Third, the Romania specific impact estimation contributes to a still thin strand of research on CSRD implementation in Central and Eastern European emerging economies, providing a baseline for future longitudinal studies.

The study is subject to several limitations. The term frequency analysis is based on the official English language versions of the directives; results may differ marginally in other official language versions due to translation choices. The estimated numbers of affected Romanian companies are derived from approximated firm size distributions in the absence of a centralized national company database that disaggregates firms by the CSRD's three-pronged threshold criteria. Furthermore, several conclusions are necessarily prospective, given that Romania's CSRD transposition was incomplete at the time of writing.

Future research should address these limitations through: (i) longitudinal empirical studies tracking the quality and comparability of CSRD compliance among BVB listed companies across reporting waves; (ii) analysis of the impact of mandatory

ESRS adoption on the cost of capital for listed Romanian issuers; (iii) comparative studies on CSRD implementation across CEE Member States, to identify common structural challenges and effective institutional responses and (iv) assessment of the effectiveness of Romania's supervisory enforcement capacity relative to the CSRD's harmonized sanctions requirement.

5.4. Conclusions

This article analyzed the impact of the CSRD Directive (2022/2464/EU) on companies in Romania and the European Union through a systematic review of specialized literature, a comparative legislative analysis and an original quantitative textual analysis of directive provisions.

The principal conclusions are as follows. The CSRD introduces a systemic transformation relative to the NFRD, characterized by a fourfold expansion in the scope of reporting entities, the mandatory ESRS standards framework, the explicit codification of double materiality as a bidirectional accountability tool and mandatory external assurance. The quantitative textual analysis quantitatively validates this paradigm shift: key regulatory terms such as 'climate' (+2,292%), 'supply chain' (+4,367%), 'biodiversity' (+9,700%) and 'materiality' (+1,850%) register increases that reflect genuine normative novelty rather than mere terminological elaboration.

Romania enters this regulatory transition from a significantly disadvantaged baseline: current legislation covers fewer than 100 entities, mandatory standards and external assurance are absent, the sanctions regime is inadequate and institutional capacity for oversight is limited. An estimated 1500–2000 Romanian companies will be directly affected by the CSRD by 2027, a fifteen to twenty fold expansion of the regulated population within three years. The concurrent risks of normative greenwashing, CSRD–ISSB divergence and double materiality operationalization complexity further compound the implementation challenge.

At the same time, the CSRD's demands create genuine opportunities: strengthened ESG disclosure could enhance Romania's attractiveness for European and global institutional capital, improve access to green finance instruments and incentivize strategic integration of sustainability into corporate governance and business models. Whether these opportunities are realized will depend critically on the quality of national transposition, the development of professional assurance capacity and the institutional will to enforce the directive's requirements with the rigor that both its ambitions and its penalties demand.

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GREEN SIGNALS OR STRATEGIC NOISE? CORPORATE REPORTING INTEGRITY ASSESSMENT THROUGH L.I.G.H.T. INDEX. A MULTI-CRITERIA COMPARATIVE ANALYSIS

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Abstract. *Recent research investigates whether political connections serve to reduce or increase the tendency of corporate greenwashing. Additionally, studies on climate reporting indicate that lobbying activities misaligned with climate commitments act as counter-signal affecting the credibility of disclosures and erode stakeholders' trust in corporate governance transparency. A significant research gap in literature is the lack of utilization of publicly available data from evaluation platforms as standardized external sources for assessing greenwashing, rather than relying solely on traditional CSR/ESG reports and specific agencies rating ESG scores. In this context, the study introduces a transparency index for evaluating the greenwashing risk, named Longitudinal Integrity & Green-Hurdle Transparency (L.I.G.H.T.) Index. This index is designed to assess the coherence among climate support, transition governance, climate performance, Climate Action 100+ transparency, and the estimated proportion of green revenues. The L.I.G.H.T. Index was empirically tested through a multi-criteria comparative analysis of three leading companies within the beauty and self-care industry. The results indicate a low risk of greenwashing for Unilever, a moderate risk for L'Oréal, and a high risk for Estée Lauder. The main contribution of this empirical study lies in its innovative approach of integrating positive alignment scores with explicit penalties for internal inconsistencies among key indicators. In this framework, greenwashing is conceptualized as a misalignment between corporate signaling, governance practices, and the economic structure underpinning the green transition. Although climate capital expenditure (CapEx) was explored as a variable, it was ultimately excluded from the central scoring due to the unavailability of fully comparable public data across all three companies. Overall, the L.I.G.H.T. Index offers a robust tool for stakeholders seeking to assess the integrity and transparency of corporate climate strategies.*

Key words: *greenwashing; LobbyMap; TPI; Climate Action 100+; Green revenue; ESG; L.I.G.H.T. index.*

JEL Classification: *M41; Q56; M14*

1. Introduction

As the global economy develops rapidly in the 21st century and environmental issues have become more serious, green finance has emerged as an innovative

financial idea, shifting financial resources to environmental protection to support sustainable economic development (Zan et al., 2025). In an ever-changing market, factors such as consumer demand, competition and regulations influence sustainability plans, and increasing awareness of environmental concerns has stimulated demand for green products and services (Zervoudi et al., 2025). However, some companies are prone to engaging in greenwashing practices, misleading consumers about the environmental advantages of their products and services (Galletta et al., 2024). Within this evolving landscape, lobbying remains a critical lever, not only for influencing policy outcomes but also for shaping the institutional context in which ESG practices and disclosure standards are defined and implemented (Taddeo et al., 2025). The flexible design of ESG reporting frameworks and the mainly qualitative nature of ESG disclosures have enabled many companies to carefully shape their ESG reports, aiming to portray their performance more positively (Cepêda et al., 2025). This often results in a misalignment between reporting and disclosure and actual corporate practices, a phenomenon which is known as ESG decoupling (Cepêda et al., 2025). In this context, external assessment platforms are useful because they ensure the transition from the analysis of company reports to comparable measurements. InfluenceMap/LobbyMap tracks companies' involvement in climate policies, the Transition Pathway Initiative (TPI) provides a framework for Management Quality and Carbon Performance, the Climate Action 100+ benchmark assesses Net-zero ambition, climate governance and disclosure, and Green Revenue provides an estimate of the share of turnover associated with products or solutions with a lower or regenerative impact on the environment (CDP, 2026; Climate Action 100+, 2025; InfluenceMap, 2025.; TPI Centre, 2026).

The existing literature includes numerous studies analyzing different aspects of climate reporting and the integrity of sustainability strategies in listed group companies across various industries. It also covers research on corporate sustainability aimed at identifying and measuring greenwashing, which is seen as the gap between a company’s publicly presented ecological image and its actual behavior. This includes areas such as climate lobbying, green transition governance, and business models. For instance, (Xu & Zhou, 2026) explore how climate regulations unintentionally affect corporate environmental disclosures, focusing on whether tighter climate policies increase greenwashing in financially constrained firms. The analyzed sample comprises A-share-listed Chinese companies over 11 years, from 2008 to 2018. Their findings indicate that the key mechanism is that stricter climate policies lead to higher non-compliance costs and increased financial distress, especially for firms with limited financial resources in low-carbon pilot cities. This situation heightens incentives for greenwashing. Additionally, these effects are stronger among firms with lower information disclosure quality, non-state-owned firms, and companies in less competitive industries. On the same note, Fang et al. (2025) develop a greenwashing index for ESG reports and analyze the CSR reports of A-share companies listed on the Shanghai and Shenzhen stock exchange from 2008 to 2022 and analyze the influence of environmental regulation the greenwashing of these CSR reports. Their results show that environmental regulations have a significant impact of increasing the greenwashing of ESG reports and ESG disclosures facilitate certain policies. These environmental regulations compel companies to greenwash their ESG reports through increasing their financing constraints. Another study conducted by Hu et al. (2023) explored the

environmental rating disagreement (ERD) (which measures the discrepancies between ESG ratings from various raters) and its influence on future corporate greenwashing behaviour. Their findings suggest that ERD heightens the probability of future corporate greenwashing, mainly through mechanisms such as corporate information opacity and agency costs. In what concerns climate lobbying, Taddeo et al. (2025) analyse the connections between lobbying contributions and ESG disclosure of S&P 500 companies from the US, from 2014 to 2022 by implementing the GMM-SYS Arellano-Bond estimator to verify how sustainability transparency is influenced by the number of lobbying contributions. Their study suggests that firms involved more heavily in lobbying might strategically reduce transparency in their sustainability reports, possibly relying on political influence instead of public accountability.

Unlike the aforementioned studies that rely on companies' own communications, such as reports and statements and on well-known rating agencies, the present study aims to measure the discrepancy between the communicated public image and actual behaviour by using publicly available data on evaluation platforms as standardised external sources, developed by institutions established in the assessment of corporate climate transition. In this way, the study identifies the research gap in the literature that consists of not using publicly available data on evaluation platforms as standardized external sources instead of the CSR/ESG reports and specific agencies rating (such as Asset4, ThomsonReuters, Bloomberg) ESG scores to assess greenwashing and aims to bring original contributions to the development of the greenwashing measurement literature through the proposed indicators and index.

This research is twofold. First, it develops a numerical index aimed at assessing companies greenwashing risk based on the following indicators, LobbyMap, TPI Management, TPI Performance, CA100+ and Green Revenue. Further, it tests the application of the index on the following three companies: Unilever, L'Oréal and Estée Lauder. The choice is significant because, although the three companies operate in the same sector, they appear to differ in how their climate performance, political backing, and the economic structure of the green transition align. The investigation approach is driven by the following research questions:

RQ1. How can publicly available data and scores on external platforms be interpreted as signals of lower or higher greenwashing risk?

RQ2. How can companies' greenwashing risk be assessed not only by analysing public messages, but also through a combination of external indicators?

The structure of the paper includes a brief introduction to the research issue followed by an anchoring in the literature and theoretical framework exposure, a description of the data, variables and methodology used, and a presentation of the results, discussions and finally the main conclusions and implications of the study.

2. Conceptual framework and literature review

To prepare this study, recent international and national literature was reviewed, with a focus on publications from the last five years. The review synthesised works that use signalling theory to evaluate the credibility of green signals conveyed by corporations (such as ESG reports, Net-zero commitments, and sustainability communications) and their links to governance mechanisms, political connections or influence, and greenwashing. From a Signaling Theory perspective, ESG

communication shapes stakeholder perceptions by signalling a firm's commitment to sustainability (Cinceoglu et al., 2026). This theory has played a key role in examining how companies employ green marketing to stand out and how consumers perceive these signals, especially regarding potential greenwashing (Forliano et al., 2025). For example, Connelly et al. (2011) argue that each company has the chance to either reveal or hide its true quality to outsiders. This suggests that, when considering the costs, lower-performing organizations also see a strong incentive, due to expected legitimacy gains, to send false signals. As a result, stakeholders are unable to differentiate between genuine and superficial value-based communication on company's green initiatives. On the same note, Spence (2002) argues that a reason for the success of corporations in providing misleading signals lies within the communication, which is based on information asymmetry between the signaler (the company) and the receiver (the stakeholders). Therefore, due to the information asymmetry between an organization and its relevant stakeholders, false green communication can be used as a signal of corporate environmental behaviour (Seele & Gatti, 2017). In the area of sustainability, green signals can include ESG/sustainability reports, certifications/labels, Net-zero promises, and advertising claims (Hilton, 2025; Montgomery et al., 2023). Recent studies indicate that companies may strategically choose among honest reporting, greenwashing (excessive disclosure), and greenhushing (withholding communication) based on cost-benefit analysis and the potential penalties for providing false signals (Hilton, 2025). Recent research indicates that lobbying activity and its alignment with climate commitments serve as signals or counter-signals. The gap between promises and actions, even in politics, increases the risk of greenwashing beyond what reports reveal (Brown et al., 2026). Simultaneously, recent reviews highlight the diversification of greenwashing practices the shift towards narratives about the future (such as net zero commitments), which increases the importance of verification mechanisms and the institutional framework (Montgomery et al., 2023).

The emergence of greenwashing as strategic signaling outcome. Theoretical research indicates that greenwashing can happen as an equilibrium when the reputational or financial gains from green signals exceed the costs and penalties of false signaling. In a signaling game context, greenwash occurs if the penalties for making false claims are too low, and greenwash can also happen if the signaling costs are disproportionately high compared to the benefits (Hilton, 2025). Recent reviews confirm that greenwashing has evolved from simple static communications to consumers to more dynamic forms and future-oriented narratives, making it harder to judge the credibility of these signals and requiring multiple sources usage for verification (Montgomery et al., 2023).

Assessing corporate governance role in supporting the signals credibility. A key empirical focus is on whether governance mechanisms make false signaling more costly and help reduce greenwashing. In an emerging market context of mandatory reporting, Lee et al. (2025) show that board independence and gender diversity are associated with reduced greenwashing, and political connections and sensitive industries may moderate the governance-greenwashing relationship. However, the evidence is not entirely conclusive, and Ghitti et al. (2024) propose new measures to detect greenwashing and some board characteristics, such as board independence, may be linked to increased greenwashing, indicating possible symbolic use of governance mechanisms. Additionally, they show that greenwashing can negatively impact firm value (Ghitti et al., 2024).

ESG assurance as a signal verification mechanism. Recent research treats ESG assurance as a mechanism that increases signal verifiability and reduces information asymmetry. Bu et al. (2024) empirically shows in a study conducted on Chinese companies from 2014 to 2022 that ESG assurance/auditing significantly reduces greenwashing. Thus, the effect is stronger in contexts with a weaker legal environment and when managerial ownership is low, and ESG performance can mediate the relationship between assurance and greenwashing (Bu et al., 2024).

Political influence (political connections) and counter-signals (lobbying). Recent literature investigates whether political connections discipline or, on the contrary, facilitate greenwashing. Chen et al. (2025) shows that politically connected non-SOE firms in China have lower greenwashing intensity, using anti-corruption campaigns as an exogenous shock, reporting an increase in greenwashing after weakening political ties, and the mechanisms identified include easing financial constraints, increased public scrutiny, and regulatory pressures. In parallel, studies on climate commitments highlight that lobbying that is not aligned with climate promises acts as a counter-signal that undermines the credibility of promises. (Brown et al., 2026) develop a framework to evaluate the greenwashing risk for over 4,000 companies, explicitly incorporating lobbying activity as a risk factor. As the authors highlight, climate commitments often involve significant greenwashing risks (Brown et al., 2026). Lee et al. (2025) also show that the network of political connections can influence how governance affects greenwashing in corporate reporting. This indicates that political influence may strengthen or weaken the impact of internal control mechanisms (Lee et al., 2025).

Operationalizing greenwashing as a gap between communication and performance. An important methodological aspect is to measure greenwashing through the misalignment between the language/tone of reporting and ESG performance or other objective data. Thus, Motz et al. (2026) propose an automated greenwashing tendency score (GTS), based on NLP (sentiment analysis on companies' sustainability reports and alignment analysis between these reports and the UN's Sustainable Development Goals (SDGs)) and ESG ratings, applied to 36 German stock index companies from 2020 to 2022, providing a reproducible tool for monitoring and analysis. Zhou & Chen (2024) build an EDG (Environmental Disclosure Greenwashing) index. Based on textual analysis of annual reports, it is shown that public attention decreases EDG primarily through a surveillance effect rather than a legitimisation incentive. Additionally, formal regulations can have negative effects, which can be mitigated through informal monitoring mechanisms.

In the table below, we present in summary the measurement objectives examined, the authors of the studies and the main research gaps identified in the selected specific literature.

Methodologically, the study is part of the literature that treats greenwashing as a problem of misalignment among several ways of interpreting corporate performance: narrative, political, operational, and financial. In the Climate Action 100+ benchmark, a company's assessment considers not only decarbonization targets, but also the delivery strategy, the role of climate solutions, capital allocation and the coherence of climate policy engagement positions (Climate Action 100+, 2025.; CA100 2024 Benchmark Results Summary, 2024).

Table 1. Operationalizing relevant studies and identifying research gaps

No.	Construct	Measuring objective	Authors of the study	Research gaps
1.	Greenwashing	Communication–performance gap; risk indicators in net-zero pledges; NLP scores versus ESG ratings; Greenwashing Tendency Score (GTS); Environmental Disclosure–Greenness (EDG) index.	Brown et al., 2026; Motz et al., 2026; Zhou & Chen, 2024; Ghitti et al., 2024	Incomplete integration of multi-channel signals: most analyses treat ESG reporting and political lobbying as separate issues, even though research on net-zero pledges clearly shows that political counter-signals are just as relevant to greenwashing risk.
2.	Governance	Board independence, gender diversity, CEO non-duality, board size, and internal control quality.	Lee et al., 2025; Ghitti et al., 2024	While recent studies offer causal insights into political connections, few address governance as an endogenous signalling cost within a formal signalling framework, or examine how governance interacts with ESG assurance to reduce greenwashing.
3.	Assurance	ESG assurance intensity; robust causal identification (PSM, instrumental variables); mediation through ESG performance quality.	Bu et al., 2024	Ambiguity in governance effects and divergent empirical findings (e.g., board independence can either reduce or increase greenwashing depending on the study), pointing to the need for boundary conditions such as institutional context, industry sensitivity, and the type of environmental signal used.
4	Political influence	Political connection dummy variables; exogenous shocks (e.g., anti-corruption campaigns) used for causal identification	Chen et al., 2025; Lee et al., 2025	Lack of long time-series data and dynamic signalling analysis. Literature reviews highlight a growing shift toward future-oriented climate pledges and more sophisticated greenwashing tactics. Longitudinal research designs are needed to capture how firms adjust their disclosure signals over time, whether they shift toward greenhushing, and how they respond to enforcement pressures.
5.	Counter signals	Lobbying alignment scores (InfluenceMap), environmental controversies and sanctions, Scope 3 inconsistencies, and similar objective indicators.	Brown et al., 2026	Over-reliance on ESG ratings and the need for data triangulation. NLP-based detection tools built on ESG ratings risk inheriting the noise and biases embedded in those ratings. Future research should combine them with objective, externally verified data — such as environmental violations, regulatory sanctions, Scope 3 coverage gaps, and lobbying records.

No.	Construct	Measuring objective	Authors of the study	Research gaps
6.	Outcomes	Market value (Tobin's Q); stakeholder reaction assessments; corporate legitimacy.	Ghitti et al., 2024; Zhou & Chen, 2024	Under-explored link between greenwashing outcomes and assurance/audit design. While the literature consistently calls for stronger verification mechanisms, very few models explicitly connect the type and quality of assurance or auditing to the signaling equilibria that determine whether firms choose truthful disclosure, greenwashing, or greenhushing.

Source: authors' work based on the synthesis of relevant studies on the topic

TPI explicitly emphasizes that Management Quality and Carbon Performance are complementary and should be read together, not separately (TPI Centre, 2026). In the context of the application of the provisions of the EU Green Claims Directive in 2026, the greenwashing phenomenon has evolved from simple advertising omissions to complex forms of "hidden lobbying" and misalignment of capital expenditure (CapEx) with declared Net-zero objectives.

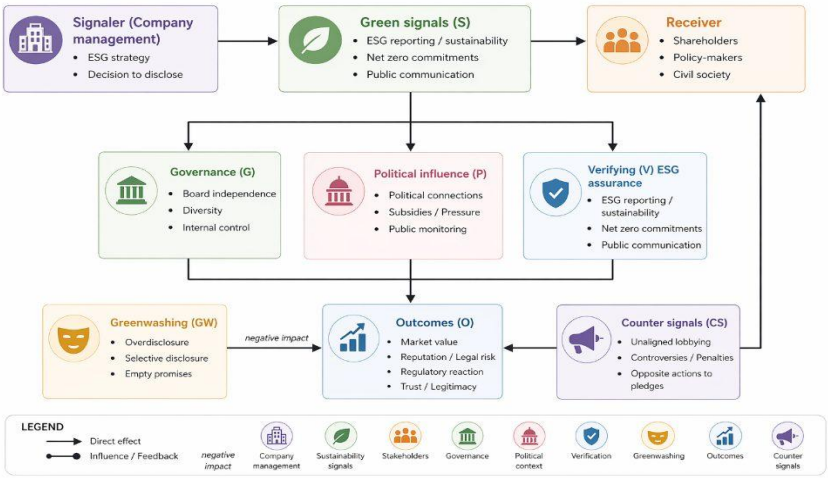


Figure 1. Theoretical framework
Source: authors' projection

The present research uses signaling theory to assess whether green signals transmissions by companies are supported by rigorous mechanisms of governance and political influence. Figure 1 illustrates the model of the conceptual theoretical framework of the present research.
On this basis, the paper treats greenwashing not as a binary variable but as a permanent risk. A company can be convincing if its scores on several dimensions converge, it can be ambiguous when its technical performance is relatively good but political support lags behind, and it can be vulnerable when management, performance, and transparency are all weak. This conceptualization justifies the

introduction of a penalty for inconsistency between indicators in the constructed index formula.

3. Data and methodology

The underlying data used for the 2026 comparative panel in calculating the greenwashing risk index was provided by external public data platforms and took the form of a harmonized working set. The selection of the three companies (L'Oreal, Unilever, Estée Lauder) is justified by the fact that they belong to the same economic sector of consumer goods, the beauty & self-care industry, but differ significantly in their exposure to external assessments regarding the climate transition. Thus, public external data were used to delimit the following indicators used in the research to build the index, LobbyMap Score, TPI Management Quality, TPI Carbon Performance, CA100+ indicators fulfilled and Green Revenue estimates (Table 2). This panel was treated as an exogenous modeling dataset. Simultaneously, the public methodology and, where possible, the public profiles of the companies were checked.

Table 2. Indicators included in the baseline scenario

Indicator	Description
InfluenceMap	Measures the alignment between public statements and political lobbying activities.
TPI Management	Assess the integration of climate governance into decision-making.
TPI Performance	Verify if emissions are on the 1.5°C trajectory according to the Paris Agreement.
CA100+	Benchmark conducted by investors to verify ten climate action criteria.
Green Revenue	Percentage of revenue generated by sustainable activities according to the taxonomy.

Source: own projection based on publicly available external data on platforms

TPI publicly displays L'Oréal level 4 and Unilever level 5 on Management Quality, and the TPI methodology specifies that Management Quality and Carbon Performance represent complementary technical foundations of the assessment (TPI Centre, 2026; L'Oréal - TPI, 2025; Unilever - TPI, 2025). In LobbyMap, L'Oréal's public profile describes a company "broadly supportive" of climate policy, but with exceptions and mixed positions on the energy transition, Unilever's public profile indicates stronger support for ambitious climate action and Estée Lauder's profile shows a very low intensity of direct engagement, so the score is derived mainly from relations with industry associations (InfluenceMap, 2025). A difference can be observed between the 2026 harmonized panel and some publicly visible values in the current LobbyMap profiles of the companies analyzed. That is why the study includes the robustness test in which the ranking of the companies is retested under an alternative scenario that substitutes the LobbyMap ranges in the panel with the publicly visible values at the time of the analysis. Climate CapEx was investigated separately. CA100+ shows that climate solutions disclosure and climate capital disclosure are closely related, but no perfect symmetrical values were identified for all three companies, consequently, CapEx was not included in the central score but discussed separately (CA100 2024 Benchmark Results Summary, 2024).

The method used is comparative case study, suitable when the research object is complex, contextual and multidimensional. From an inferential point of view, the study does not aim to demonstrate strict causality, but to identify patterns of convergence or divergence between external scores and interpret them as signals of a lower or higher risk of greenwashing.

Variables, standardization and construction of the L.I.G.H.T. index. In this study, the risk of greenwashing is assessed through three types of gaps:

- political support gap: the company communicates climate ambition, but InfluenceMap scores indicate weak or ambiguous alignment of its involvement in climate policies.
- corporate governance gap: the company formulates climate objectives, but TPI Management indicates limited integration of the transition into decision-making processes.
- the economic transparency of solutions gap: the company claims to participate in the green transition, but there is no sufficient external evidence of revenues from "climate solutions" or externally assessed carbon performance.

The proposed indicator based on data identified in external platforms is called *"The Longitudinal Integrity & Green-Hurdle Transparency Index"*, acronym LI.G.H.T. index and measures the risk of greenwashing. The basic idea behind the index construction is simple: first build a positive alignment score, then add a penalty for internal inconsistency. Thus, greenwashing is modeled as the opposite of climate ESG coherence.

For the LobbyMap component, the ranges were transformed to an ordinal scale of 0-100. In the 2026 panel, Unilever = A-, L'Oréal = B, Estée Lauder = C+ were converted to scores of 90, 70 and 50. For the TPI Management Quality, the scale was standardized to 100 for 4*, 90 for 4 and 70 for 3. For the TPI Performance, the category "1.5°C aligned" was coded 100 and "Below 2°C" was coded 70. For CA100+, the fulfilled indicators were scaled proportionally, 8/10 = 80, 7/10 = 70, 4/10 = 40. Green Revenue was normalized relative to the maximum in the sample, not to a universal threshold, as there is not yet a unified and homogeneous methodological consensus for a perfectly comparable 2026 sectoral threshold between platforms. Thus, the identified estimates were transformed as follows: 32% was mapped to 100, 28% to 87.5 and 12% to 37.5.

The Longitudinal Integrity & Green-Hurdle Transparency Index formula is:

$$L.I.G.H.T.\ index_i = 100 - \Sigma (w_t * S_{it}) + \lambda * \sigma_i,$$

Where: S_{it} represents the standardized score of company i for indicator t, and σ_i is the standard deviation of the company's standardized score vector, w represents the weight of indicator t. The theoretical weights used in the baseline scenario were: LobbyMap 0.30; TPI Management 0.20; TPI Performance 0.20; CA100+ 0.15; Green Revenue 0.15. The penalty parameter was set at $\lambda = 0.25$. A higher value of the index means a higher risk of greenwashing.

4. Results

Table 3 summarizes the raw values of the indicators used in the baseline scenario. In descriptive terms, Unilever dominates the panel in both climate lobbying and

management, performance and transparency. L'Oréal has a strong but slightly lower profile and Estée Lauder consistently ranks below the other two companies, especially in Green Revenue and the CA100+ indicators.

Table 3. 2026 comparative panel used in the baseline scenario

Company	LobbyMap Score	TPI Management	TPI Performance	CA100+	Green Revenue est.
L'Oréal	B	4	Aliniat 1.5°C	7/10	28%
Unilever	A-	4*	Aliniat 1.5°C	8/10	32%
Estée Lauder	C+	3	Below 2°C	4/10	12%

Source: data gathered from the external platforms

Green Revenue represents working estimates based on the degree of green economic transition. Thus, for L'Oréal and Unilever there are additional public sources on ESG positioning, but no single and perfectly comparable taxonomic threshold for the three companies at the time of the analysis. Therefore, a percentage of 32% was set for Unilever's already partially green economic model, 28% for L'Oréal's advanced but incomplete transition and 12% for Estée Lauder's attachment to the traditional business model. The premise from which the estimate was made was that without green revenues there is a high risk of greenwashing. Applying the formula for determining the L.I.G.H.T. index leads to the following values: Unilever = 8.0, L'Oréal = 20.3 and Estée Lauder = 48.9 (Table 4). Their interpretation is consistent with theoretical expectations. Unilever has the lowest risk of greenwashing, which reflects the convergence between supported public policies, climate management and the relatively high share of green revenues. L'Oréal is positioned in an intermediate zone, technical and managerial performance is high, but lobbying and disclosure are less convergent than in the case of Unilever. Estée Lauder has the highest risk, as all relevant components are weaker and Green Revenue is much lower. What is important to mention is that the L.I.G.H.T. index should not be interpreted as a legal verdict or as evidence of fraudulent intent. It is a comparative risk index. It shows how likely it is that the public image of a "green" company is stronger than the observable concrete substance offered by the selected indicators. In this sense, the index is closer to the logic of reputational risk and stewardship than to the logic of a regulatory sanction.

Table 4. Standardization and results of the L.I.G.H.T. index

Company	Alignment score	Inconsistency penalty	L.I.G.H.T. index
L'Oréal	82.6	2.9	20.3
Unilever	94.0	2.0	8.0
Estée Lauder	54.6	3.5	48.9

Source: own calculations

To interpret the index, heuristic thresholds were imposed that serve the multi-criteria comparative analysis only for the present case study, as follows: 0-15 = low risk; 15-35 = moderate risk; over 35 = high risk; over 50 = very high risk. Figure 2 illustrates the comparative profile of the indicators analyzed and included in the construction of the index.

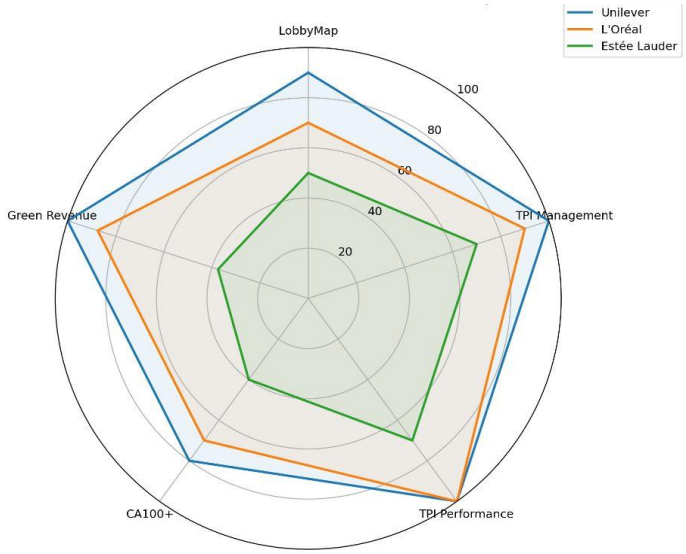


Figure 2. Comparative profile of standardized indicators
Source: own calculations based on the 2026 harmonized panel

As can be seen from Figure 3, Unilever has the lowest risk of greenwashing, L'Oréal a moderate risk and the Estée Lauder index indicate a high risk.

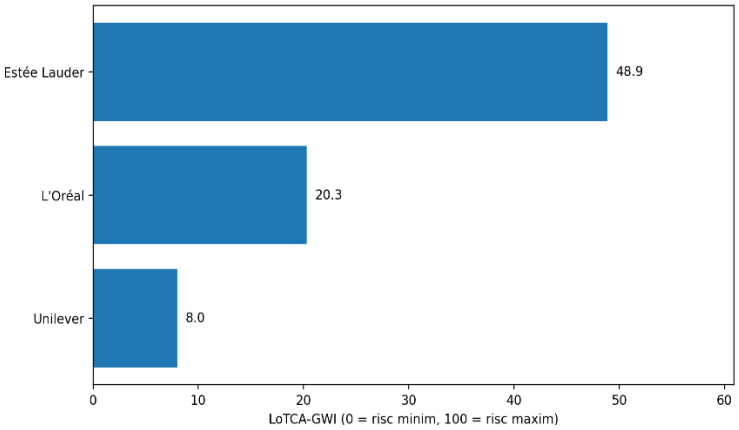


Figure 3. The L.I.G.H.T. index
Source: own calculations

Robustness of the results. Robustness was tested in four alternative ways. The first scenario is the baseline and imposes theoretical weights plus the inconsistency penalty. The second uses equal weights. The third removes the penalty, to see if the ordering is produced only by the average alignment and the fourth replaces the LobbyMap band in the panel with the publicly visible values at the time of the analysis, respectively B-for Unilever, C+ for L'Oréal and D+ for Estée Lauder, keeping the other components unchanged (InfluenceMap, 2025). In all four scenarios, the hierarchy remains the same: Unilever has the lowest risk, L'Oréal remains in the middle, and Estée Lauder has the highest risk of greenwashing

(Figure 4). This stability is important. It shows that the result does not depend on a single arbitrary choice of weight nor on a single version of the LobbyMap scores. Furthermore, the difference between Unilever and Estée Lauder is large enough not to be cancelled out by reasonable rescaling scenarios.

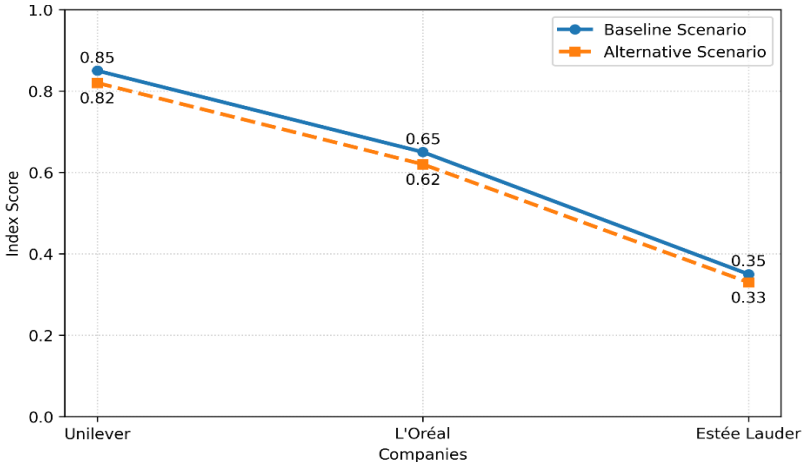


Figure 4. Robustness test
Source: own calculations

5. Discussion

Beyond the L.I.G.H.T. greenwashing index score, the data also allows for an integrated reading of climate ESG performance. L'Oréal reports a CDP triple A score for climate, water and forests for 2025 and an EcoVadis Platinum rating of 84/100, confirming a very solid ESG infrastructure (L'Oréal, 2025a; L'Oréal, 2025b). Estée Lauder, in turn, shows recognition on the CDP A List for its 2024 climate change disclosure, which suggests that its problem is not the complete absence of ESG effort, but rather insufficient coherence between disclosure, lobbying and economic structure (Estée Lauder Companies, 2025a). Unilever has a very robust climate policy engagement review and climate transition action plan framework, and the CA100+ benchmark gives it a relatively advanced position among companies in the sector (Climate Action 100+, n.d.; Unilever, 2025a; Unilever, 2025b). Thus, the L.I.G.H.T. greenwashing index should not be confused with a general ESG rating.

A company can have good ESG or disclosure scores and still be penalized by a greenwashing model if its political support or green revenue structure does not confirm the same ambition. In this sense, L'Oréal is a case of "moderate risk through misalignment", not poor ESG performance. At the opposite end, Unilever achieves both a relatively strong climate performance and a more coherent lobbying profile. Thus, the results obtained for the L.I.G.H.T. index reveal a lack of convergence between the dimensions analyzed within the integrated approach to the risk of greenwashing, the analysis relying almost exclusively on public data existing on external platforms.

The results show that, in this comparison, the best predictor of greenwashing risk is not the simple existence of declared climate objectives, but the convergence of several dimensions, such as the quality of climate management, lobbying alignment, and the density of external evaluation. Unilever outperforms precisely because these

three dimensions support each other. L'Oréal has a reasonable but less consolidated profile. Estée Lauder is disadvantaged by the combination of a weak InfluenceMap score and a lower TPI Management level. A second important observation is that the lack of data is itself a research information. The fact that TPI Carbon Performance is not publicly assessed for any of the companies prevents testing a key hypothesis, whether better managed companies also have better carbon performance. Also, the fact that only Unilever is a fully covered company on CA100+ limits the comparability of the CA100+ and Green Revenue indicators. Furthermore, the analysis suggests that political support is one of the most sensitive areas for detecting greenwashing. A company can have well-articulated targets, reports and narratives, but if political engagement is weak, contradictory or non-transparent, climate credibility decreases. In this regard, the InfluenceMap platform is particularly valuable, as it moves the analysis from claims to conduct.

Furthermore, the search for comparable data on climate CapEx confirmed the relevance of the indicator, but also the difficulty of using it in a case study based on comparative analysis with heterogeneous public sources. The CA100+ benchmark summary for 2024 shows that 38% of the companies assessed disclose the amount of capital expenditures allocated to climate solutions and that 37% disclose the future capital allocation for such solutions, while 78% of the companies that aim to increase their revenues from climate solutions also disclose at least some data on their future CapEx (CA100 2024 Benchmark Results Summary, 2024). However, for the three companies analyzed in this study, not perfectly comparable, public and methodologically homogeneous values were identified for the same reporting year. Consequently, including CapEx in the L.I.G.H.T. index formula would have introduced more uncertainty than explanatory value. The decision to exclude is deliberate and conservative. A narrower, but auditable index was preferred over a richer, but fragile index.

For academic research, the L.I.G.H.T. index provides a transparent way to operationalize greenwashing as a numerical variable. For investors, it can function as an auxiliary stewardship tool, especially where aggregate ESG scores mask gaps between political support, governance, and business models. For regulators, the results reinforce the idea that climate disclosure should be more explicitly linked to disclosure on climate lobbying, climate solutions and capital allocation. In the absence of interoperable standards between these components, companies may project a more coherent climate image than their economic architecture actually is.

6. Conclusions

In the context of the evolution of climate taxonomies (EU Taxonomy 2026, CA100+), the assessment of ESG credibility requires the simultaneous integration of:

- real climate performance (TPI Performance)
- climate governance (TPI Management)
- political influence (InfluenceMap)
- implementation of climate transparency (CA100+)
- economic structure of the business model (Green Revenue, Green CapEx)

This research proposes an integrated model that allows the identification and assessment of greenwashing as a phenomenon of systemic misalignment between these dimensions.

The central goal of the study is to create and test a greenwashing risk index, the L.I.G.H.T. index, for three companies in the beauty and self-care industry. The

Longitudinal Integrity & Green-Hurdle Transparency Index (L.I.G.H.T.) index is an original indicator that semantically suggests the action of shedding light on the "gray" or dark areas of corporate reporting. A high L.I.G.H.T. score means a non-transparent company, operating in the "shadow" (greenwashing), while a low score indicates a company is transparent and acts as it declares. For the companies selected to be included in the case study, the main result is stable, with Unilever presenting the lowest risk, L'Oréal a moderate risk, and Estée Lauder a high risk. The major theoretical contribution is the introduction of explicit penalization of inconsistency between indicators.

In this model, greenwashing is not just underperformance, it is mainly a misalignment between what the company declares, how it governs its transition, what it supports in the political space, and how much of its economic activity can be associated with products or solutions with a better climate profile. At the same time, the study maintains strict methodological discipline, insufficiently comparable indicators, such as climate CapEx, are discussed but not forced into the index. This conservative choice makes the results more robust and credible.

The robustness of the analysis is demonstrated by multi-source triangulation, convergence between independent indicators, and consistency between performance and the economic structure of the business model. As with any research, the study has limitations that can be found in the estimates made for Green Revenue, the interpretation of CapEx based on proxies, and the lack of global standardization. Future work can extend the model by integrating time series, official taxonomic thresholds for Green Revenue, and comparable values of CapEx aligned with the climate transition.

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ESG PERFORMANCE UNDER A COMMON REGULATORY FRAMEWORK: COMPARATIVE EVIDENCE FROM ROMANIA, POLAND, AND ADVANCED EU ECONOMIES

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Abstract: *This study provides a comparative assessment of ESG performance among listed companies in Romania and Poland, benchmarked against advanced European Union economies, within a shared regulatory setting shaped by the CSRD and the EU Taxonomy. Using Refinitiv/LSEG ESG scores (0–100) for 2024—both the overall score and the E, S, and G pillars—we combine descriptive statistics, mean-difference tests (Welch's t-test and the Mann–Whitney test), and OLS (Ordinary Least Squares) regressions with industry fixed effects. Descriptively, Polish firms exhibit higher average ESG scores than Romanian firms; however, the Romania–Poland gap is not statistically robust once industry composition is accounted for. Relative to the advanced-EU benchmark, both countries underperform in the raw comparisons, yet the econometric results indicate that Romania remains significantly below the benchmark after controlling for industry, whereas the difference for Poland is not statistically robust. Pillar-level analyses do not reveal statistically significant differences when E, S, and G are examined separately, suggesting that the observed variation is largely driven by sample composition. Taken together, the results suggest only partial ESG convergence within Central Europe and a wider, persistent gap between Romania and the advanced-EU benchmark—highlighting how strongly sector mix can shape cross-country ESG comparisons.*

Keywords: *ESG performance; ESG convergence; sustainability reporting; Romania; Poland.*

JEL Classification: *Q56; G32; G34; M14; L21*

1. Introduction

The EU's shift toward a more sustainable economy takes place against a backdrop of persistent structural differences among member states. Romania and Poland offer a useful comparison: they share a broadly similar regional and regulatory environment, yet differ in economic scale, energy intensity, and emissions patterns. In 2024, Poland reports a larger economy and higher income levels (GDP and GDP per capita), stronger growth, and lower unemployment—signals of greater macroeconomic resilience. Yet stronger macro fundamentals do not necessarily imply better ESG outcomes at firm level. While the two countries overlap on several structural dimensions, they diverge in trade openness and, most importantly, in their energy systems. Poland remains strongly coal-dependent and has higher per-capita CO_2 emissions, whereas Romania's more diversified energy mix translates into a

different emissions profile. Even under the same EU-wide reporting and classification rules (CSRD and the EU Taxonomy), such structural contrasts can plausibly be reflected in ESG scores. For these reasons, a Romania–Poland comparison is methodologically warranted: it keeps the institutional framework broadly constant while allowing ESG performance to be examined within a region that remains uneven in its economic and energy foundations.

In the recent literature (2020–2025), research on ESG performance in the European Union highlights three dominant trends: (1) the persistence of sizeable gaps between Western European economies and those in Central and Eastern Europe, even under a shared regulatory framework; (2) the central role of institutional factors and sectoral structure in explaining cross-country variation in ESG scores; and (3) the impact of the shift toward mandatory sustainability reporting (CSRD) on data quality and comparability, with asymmetric effects between mature and emerging economies. Taken together, these trends suggest that a uniform regulatory architecture does not guarantee ESG convergence, and that comparative analyses should explicitly control for industry composition and institutional maturity.

Nevertheless, the literature that offers direct comparisons between emerging EU economies—particularly between Romania and Poland—remains limited. Existing studies often treat these economies in aggregate or benchmark them against the EU average without separating country effects from sectoral structure effects. Moreover, firm-level analyses of listed companies that explicitly control for industry composition and are benchmarked against advanced EU economies are still underexplored for Central and Eastern Europe. As a result, it remains unclear whether observed Romania–Poland ESG differences reflect a genuine country (institutional) effect or are primarily driven by differences in the sectoral composition of the samples. This study addresses these gaps, as detailed in the following sections.

This study makes two main contributions. First, it compares ESG performance in Romania and Poland within the same EU reporting architecture, and it does so while controlling explicitly for sectoral structure—so that differences driven by industry mix can be separated from country-specific effects. Second, by adding a benchmark group of advanced EU economies, it allows us to gauge how close Central European emerging markets are to the ESG levels observed in more mature settings and to identify gaps that may be obscured by simple descriptive comparisons.

2. Literature review

Research linking corporate governance, social responsibility, and financial performance delivers mixed—and often strongly context-dependent—results, shaped by institutional arrangements and the maturity of capital markets. For OECD firms, Hamad and Cek (2023) report that governance mechanisms are generally associated with stronger performance (e.g., ROA, ROE, EPS), but the magnitude of these effects varies widely across countries, reflecting differences in culture and institutional design. Evidence from Romania points in a similar direction: Dănescu et al. (2021) find that sound governance supports financial performance, yet its practical effectiveness is constrained by capital-market maturity. This point matters for a Romania–Poland comparison, as both are emerging EU economies but with distinct institutional trajectories.

The ESG/CSR literature has also expanded rapidly, but findings remain nuanced. Using data on listed firms from 58 countries, Luo et al. (2024) show a positive

association between ESG and financial performance, while emphasizing that the relationship is stronger where country-level governance is higher (political stability, regulatory effectiveness, and control of corruption). For Romania and Poland, differences along these dimensions may therefore help explain cross-country variation in the payoffs of ESG investments. Relatedly, Gunardi et al. (2017) argue that CSR can strengthen the governance–performance link, but mainly under specific institutional configurations rather than as a stand-alone driver.

For Romania, Bogdan et al. (2021)—drawing on ISO 26000—find that financially relevant effects come primarily from strategically oriented social responsibility initiatives, whereas sponsorship expenditure is not statistically significant. The distinction between strategic CSR and more ad hoc corporate philanthropy is useful when interpreting aggregate ESG scores, which can mask differences in the coherence and substance of firms' sustainability practices.

Țăran et al. (2026) emphasize the role of board characteristics—size, independence, and sustainability expertise—in shaping performance, noting that effects differ across countries depending on how deeply ESG criteria are embedded in governance structures. Taken together, this body of work confirms that the ESG–financial performance link is not universal, but mediated by institutional factors and by the relative weight of ESG pillars—making a direct Romania–Poland comparison relevant for testing how sensitive the relationship is to differences in institutional maturity.

Using European data for 2011–2020, Iwanicz-Drozdowska et al. (2025) document that countries that joined the EU later exhibit systematically lower ESG scores, particularly on the Social and Governance dimensions. They also note that cross-country comparisons are sensitive to measurement and aggregation choices, and that the ESG–growth relationship is dynamic: ESG improvements often follow GDP growth, while their economic effects materialize over the medium term. These findings support both benchmarking Romania and Poland against advanced EU economies and explicitly controlling for sectoral structure in any comparative analysis.

Birlan et al. (2025) extend the perspective to the subnational level by proposing a framework for measuring ESG performance across EU NUTS regions using PLS techniques suited to high-dimensional data. Their results indicate that governance—operationalized through indicators such as voice and accountability and control of corruption—is the main determinant of aggregate ESG performance, and that spatial disparities between northwestern regions and southern/southeastern regions remain persistent, with the two groups responding differently to external shocks such as the pandemic. A common regulatory framework therefore does not eliminate differences in institutional capacity—an implication that calls for caution when interpreting Romania–Poland comparisons.

Grigorescu et al. (2025), using a case study of a Romanian company, show that implementing CSRD requirements entails deep organizational change: redefining accounting roles, integrating ESG KPIs into budgeting, and adopting analytical tools such as an internal carbon price. Implementation is, however, hindered by fragmented data systems, limited ESG competencies, and low digitalization. This evidence suggests that, even under the same regulatory framework, implementation capacity differs substantially between Western European and Central/Eastern European economies—creating systematic variation in the quality of reported ESG scores that should be accounted for in comparative work.

Two insights from the reviewed literature are especially relevant for the empirical design. First, ESG scores differ across countries, but these differences are often strongly shaped by sectoral structure and the institutional environment; consequently, comparisons based solely on mean differences may conflate country effects with industry effects (Iwanicz-Drozdowska et al., 2025; Luo et al., 2024; Birlan et al., 2025). Second, emerging economies may lag behind advanced economies even under a shared regulatory framework, due to differences in implementation capacity and reporting quality (Grigorescu et al., 2025; Dănescu et al., 2021).
Accordingly, we test whether the Romania–Poland difference persists after controlling for industry composition (H1).
H1: There are statistically significant differences in ESG performance between Romanian and Polish firms, but these differences are influenced by sectoral structure such that controlling for industry reduces or eliminates country effects.
Separately, we compare Romania and Poland to an advanced-EU benchmark (H2).
H2: Romanian and Polish firms have ESG scores that differ significantly from the benchmark of advanced EU economies.

3. Data and methodology

The empirical analysis uses ESG scores provided by LSEG Data & Analytics (formerly Refinitiv), one of the most widely used international datasets for assessing firm-level sustainability performance. The scores are standardized on a 0–100 scale and reflect firms' transparency, policies, and performance across environmental, social, and governance dimensions. The main dependent variable is the aggregate ESG score (ESG Score). In complementary analyses, the overall score is decomposed into its three core pillars—Environment (E), Social (S), and Governance (G)—computed according to the LSEG methodology as aggregates of pillar-specific subcomponents. The analysis is cross-sectional and relies on 2024 scores, the most recent year available in LSEG at the time of data collection.
The sample is constructed from listed companies on European markets tracked via the Nasdaq European Market Activity platform, for which LSEG Data & Analytics reports ESG scores for 2024. For Romania, we include firms listed on the Bucharest Stock Exchange (BVB); for Poland, firms listed on the Warsaw Stock Exchange (GPW). A firm is retained if it meets three conditions simultaneously: the aggregate ESG score is available in LSEG, the firm can be assigned to an identifiable sector according to LSEG's classification, and it is actively listed on the relevant national exchange at the time of data collection. Firms from non-EU countries are excluded. The initial dataset includes 122 firms with an available aggregate ESG score.
Depending on the availability of additional variables (pillar scores and sector classification), we derive subsamples used at different stages of the analysis: 54 firms for the bilateral Romania–Poland comparison (28 from Romania and 26 from Poland), 68 firms for the extended benchmark comparison with advanced EU economies, and 84 observations for the pillar-level analysis. Differences in subsample sizes reflect incomplete data availability across variables; this approach allows us to use the maximum number of observations without compromising the coherence of each analysis. The dataset is organized as a unified file in which each firm is identified by country, sector, and the relevant ESG scores, ensuring traceability between raw data and reported results. Table 1 summarizes the variables used.

Table 1. Description of variables

Variable	Definition	Source	Scale
ESG Score	Firm's aggregate ESG score	LSEG (Refinitiv)	0–100
Environmental (E)	Environmental pillar score	LSEG	0–100
Social (S)	Social pillar score	LSEG	0–100
Governance (G)	Governance pillar score	LSEG	0–100
Dummy RO	1 if firm is from Romania	Author's calculation	0/1
Dummy PL	1 if firm is from Poland	Author's calculation	0/1
Industry	Firm's sector	LSEG	categorical

Source: author's processing based on LSEG Data & Analytics (Refinitiv ESG) data, 2024

To provide a clear picture of the sample composition, the distribution of firms by sector and geographic group is reported in Table 2.

Table 2. Distribution of firms by sector and group

Sector	Romania	Poland	Advanced EU	Total
Energy & Utilities	4	4	11	19
Bank & Insurance	4	4	11	19
Construction Materials	3	3	6	12
Food, Beverage & Tobacco	4	4	12	20
Retailers & Consum	3	3	6	12
Software & IT Services	3	2	6	11
Medicine	3	3	6	12
Other	4	3	10	17
Total	**28**	**26**	**68**	**122**

Source: author's processing based on LSEG Data & Analytics (Refinitiv ESG) data, 2024

For the econometric analysis, the aggregate ESG score is used as the dependent variable, while Romania and Poland membership is captured through country dummy variables together with industry fixed effects to isolate the role of industrial structure. To ensure methodological consistency, each stage of the analysis uses

an explicitly defined sample, and results are interpreted strictly within that sample's scope. The bilateral comparison, the benchmark analysis, and the pillar-level decomposition are conducted on distinct subsamples determined by data availability, thereby limiting distortions due to missing values and supporting robust interpretation.

The reference group consists of listed firms from five Western European EU economies—France, Germany, Denmark, Finland, and Sweden—selected using the same criteria applied to the Romania and Poland samples. These countries were chosen to reflect both capital market maturity and more advanced ESG implementation, providing a meaningful benchmark for assessing convergence among emerging Central European economies.

This approach enables interpretation in terms of relative differences against a common European benchmark. The analysis proceeds in three complementary steps. First, descriptive statistics compare means and distributions of ESG scores across the three groups—at the aggregate level and by pillars (E, S, G)—to identify initial differences. Second, the robustness of the observed differences is evaluated using mean-difference tests, combining Welch's t-test (which does not assume equal variances) with the Mann–Whitney test as a non-parametric alternative. Using both tests is appropriate given the relatively small sample size and potential departures from normality. Third, to separate country effects from industry composition, we estimate an OLS (Ordinary Least Squares) regression model. OLS estimates the coefficients of a linear model by minimizing the sum of squared deviations between observed and predicted values, and is widely used in cross-sectional settings. In this study, the OLS specification quantifies average ESG differences between Romania, Poland, and advanced EU economies while jointly controlling for sectoral structure. OLS is appropriate because the dependent variable—the ESG score—is continuous and the objective is to estimate mean differences between groups rather than to generate firm-level predictions. The estimated model is:

$$ESG_i = \alpha + \beta_1 RO_i + \beta_2 PL_i + \sum_k \gamma_k \, Industry_{ik} + \varepsilon_i$$

where:

– the ESG score of firm *i* (dependent variable; the aggregate score or, in separate analyses, the E, S, or G pillar score);

– the constant term (intercept);

– a dummy variable equal to 1 if firm *i* is from Romania and 0 otherwise;

– a dummy variable equal to 1 if firm *i* is from Poland and 0 otherwise;

the omitted (reference) category consists of firms from the advanced EU economies;

– dummy variables for business sectors, where *k* indexes industries; these capture industry fixed effects;

– sector-specific coefficients that control for systematic differences across industries;

– the error term capturing unobserved factors that influence ESG scores.

Using an OLS model is appropriate in this context given the cross-sectional nature of the data and the objective of estimating average differences between groups. Industry fixed effects are introduced as sector dummy variables for each sector represented in the sample: Energy & Utilities, Bank & Insurance, Construction Materials, Food, Beverage & Tobacco, Retailers & Consum, Software & IT Services, Medicine, and Other. These controls capture systematic differences in ESG scores across industries that are independent of a firm's country of origin. This is important

because ESG performance varies structurally across sectors: firms in environmentally intensive industries—such as Energy & Utilities—may report higher ESG scores in response to stronger regulatory pressure, not necessarily because their practices are intrinsically superior. Without this control, observed differences between Romania, Poland, and advanced EU economies could simply reflect different industry mixes rather than genuine country effects. Including industry fixed effects therefore helps separate country effects from industry effects and improves the interpretability of the estimated coefficients.

4. Results and discussion

The descriptive analysis points to visible differences between Romanian and Polish firms in terms of the aggregate ESG score.

On average, Polish firms report higher ESG scores than Romanian firms. The differences are not uniform across the three ESG pillars; both their magnitude and pattern vary across Environment, Social, and Governance.

The score distribution appears more polarized for Romania, where both very high and notably low values are observed. Poland exhibits a more compact distribution, suggesting a more uniform level of ESG practices across firms.

Benchmarking against the reference group—advanced EU economies—helps assess the degree of ESG convergence. The gap is defined as:

The mean values and the computed gaps are reported in Table 3.

Table 3. ESG gap relative to the advanced-EU mean

Dimension	Advanced-EU mean	Romania (mean)	Romania (gap)	Poland (mean)	Poland (gap)
Environment	58.19	52.42	**-5.78**	64.63	**6.43**
Social	60.96	58.33	**-2.63**	65.44	**4.48**
Governance	56.12	56.50	**0.38**	55.94	**-0.18**

Source: author's processing based on LSEG Refinitiv ESG data (2024).

Pillar-level patterns differ across Romania, Poland, and advanced EU economies. On Environment, Poland records the highest mean score (64.63), exceeding even the advanced-EU mean (58.19), while Romania lags behind (52.42) and shows higher dispersion, consistent with sectoral heterogeneity or differences in the maturity of environmental practices. On Social, Poland again exceeds the advanced-EU mean (65.44 versus 60.96), while Romania is closer to the benchmark (58.33), with a smaller gap relative to Poland than for Environment. On Governance, the three groups report nearly identical mean scores—Romania (56.50), advanced EU (56.12), and Poland (55.94)—suggesting no meaningful structural differences on this dimension.

Overall, the descriptive results suggest that Poland is positioned more favorably than Romania in ESG terms, both in absolute levels and relative to advanced EU economies, with the largest differences on the Environment pillar. Romania also displays higher score variability, pointing to a more heterogeneous firm-level ESG performance distribution.

At the aggregate level, the mean ESG score is 46.25 for Romania and 57.19 for Poland, a difference of about 10.94 points in favor of Polish firms. However, without

statistical testing, this descriptive gap cannot be interpreted as evidence of a structural difference. We therefore extend the analysis by applying statistical tests of mean differences.

To test H1, we assess whether the difference in ESG scores between Romanian and Polish firms is statistically significant. The null hypothesis assumes no difference between the two distributions. To evaluate whether the observed gap is statistically robust, we apply two complementary tests reported in Table 4.

Table 4. Testing the significance of the ESG mean difference (Romania vs. Poland)

Test	Statistic	p-value	Conclusion (α = 0.05)
Welch t-test (unequal variances)	t = -1.37	0.194	The difference is not statistically significant
Mann–Whitney U (non-parametric)	—	0.209	The difference is not statistically significant

Source: author's calculations based on LSEG Refinitiv ESG data (2024).

Both tests indicate that the difference between Romanian and Polish ESG means is not statistically significant at the 5% level. While Poland records a higher mean, the evidence is insufficient to support a systematic difference between the two countries. The gap is therefore visible descriptively but not confirmed statistically.

In the second step of testing H1, we estimate an OLS regression with industry fixed effects to assess whether the Romania–Poland differences persist after controlling for industrial structure. The results show that once industry fixed effects are included, the country difference becomes statistically insignificant (coefficient = −2.29; p = 0.761). Moreover, the negative sign indicates that the initial descriptive advantage of Poland does not hold in the econometric specification. Overall, the Romania–Poland differences are not statistically robust after controlling for sectoral structure, suggesting that the aggregate ESG variation is driven primarily by the sample's industry composition rather than by a systematic country effect.

These results are consistent with Iwanicz-Drozdowska et al. (2025), who show that ESG gaps between Eastern and Western European economies are often attenuated after controlling for structural factors, and with Birlan et al. (2025), who document that within-EU ESG disparities are driven more by institutional capacity than by country labels per se. The finding that the Romania–Poland difference disappears after industry controls also aligns with Luo et al. (2024), who emphasize that industry structure and country-level governance are stronger determinants of ESG performance than nationality alone. By contrast, Romania's more pronounced gap relative to the advanced-EU benchmark—persisting after industry controls—is consistent with Grigorescu et al. (2025), who argue that CSRD implementation in emerging Eastern European economies is constrained by limited institutional capacity and fragmented data systems.

Accordingly, the evidence does not support a statistically meaningful structural difference between Romania and Poland in firm-level ESG performance.

This conclusion motivates a pillar-level analysis (Environment, Social, and Governance), which may reveal patterns that are not visible in the aggregate ESG score.

To identify the potential sources of Romania–Poland differences, we decompose the aggregate ESG score into the three core pillars: Environment (E), Social (S), and Governance (G), computed according to the LSEG (Refinitiv) methodology. Descriptively, Poland records higher mean scores than Romania on Environment (62.66 versus 50.21) and Social (64.76 versus 58.17). For Governance, mean values are close, with Romania marginally higher (54.67 versus 52.42). However, the applied tests (Welch's t-test and Mann–Whitney) indicate that the observed differences are not statistically significant at the 5% level for any pillar. Overall, the results suggest that the descriptive advantages—especially on Environment—do not reflect robust structural differences between the two economies and may instead be driven by sample heterogeneity and sectoral composition rather than a systematic country effect.

To test H2, we compare ESG scores for firms in Romania and Poland with those in advanced EU economies used as the benchmark. The null hypothesis assumes no significant differences between emerging and advanced economies. The mean ESG score for the advanced-economy group is 62.54, compared to 57.19 for Poland and 53.08 for Romania. Descriptively, this implies a gap of 5.35 points for Poland and 9.46 points for Romania relative to the advanced-EU mean. However, the applied tests (Welch's t-test and Mann–Whitney) indicate that these differences are not statistically significant at the 5% level. Thus, although advanced economies exhibit higher ESG scores, the observed differences are not statistically robust in the simple mean-difference tests.

For a more systematic assessment, we estimate a regression model in which the dependent variable is the ESG score and the key explanatory variable is a dummy for emerging-economy status (Romania and Poland). The estimated coefficient is negative (−7.11), suggesting lower ESG levels in emerging economies; however, the estimate is not statistically significant.

Overall, the results suggest that ESG differences between the two analyzed Eastern European economies and the advanced-economy group are largely descriptive rather than statistically demonstrated structural gaps. The observed variation may be influenced by sample size and sectoral composition.

The comparative analysis indicates that the Romania–Poland difference is visible descriptively but not statistically supported. Likewise, the comparison between emerging and advanced economies points to an apparent gap that is not statistically significant. Introducing controls for sectoral structure eliminates the Romania–Poland differences, suggesting that the initial variation is better explained by industry composition than by country-specific effects.

A simple convergence view is to evaluate the "distance" to the advanced-EU mean using the average gap (Figure 1): Romania −11.88, Poland −5.49.

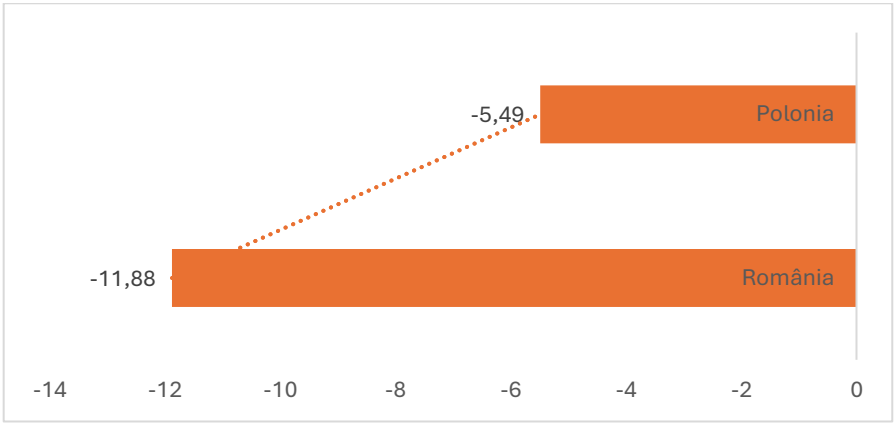


Figure 1. Distance to the advanced-EU mean ESG score
Source: author's processing based on LSEG Refinitiv ESG data (2024).

Poland appears to be at a more advanced stage of convergence toward the ESG level of advanced EU economies. Romania remains at a larger distance, and the industry-controlled model indicates that this gap is not fully explained by the industrial mix.
Effect size (Cohen's d, indicative) is reported in Table 5.

Table 5. Effect size relative to the advanced-EU mean (Cohen's d)

Comparison	Cohen's d	Effect
Romania vs. advanced EU	-0.62	moderate
Poland vs. advanced EU	-0.3	small

Source: author's calculations based on LSEG Refinitiv ESG data (2024).

These values support the same conclusion: Romania's gap relative to the advanced-EU benchmark is more pronounced.
The findings indicate that ESG performance differences between Romanian and Polish listed firms are visible descriptively, but are not statistically robust once sectoral structure is controlled for. This suggests that the observed variation does not reflect a country effect per se, but is largely driven by the sample's industry composition.
Benchmarking against advanced EU economies reveals an ESG gap for both countries, more pronounced for Romania. In the econometric specification with industry fixed effects, Romania remains significantly below the European benchmark, while the difference for Poland is not statistically robust, pointing to incomplete ESG convergence under a shared regulatory framework.
The pillar-level analysis does not reveal consistent structural differences between the two economies on Environment, Social, or Governance, suggesting that the aggregate ESG score reflects cumulative factors rather than a single dominant component.
The results should be interpreted in light of limitations related to sample size and the cross-sectional nature of the data, which may reduce statistical power and limit

generalizability. Extending the analysis by adding firm-level controls and using panel data are relevant directions for future research.

The pillar-level analysis uses a subsample of 22 firms from Romania, 26 from Poland, and 36 from advanced EU economies, totaling 84 observations. The smaller sample reflects limited availability of complete E, S, and G scores; only firms reporting all three pillars are included. A comparative summary of mean ESG levels and gaps relative to the advanced-EU benchmark is reported in Table 6.

Table 6. Descriptive benchmark by ESG pillars (Romania, Poland, advanced EU)

Dimension	Romania (mean)	Poland (mean)	Advanced EU (mean)	RO vs. EU (diff.)	PL vs. EU (diff.)	Statistical significance
ESG Total	53.08	57.19	62.54	−9.46	−5.35	Not significant ($p > 0.05$)
Environment (E)	52.42	64.63	58.19	−5.77	6.44	RO–PL: −12.21 ($p > 0.10$)
Social (S)	58.33	65.44	60.96	−2.63	4.48	Not significant
Governance (G)	56.50	55.94	56.12	0.38	−0.18	Not significant

Source: author's processing based on LSEG Refinitiv ESG data (2024).

At the level of the analyzed dimensions, no meaningful structural differences are observed across the three groups.

To assess whether the observed differences persist after controlling for sectoral structure, we examine the results of the OLS model described in the methodology section.

At the aggregate level, Poland records higher mean ESG scores than Romania; however, these differences are not statistically significant in bivariate tests. Once sectoral structure is controlled for in the OLS model, the Romania–Poland differences disappear, indicating that they are driven primarily by industry composition rather than by country-specific effects. By contrast, Romania remains significantly below the EU benchmark after controlling for sector fixed effects, while Poland does not exhibit a statistically robust difference.

Overall, the evidence points to a more nuanced picture than what simple mean comparisons suggest. In bivariate tests, the Romania–Poland differences are not statistically significant. Relative to advanced EU economies, both countries lie below the benchmark descriptively; however, in the econometric model with sector fixed effects, only Romania remains significantly below the EU benchmark.

The pillar-level analysis indicates that differences are not statistically robust when the Environment, Social, and Governance dimensions are examined separately. The effects, when present, are more visible in the aggregate ESG score than in any individual pillar.

This pattern may reflect the fact that the aggregate ESG score bundles several elements—institutions, reporting capability, and how deeply ESG is integrated into strategy—that are not easily isolated in pillar-by-pillar comparisons. In our sample, Romania shows a larger shortfall relative to the advanced-EU benchmark, whereas

Poland lies closer to the reference level. These results should be read with caution, given the relatively small samples and the risk that industry composition still influences the comparisons.

Overall, the evidence points to incomplete ESG convergence among the economies analyzed, and it does not support a stable structural advantage of one country over the other. Although Poland's average ESG score is higher, the Romania–Poland difference is not statistically confirmed in the tests applied.

Although Poland shows higher average ESG values, the differences relative to Romania are not statistically confirmed.

Accordingly, the data do not provide empirical support for a strong, country-level structural gap in firm-level ESG performance between Romania and Poland.

When benchmarked against advanced EU economies, both emerging markets sit below the reference mean in descriptive terms: Romania's average ESG score is about 9–12 points lower, while Poland's is roughly 5–6 points lower.

In the simple mean-difference tests, these benchmark gaps are not statistically significant. Once sectoral structure is controlled for in the regression framework, however, Romania remains significantly below the advanced-EU benchmark, whereas the estimated difference for Poland is not statistically robust. In other words, within this sample, Romania's shortfall relative to advanced economies persists even after accounting for industry mix.

This finding suggests that, in the analyzed sample, Romania displays a more pronounced ESG gap relative to advanced economies, even after controlling for industrial structure.

Breaking the ESG score into pillars yields a broadly balanced picture. On Environment, Poland has higher mean values than Romania and scores that are comparable to—or slightly above—the advanced-EU mean, but the differences are not statistically supported. On Social, both Romania and Poland cluster near the European mean, with no robust gaps. On Governance, the three groups are very close, suggesting no clear structural discrepancies.

The sector-controlled regressions likewise show no significant country effects for any single pillar. This suggests that the observed gap is not concentrated in one dimension; instead, it is more consistent with an aggregate effect linked to the overall consistency of ESG practices and the strength of reporting and governance arrangements.

Beyond its academic contribution, the study has several practical implications. First, for listed firms in Romania, the fact that the ESG gap relative to the European benchmark persists after sector controls suggests that closing it will require more than formal CSRD compliance; it calls for investments in reporting capacity, stronger internal governance, and the integration of ESG criteria into core decision-making.

5. Conclusions

Based on the available data, the following conclusions can be drawn:

ESG differences between Romania and Poland are visible descriptively but are not statistically robust.

Both Romania and Poland fall below the mean of advanced EU economies.

After controlling for industry, Romania remains significantly below the EU benchmark for the total ESG score, while Poland does not.

There are no significant structural differences on the individual E, S, or G pillars.

These results suggest that ESG performance in Central Europe exhibits a higher degree of convergence than what simple raw-mean comparisons would imply. At the same time, they point to a moderate gap for Romania relative to advanced economies that cannot be explained solely by sectoral structure.

Overall, the results imply that the Romania–Poland differences in ESG scores are mainly descriptive and should not be read as structural once industry composition is taken into account. By contrast, the benchmark exercise points to a larger shortfall for Romania that persists even with sector fixed effects. This pattern may be consistent with differences in reporting maturity, investor scrutiny, or the depth with which ESG practices are implemented at the firm level.

At the same time, the conclusions must be viewed in light of the sample constraints and the coverage of the LSEG/Refinitiv database. The limited number of observations and the way firms enter the dataset may reduce statistical power and introduce selection effects—particularly for Romania—so the estimates should be interpreted as indicative rather than definitive.

Future research directions follow naturally from these limitations and results. First, extending the sample over time (a multi-year panel) would allow testing ESG convergence and separating cyclical from structural effects. Second, adding firm-level controls (size, profitability, leverage, asset intensity, export exposure) would reduce the risk that the country coefficient captures differences in financial structure. Third, linking ESG scores to financial performance indicators (e.g., ROA, ROE, Tobin's Q) within a fixed-effects framework and robustness tests would enable an explicit assessment of the channels through which sustainability may translate into economic outcomes.

Finally, the results support the relevance of intra-EU comparative approaches for emerging economies: the same regulatory architecture does not automatically produce homogeneous outcomes. The differences observed between Romania, Poland, and advanced economies suggest that, beyond sectoral structure, institutional and organizational capacity to internalize ESG requirements into processes and governance—rather than merely to report compliance—also matters.

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SECTION MANAGEMENT, MARKETING, ECONOMIC INFORMATICS AND CYBERNETICS

THE EVOLUTION OF MANAGEMENT CONSULTING: HISTORICAL FOUNDATIONS, KNOWLEDGE INTEGRATION, AND IMPLICATIONS FOR MANAGERIAL DECISION-MAKING

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Abstract: *Management consulting has evolved from a narrowly defined technical support function into a complex, knowledge-intensive activity playing a central role in managerial decision-making. This paper aims to provide a structured and interpretive overview of the historical development of management consulting, with particular attention to its transformation from scientific management roots to contemporary knowledge integration practices. The study addresses the following research question: how has the role of management consulting evolved over time, and how does this evolution shape its contribution to managerial decision-making? The paper adopts a conceptual approach, drawing on seminal contributions in management theory, organizational learning, and knowledge management. Rather than offering a purely chronological account, the paper emphasizes the shifting role of consultants, highlighting how their role has gradually shifted from delivering standardized solutions towards facilitating context-dependent learning processes within organizations. The analysis demonstrates that early consulting practices, grounded in the principles of scientific management, focused primarily on efficiency and rationalization, assuming that organizational problems could be addressed through objective, universally applicable solutions. Over time, however, the increasing complexity of organizational environments, coupled with the growing recognition of human and contextual factors, led to the emergence of more sophisticated approaches, including strategy consulting and process-oriented approaches. In recent decades, the emphasis has further shifted towards co-creation and knowledge integration, where the value of consulting lies not only in expertise but also in supporting organizational learning, interpretation, and informed decision-making under conditions of uncertainty. The paper contributes to the literature by offering an integrated perspective on the historical evolution of consulting and by highlighting its implications for understanding the conditions under which consulting inputs are effectively translated into managerial decision-making and action. It draws attention to the increasing importance of trust, contextual*

sensitivity, and interpretive capacity in shaping the outcomes of consulting engagements. By positioning consulting as a dynamic and relational process, the study provides a conceptual foundation for future research on managerial decision-making and the practical applicability of external advisory inputs in managerial contexts.

Keywords: *management consulting; managerial decision-making; knowledge integration; organizational learning; consulting evolution; decision support*.

JEL Classification: *M10; D83; L20*

1. **Introduction**

Management consulting has become a significant component of modern organizational practice, yet its role and underlying logic have undergone substantial transformation. While early forms of consulting focused on efficiency and process optimization, contemporary consulting goes beyond technical problem-solving and is closely linked to managerial decision-making, organizational learning, and knowledge integration. Managerial decision-making is inherently affected by cognitive biases and noise, thereby increasing the relevance of external advisory support under conditions of uncertainty (Kahneman et al., 2021). At the same time, the growing importance of learning from failure underscores the need for adaptive, learning-oriented consulting approaches (Edmondson, 2023). Taken together, these developments reflect a broader shift from mechanistic models towards more context-sensitive and adaptive approaches to organizations and management (Katz and Kahn, 1966; Lawrence and Lorsch, 1967).

The origins of management consulting can be traced to scientific management and early administrative theories, which aimed at rationalizing organizational processes through systematic analysis (Taylor, 1911; Fayol, 1949). However, growing organizational complexity revealed the limitations of these approaches, leading to greater emphasis on human, social, and contextual factors, as well as organizational behaviour and learning (Mayo, 1933; Katz and Kahn, 1966). Over time, consulting has evolved into a distinct professional field that not only provides expertise but also shapes managerial practices and decision processes (Kipping and Clark, 2012; Armbrüster, 2006). Consultants increasingly engage in collaborative processes, supporting problem framing, interpretation, and knowledge co-creation (Schein, 1999; Argyris, 1991). In addition to its problem-solving role, consulting also contributes to the legitimization of managerial decisions, influencing both decision quality and acceptance (Alvesson and Johansson, 2002). As a result, consulting effectiveness depends not only on analytical accuracy, but also on trust and contextual interpretation.

Against this background, this paper provides an interpretive overview of the historical development of management consulting and its evolving role in managerial decision-making. It addresses the following research question: how has the role of management consulting evolved over time, and how does this evolution shape its contribution to managerial decision-making? The study adopts a conceptual approach based on a structured review and interpretive synthesis of key contributions from management theory, organizational learning, and consulting literature. This perspective is particularly relevant in the Central and Eastern

European context, where consulting practices are shaped by specific institutional and market conditions (Poór, 2016; Poór et al., 2024).
By examining the development of consulting from its scientific management origins to contemporary knowledge-based practices, the paper contributes to a more nuanced understanding of consulting as a dynamic and relational process, highlighting the conditions under which consulting inputs translate into managerial action.

2. From Rationalization to Organizational Complexity: The Evolution of Management Approaches

The origins of management consulting are closely linked to the development of modern management thought and the structural transformations of industrial society. The emergence of large-scale organizations created new managerial challenges that required more systematic approaches to coordination and control. In this context, early consulting focused on efficiency and process rationalization, evolving as an applied extension of scientific management and administrative principles rather than an independent profession. This section outlines these foundations and their role in shaping consultants as external experts focused on technical optimization.

2.1. Scientific Management and the Logic of Rationalization

The emergence of management consulting is closely linked to the economic and organizational transformations of the late nineteenth and early twentieth centuries. The industrial revolution increased organizational scale and created new challenges in coordination, efficiency, and control. As traditional managerial practices proved insufficient, organizations began to adopt more systematic and analytical approaches to managing work processes, reflecting a broader shift towards rationalization characterized by formalization, predictability, and control (Weber, 1978; Drucker, 1954). Within this context, the foundations of management consulting can be traced to scientific management, most notably associated with Frederick Winslow Taylor. Taylor argued that work processes could be decomposed, measured, and optimized through scientific analysis, based on the assumption of a ‘one best way’ to perform each task (Taylor, 1911). This logic emphasized standardization, control, and the separation of planning from execution, redefining management as a rational and analytical function and laying the groundwork for the externalization and subsequent transfer of managerial knowledge (Armbrüster, 2006).
Henri Fayol further contributed to the formalization of management by identifying key managerial functions such as planning, organizing, coordinating, and controlling activities (Fayol, 1949). Despite differences in focus, both approaches shared the assumption that organizational performance can be improved through universal principles and structured intervention, supporting the emergence of advisory roles based on transferable practices (Kipping, 2002; Kipping and Clark, 2012). From a consulting perspective, these developments established the role of the external expert, focused on diagnosing inefficiencies and providing standardized, analytically grounded solutions. The value of consulting was closely tied to objectivity and scientific rigor, reflecting a mechanistic view of organizations in which problems were treated as technical issues to be optimized. This aligns with early conceptions of decision-making as a rational process (Simon, 1947). However, this

rationalization logic also had limitations. Its emphasis on standardization often neglected social and behavioural factors, which later proved critical for implementation. As organizational complexity increased, this model increasingly came under scrutiny, opening the way for approaches that emphasized human factors, organizational context, and bounded rationality (Katz and Kahn, 1966; Simon, 1947).

2.2. Expanding Perspectives: From Rational Systems to Human and Organizational Complexity

As the limitations of purely technical and rational approaches became more apparent, management thinking shifted towards a broader understanding of organizations. It became clear that efficiency cannot be achieved solely through process optimization, leading to greater emphasis on human behaviour, social dynamics, and organizational context. This shift also reflected the recognition that performance is shaped not only by formal structures but also by informal processes and knowledge flows (Drucker, 1954; Alvesson, 2004).

A key turning point was the human relations movement, associated with the work of Elton Mayo, which highlighted the importance of informal structures and social interactions in shaping performance (Mayo, 1933). This challenged the assumptions of scientific management by demonstrating that productivity depends not only on technical efficiency but also on psychological and social factors. As a result, organizations came to be understood as social systems in which behaviour cannot be fully explained by formal rules alone (Katz and Kahn, 1966). At the same time, these developments led to systems-oriented perspectives that viewed organizations as open systems interacting with their environment, emphasizing interdependence and adaptation (Katz and Kahn, 1966). Contingency theory further rejected universal solutions, arguing that effective management depends on situational factors (Lawrence and Lorsch, 1967; Donaldson, 2001). From a constructivist perspective, these developments also suggest that managerial knowledge is not simply transferred but co-created through interaction between organizational actors, including consultants and clients (Czarniawska and Mazza, 2012).

These developments reshaped management consulting. The consultant's role could no longer be limited to providing standardized solutions but required understanding organizational context and supporting adaptive processes. This marked a transition from an expert-driven model towards more context-sensitive forms of consulting, combining analytical expertise with interpretive and relational capabilities (Kipping and Clark, 2012; Armbrüster, 2006). At the same time, the assumption of fully rational decision-making was challenged by the concept of bounded rationality, which emphasized the cognitive and informational limits of decision-makers (Simon, 1947). This further highlighted the need for consulting approaches that support interpretation, judgment, and learning. Organizational learning theory reinforced this view by emphasizing reflection and adaptation as key elements of effective problem-solving (Argyris and Schön, 1978; Argyris, 1991).

Overall, these developments expanded the conceptual foundations of management consulting by highlighting the importance of human, organizational, and contextual factors, paving the way for later approaches emphasizing facilitation, knowledge integration, and co-creation (Schein, 1999; Nonaka and Takeuchi, 1995).

3. The Early Development of Management Consulting (1930–1960)

The period between the 1930s and the 1960s marks a critical phase in the development of management consulting, characterized by gradual institutionalization and the emergence of consulting as a distinct professional field. While earlier forms of consulting were closely tied to technical efficiency and process optimization, this period marked a broadening of consulting activities, driven by the growing scale of organizations and the expansion of managerial functions. As firms grew and expanded their geographical reach, particularly with the rise of holding structures and multinational enterprises, the demand for specialized managerial expertise increased significantly (Chandler, 1962; Kipping and Clark, 2012).

This transformation was closely linked to changes in managerial problems. Organizations were no longer concerned solely with operational efficiency, but increasingly faced strategic challenges related to growth, diversification, and competitive positioning. As a result, management consulting moved beyond its original focus on technical rationalization and became more deeply involved in supporting higher-level managerial decision-making processes (Armbrüster, 2006; Sturdy et al., 2009).

3.1. The Emergence of Strategy Consulting

The growing importance of strategic decision-making created the conditions for the emergence of strategy consulting as a distinct area within the broader consulting field. Large corporations required support in addressing complex issues such as market expansion, resource allocation, and long-term planning. In this context, consulting firms such as McKinsey & Company and Boston Consulting Group played a pivotal role in shaping modern consulting practices.

These firms contributed to the development of systematic analytical frameworks that enabled organizations to evaluate their business portfolios and competitive positions. Concepts such as portfolio analysis and experience curves became widely used tools for strategic planning, reflecting a shift towards more structured, data-driven decision-making. Consulting became increasingly associated with analytical rigor and the use of formalized methods to address strategic problems, reflecting broader developments in the consulting industry shaped by changing managerial needs (Kipping, 2002; Kipping and Clark, 2012).

At the same time, the rise of strategy consulting reinforced the perception of consultants as providers of high-level expertise. Their role extended beyond diagnosing operational inefficiencies to supporting top management in critical decision-making under conditions of uncertainty. This shift also contributed to the growing importance of consulting in shaping managerial thinking, as consultants introduced new analytical frameworks, models, and conceptual tools into organizational practice (Clark, 1995; Armbrüster, 2006).

However, the increasing reliance on analytical models also raised questions regarding the applicability of standardized approaches across different organizational contexts. While these frameworks provided valuable structure, their effectiveness depended on how well they could be adapted to specific situations. This tension between standardization and contextualization would later become a central issue in the development of consulting practice.

3.2. Consulting as a Management Profession

Alongside the emergence of strategy consulting, this period also witnessed the consolidation of management consulting as a recognized professional field. Consulting firms developed more formalized structures, established specialized areas of expertise and introduced standardized methodologies for diagnosing and solving organizational problems, reflecting the emergence of consulting as a structured professional activity with defined methods and practices (Kubr, 2002). These developments contributed to the professionalization of consulting, distinguishing it from earlier, more ad hoc forms of advisory activity (Kipping and Clark, 2012; Sturdy et al., 2009).

A key feature of this professionalization process was the increasing reliance on standardized methods and tools. Consultants began to use benchmarking techniques, comparative analyses, and so-called “best practice” approaches to identify solutions that could be transferred across organizations. This approach was grounded in the assumption that certain managerial practices are universally applicable and can be replicated to achieve similar results. As a result, consulting became closely associated with the codification and dissemination of managerial knowledge (Alvesson and Johansson, 2002; Armbrüster, 2006).

At the same time, the professionalization of consulting also involved the construction of legitimacy. Consulting firms positioned themselves as authoritative sources of managerial expertise, capable of providing objective and reliable advice. The development of professional norms, reputational mechanisms, and institutional recognition supported this process. However, as later critical perspectives have shown, this legitimacy was not based solely on technical competence, but also on social and symbolic factors that influenced how consulting interventions were perceived and accepted within organizations (Fincham, 1999; Alvesson and Johansson, 2002).

Table 1. Key Characteristics of the Early Development of Management Consulting (1930–1960)

Dimension	Description
Main focus	Shift from operational efficiency to strategic decision-making
Role of consultants	From technical experts to strategic advisors
Type of problems	Growth, diversification, competitive positioning
Methods used	Analytical frameworks, portfolio analysis, benchmarking
Organizational context	Expansion of large firms, emergence of multinational enterprises
Professionalization	Development of structured firms, methodologies, and expertise areas
Key contribution	Establishment of consulting as a distinct professional field
Key tension	Standardization vs. contextual adaptation

Source: Author’s own compilation based on Armbrüster (2006), Sturdy et al. (2009), Kubr (2002), Kipping and Clark (2012), and Chandler (1962).

The institutionalization of management consulting during this period laid the foundations for its contemporary form. Consulting became established as a

professional service industry, supported by structured analytical approaches to strategic decision-making and the diffusion of managerial knowledge. At the same time, tensions emerged between standardization and contextual adaptation, which continue to shape consulting practice in modern organizational environments. The key characteristics of this period are summarized in Table 1.

4. The Human Relations and Learning Turn in Management Consulting (1960–1990)

The period between the 1960s and the 1990s marked a fundamental shift in the development of management consulting, characterized by a growing recognition of the limitations of purely analytical and standardized approaches. Although the origins of the human relations movement date back to the 1930s, particularly through the work of Elton Mayo, its influence on management consulting became more pronounced only in later decades, when consulting practices increasingly incorporated process-oriented and human-centered approaches. As organizations became more dynamic, it became increasingly evident that effective management could not be reduced to technical optimization alone. Instead, attention gradually shifted towards human, cultural, and organizational dimensions, fundamentally reshaping both management theory and consulting practice.

This transformation was closely associated with broader developments in organizational thought, including the rise of organizational behaviour, leadership studies, and change management. These perspectives emphasized that organizational performance is deeply influenced by factors such as values, communication, and social interaction, which cannot be fully captured by formal models or quantitative analysis (Katz and Kahn, 1966; Alvesson, 2004). As a result, the role of consulting began to expand beyond problem diagnosis and solution delivery towards supporting more context-dependent organizational processes.

4.1. The Increasing Importance of “Soft” Factors

One of the most significant developments during this period was the growing emphasis on “soft” factors, including organizational culture, leadership, and change management. These elements were increasingly recognized as critical determinants of organizational effectiveness, particularly in contexts of transformation and uncertainty. As a result, management thinking shifted towards a more holistic view of organizations as socially constructed systems shaped by shared meanings and interactions.

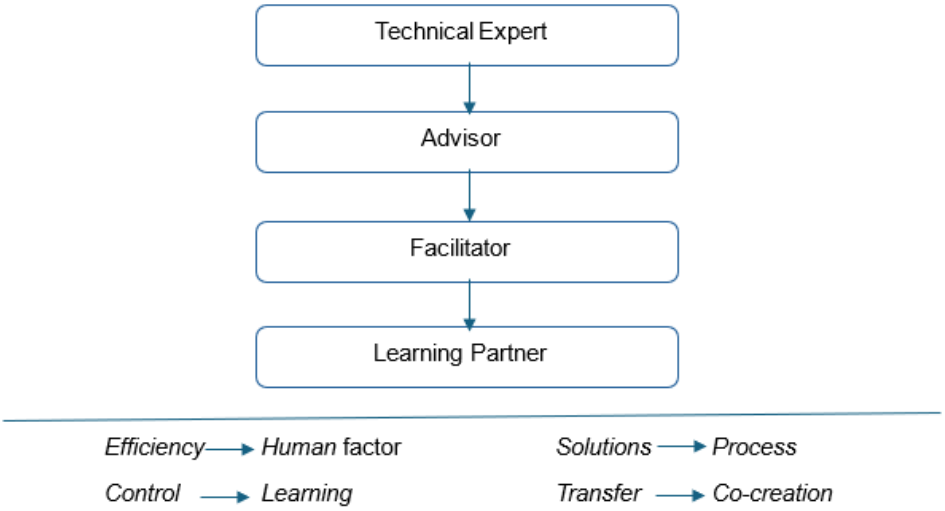
A central figure in this shift was Edgar H. Schein, whose work on organizational culture and process consultation redefined the role of consultants. Schein (1999) argued that effective consulting goes beyond the application of expert knowledge and involves the development of a helping relationship in which consultants support problem diagnosis, interpretation, and context-specific solution development. This process-oriented approach emphasized collaboration, trust, and mutual learning, fundamentally transforming the consultant–client relationship. This perspective closely aligns with helping-oriented approaches, in which the consultant’s role is to facilitate problem understanding and capability development rather than to provide direct solutions (Egan, 2013), a distinction already emphasized in earlier work on the consultant’s role as a process facilitator rather than a content expert (Schein, 1978).

In this context, the consultant is no longer seen as an external expert delivering ready-made solutions, but as a facilitator who supports organizational understanding and learning. This aligns with the broader shift towards organizational learning, which highlights reflection and adaptation as key drivers of performance (Argyris and Schön, 1978; Argyris, 1991). Consequently, consulting effectiveness increasingly depends on the ability to support learning processes rather than provide technical answers.

The work of Peter Drucker further reinforced this transformation by emphasizing knowledge as a central organizational resource. Drucker (1954) highlighted the importance of knowledge workers and the role of knowledge in shaping managerial decision-making. This perspective strengthened the view that consulting should enable organizations to generate, interpret, and apply knowledge.

Taken together, these developments reflect a redefinition of management consulting from a purely expert-driven activity to a relational and process-oriented practice. This transformation can be summarized as a shift in the consultant's role: from expert to facilitator, and ultimately to partner, where value is created through interaction, learning, and the co-construction of solutions (Schein, 1999; Alvesson and Johansson, 2002). This shift in the consultant's role is illustrated in Figure 1.

Figure 1. Transformation of the Consultant's Role (1960–1990)



Source: author's own compilation based on Schein (1999), Argyris (1991), Argyris and Schön (1978), and Alvesson and Johansson (2002).

5. The Contemporary Era of Management Consulting (1990–Present)

From the 1990s onwards, management consulting entered a new phase characterized by globalization, increasing specialization, and the growing importance of knowledge as a strategic resource. As organizations faced rapidly changing environments shaped by technological development, market liberalization, and intensified competition, the demand for external expertise expanded significantly. In this context, consulting evolved into a highly diversified and knowledge-intensive industry, where value creation is closely linked to the ability to integrate and apply complex forms of knowledge within organizational

settings (Sturdy et al., 2009; Kipping and Clark, 2012). At the same time, the nature of managerial problems continued to change. Organizations were no longer dealing primarily with clearly defined technical or structural issues, but increasingly faced ambiguous, non-routine challenges that required interpretation, judgment, and continuous adaptation. This shift further reinforced the move away from standardized solutions toward more flexible and context-sensitive consulting approaches.

5.1. Globalization and Diversification of Consulting Services

One of the defining features of contemporary consulting is its global expansion and functional diversification. Large consulting firms, including the so-called Big Four, have developed extensive international networks and offer a wide range of services that extend far beyond traditional management advice. These include IT consulting, human resource advisory, financial consulting, and, more recently, sustainability and ESG-related services. As a result, consulting has become embedded in multiple aspects of organizational functioning, often operating across different functional domains.

This diversification is closely linked to the project-based and multidisciplinary nature of modern consulting work. Consulting engagements are increasingly organized around specific projects that require the collaboration of experts from different fields, combining technical, organizational, and strategic perspectives. Such projects often involve not only problem diagnosis and solution design, but also implementation support, change management, and capability development within client organizations (Sturdy et al., 2009; Armbrüster, 2006). Recent studies also highlight the growing role of artificial intelligence in supporting managerial decision-making processes within such complex project environments, enhancing analytical capabilities while introducing new interpretive challenges (Bucurean and Țarcă, 2025).

At the same time, globalization has intensified competition in the consulting industry, leading to greater pressure to differentiate and innovate. Consulting firms must continuously adapt their service offerings and develop new capabilities to remain relevant in rapidly evolving markets. This dynamic environment further reinforces the importance of knowledge as a core asset and highlights the need for continuous learning and renewal within consulting organizations themselves.

5.2. Knowledge Integration and Organizational Learning

In the contemporary era, management consulting is increasingly understood as a process of knowledge integration and co-creation rather than mere expertise transfer. This perspective builds on Nonaka's view of organizations as dynamic systems of knowledge creation, where value emerges from the interaction between tacit and explicit knowledge (Nonaka, 1994; Nonaka and Takeuchi, 1995). Knowledge integration is closely linked to transfer processes that influence employee engagement and organizational effectiveness (Heder, 2020), and is also shaped by internal organizational functions, including HR functions, which can support coordination and capability development within organizations (Kun and Dajnoki, 2020). From this viewpoint, consulting involves not only providing external input, but also facilitating its combination, interpretation, and application within the client organization. Recent research also highlights the role of management consulting within corporate governance systems, emphasizing its contribution to

oversight, accountability, and informed decision-making (Kostiuk and Chikalkin, 2024). This shift is closely related to organizational learning, as effective consulting depends on creating conditions for reflection, questioning assumptions, and developing new ways of thinking and acting (Argyris and Schön, 1978; Schein, 1999). As a result, consulting contributes not only to individual learning but also to the development of organizational routines and capabilities.

Amy Edmondson's work highlights the importance of relational and contextual factors in these processes. Edmondson (2018) emphasizes that learning and knowledge sharing require psychological safety—an environment in which individuals feel able to express ideas, raise concerns, and engage in open dialogue without fear of negative consequences. This is particularly relevant for consulting, as the effectiveness of advisory processes depends on the quality of interaction between consultants and organizational members. From this perspective, consulting can be understood as a form of knowledge co-construction, where value is created through interaction, dialogue, and joint problem-solving. The consultant's role extends beyond providing solutions to facilitating processes through which organizations generate and apply their own knowledge, reinforcing the view of consulting as a relational and context-sensitive activity.

Within this framework, several factors become critical for effectiveness. Trust plays a central role in shaping organizational members' willingness to engage with external advice and incorporate it into decision-making (Schein, 1999; Alvesson and Johansson, 2002). Similarly, the applicability of recommendations depends on their alignment with the organizational context rather than generic solutions. Finally, the perceived value of consulting is closely linked to its impact on decision quality and organizational outcomes, which are often difficult to measure but remain central to managerial expectations.

These considerations suggest that consulting effectiveness is shaped not only by the quality of proposed solutions, but also by the interaction of relationships and organizational context. This perspective helps explain how external advice contributes to managerial decision-making in contemporary organizations. The main functions of management consulting in contemporary organizational settings are summarized in Table 2.

Table 2. Functions of Management Consulting in Contemporary Organizations

Function	Description	Impact on Decision-Making
Knowledge transfer	Provision of external expertise and best practices	Enhances analytical quality and information availability
Interpretation	Framing problems and supporting sensemaking	Reduces ambiguity and improves understanding
Facilitation	Supporting communication and interaction	Increases alignment and consensus
Legitimization	Providing external validation of decisions	Strengthens acceptance and credibility
Learning support	Enabling capability development and reflection	Improves long-term decision effectiveness

Source: author's own compilation based on Schein (1999), Nonaka and Takeuchi (1995), Argyris and Schön (1978), Alvesson and Johansson (2002), and Sturdy et al. (2009).

6. Critical Perspectives and Dilemmas in Management Consulting

Despite its widespread use, management consulting has long been subject to critical debate. While often presented as a rational and objective source of expertise, the literature highlights its ambiguities, limitations, and context-dependent nature.

A central concern relates to subjectivity. Although consulting is frequently framed as analytical and evidence-based, it inherently involves elements of interpretation, judgment, and negotiation. Problem identification, framework selection, and recommendation development are influenced by both consultants and clients, implying that outcomes are shaped by social interactions and contextual factors rather than purely objective analysis (Alvesson and Johansson, 2002; Fincham, 1999).

A related dilemma concerns the reliance on formalized methodologies. While standardized tools and “best practice” approaches provide structure and comparability, they may oversimplify complex organizational realities and constrain and limit context-specific adaptation. Benchmarking practices, for example, are widely used in consulting to identify transferable solutions, yet their effectiveness depends heavily on how well they are adapted to specific organizational contexts (Kuntz and Driha, 2022). This creates a tension between analytical rigor and practical relevance (Armbrüster, 2006; Sturdy et al., 2009).

Another critique highlights the legitimizing function of consulting. Beyond problem-solving, consultants often contribute to the justification and acceptance of managerial decisions. By providing external validation, they enhance decision credibility, even when their substantive contribution is limited. This symbolic dimension underscores that consulting value is not only technical, but also social and political (Alvesson and Johansson, 2002; Clark, 1995). The role of multiple stakeholders further reinforces that consulting outcomes are shaped by diverse expectations and interpretations, which influence how recommendations are understood and implemented (Khadija, 2022).

Measurement challenges further complicate the evaluation of consulting effectiveness. Its impact is often indirect, long-term, and difficult to quantify, as outcomes such as improved decision quality or organizational learning are not easily captured by standard metrics (Sturdy, 2011; Kipping and Clark, 2012). This challenge is particularly visible in small and medium-sized enterprises, where decision-support tools and controlling practices play a key role, yet their contribution to performance remains difficult to isolate and measure (Vilmos, 2020).

Taken together, these critiques suggest that consulting should be understood as a complex, context-sensitive practice rather than a straightforward application of technical expertise. Its effectiveness depends not only on analytical tools, but also on relationships, organizational context, and interpretation processes. The main challenges and critical perspectives discussed are summarized in Table 3.

Table 3. Core Challenges of Management Consulting

Issue	Description	Implication
Subjectivity	Consulting involves interpretation and judgment rather than purely objective analysis	Limits objectivity and introduces bias
Standardization	Use of frameworks and "best practices" may oversimplify complex situations	Reduces context sensitivity
Legitimization	Consultants provide external validation of managerial decisions	May reinforce decisions without substantive improvement
Measurement	Outcomes of consulting are difficult to quantify and evaluate	Complicates the assessment of effectiveness

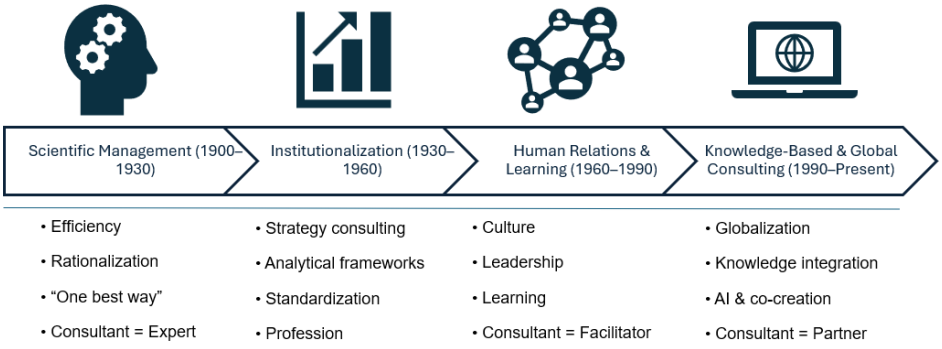
Source: author's own compilation based on Alvesson and Johansson (2002), Fincham (1999), Armbrüster (2006), Sturdy et al. (2009), and Kipping and Clark (2012).

These limitations also point to important directions for future research. There is an increasing need for empirical studies examining how consulting interventions are interpreted and implemented within organizations. Qualitative approaches, such as semi-structured interviews, are particularly suited to exploring issues such as trust, applicability, and the translation of recommendations into practice, particularly in specific regional contexts, such as Central and Eastern Europe.

7. Conclusion and Future Research Directions

This paper examines the historical evolution of management consulting and interprets how this development has shaped its role in managerial decision-making. By tracing the trajectory of consulting from its origins in scientific management through its institutionalization and subsequent transformation towards process-oriented and knowledge-based approaches, the study highlights that management consulting is not a static or uniform activity.

Figure 2. The Evolution of Management Consulting Practice



Source: author's own compilation based on Frederick Winslow Taylor (1911), Henri Fayol (1949), Elton Mayo (1933), Herbert A. Simon (1947), Edgar H. Schein (1999), Ikujiro Nonaka and Hirotaka Takeuchi (1995), as well as Matthias Kipping and Timothy Clark (2012).

Rather, it represents a continuously evolving practice that adapts to changing organizational, economic, and technological conditions. The overall trajectory of this evolution is summarized in Figure 2, which reflects the changing emphasis of consulting practice over time.

The analysis demonstrates that early consulting was primarily grounded in the logic of rationalization, focusing on efficiency, standardization, and the application of universal principles. Over time, however, this perspective proved insufficient. Greater attention to human factors, organizational context, and learning processes led to a redefinition of consulting, shifting its focus from technical problem-solving towards facilitation, interpretation, and collaboration. Today, consulting can be understood as a knowledge-intensive and relational activity. These developments suggest that management consulting operates as a continuously evolving practice.

This adaptation occurs across multiple levels. At the technological level, digitalization and the increasing role of data and artificial intelligence are reshaping the tools and methods used in consulting (Berente et al., 2021). At the organizational level, growing interdependence and diversity require more flexible and context-sensitive approaches. At the managerial level, decision-making is becoming more complex and ambiguous, reinforcing the need for advisory processes that support understanding and judgment rather than predefined solutions.

Against this background, the future of management consulting depends on balancing key dimensions, including objectivity, organizational learning, and value creation. Maintaining credibility while acknowledging the inherently interpretive nature of consulting is essential, as is the ability to support reflection, adaptation, and capability development (Argyris and Schön, 1978; Schein, 1999). At the same time, the question of value creation is particularly important, given ongoing concerns regarding the measurability and practical impact of consulting interventions.

From a research perspective, these challenges point to the need for further empirical investigation into the processes by which consulting contributes to managerial decision-making. Future studies should examine how consulting inputs are interpreted, adapted, and implemented within organizations, with particular attention to the role of trust, contextual fit, and perceived usefulness. Qualitative research designs, including in-depth interviews and case studies, offer promising avenues for exploring these issues in greater detail. Such approaches can provide valuable insights into the mechanisms through which consulting generates value and into the conditions under which this value is realized in practice.

In conclusion, management consulting should be understood not as a provider of ready-made solutions, but as a dynamic and relational process that supports organizations in navigating increasing complexity and uncertainty. Its effectiveness depends not only on analytical tools, but also on its ability to foster learning, support decision-making, and contribute to organizational change.

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THE ROLE OF GOVERNANCE IN DIGITAL TRANSFORMATION: AN ORGANISATIONAL META-CAPABILITY FRAMEWORK

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Abstract: *Digital transformation initiatives in large organisations fail at rates between 70% and 84% despite substantial technological investment, a pattern that points to organisational rather than technological causes. This conceptual paper argues that the missing variable is governance, understood not as board oversight or regulatory compliance, but as an active organisational capability with design implications. Drawing on dynamic capabilities' theory (Teece, 2007), digital leadership research (Albannai et al., 2024), and recent empirical work on supply chain digitalisation (Al Mashalah et al., 2022) and board governance of digital transformation (Andersson et al., 2025), we develop a framework that positions digital transformation governance as an organisational meta-capability. This higher-order capability does not sense, seize or transform directly. Rather, it creates the organisational conditions under which these dynamic capabilities can be coordinated and strategically aligned. We articulate a three-way distinction between corporate governance, digital transformation governance, and digital transformation management, three constructs the literature frequently conflates. We then identify five governance dimensions, each derived systematically from the processual characteristics of digital transformation and from a corresponding dynamic capability: strategic alignment, decision-making architecture, strategic resource allocation, organisational reconfiguration, and organisational learning. The Romanian institutional context, where Government Emergency Ordinance 109/2011 (amended by Law 187/2023) established a corporate governance framework for public enterprises aligned with OECD principles, offers a contemporary setting in which these analytical distinctions carry direct policy weight. The contribution is twofold: a sharper conceptual vocabulary for distinguishing governance from management in digital contexts, and a framework that bridges dynamic capabilities theory with organisational design research.*

Keywords: *governance; digital transformation; dynamic capabilities; meta-capability; digital leadership; corporate governance Romania*

JEL Classification: *M10; O33; L23*

1. Introduction

Organisations with similar technological endowments often diverge sharply in their digital transformation (DT) outcomes. Failure rates for major DT initiatives have been estimated at between 70% and 84% (BCG, 2020; McKinsey & Company, 2018), a pattern that recurs across industries and geographies with a consistency that

technological inadequacy alone cannot explain. The dominant analytical lenses applied to the phenomenon, digital leadership (Albannai et al., 2024), dynamic capabilities (Teece, 2007; Warner and Wäger, 2019), and strategic technology management (Al Mashalah et al., 2022), each illuminate part of the picture. One question, however, remains largely unanswered in each of them: through what organisational mechanism are these factors coordinated?

We propose that the most useful conceptual lens for this coordination problem is governance, but governance understood differently from how it usually appears in the DT literature. In that literature, governance is rarely treated as a distinct theoretical construct. It appears either as a synonym for board-level oversight (corporate governance), as a subset of IT resource control (Van Grembergen and De Haes, 2009), or, more problematically, as interchangeable with project management. The recent systematic review by Kulichyova et al. (2025) illustrates this pattern: governance is acknowledged as relevant to DT in large established organisations, but it is coded as a sub-element of reconfiguring capabilities rather than as a construct in its own right. Bozintan, Crișan and Pinco (2023) reach a related conclusion in their analysis of the impact of digital transformation on strategic management: the literature documents that conventional managerial practices no longer work at maximum efficiency in digital contexts, yet stops short of specifying what organisational mechanism should replace them.

Our central proposition is that DT governance functions as an organisational *meta-capability*, a higher-order capability that does not directly sense, seize or transform (these are the dynamic capabilities of digital leaders and their teams), but creates the conditions under which sensing, seizing and transforming can be exercised in an integrated and strategically aligned way. The argument is conceptual rather than empirical. We develop a framework, identify logical relationships, and ground them in published evidence, but the empirical validation we describe in Section 6 remains future work.

The argument has direct policy relevance in the Romanian institutional context. Romania's Government Emergency Ordinance 109/2011, substantially amended by Law 187/2023 in alignment with the OECD Guidelines on Corporate Governance of State-Owned Enterprises (OECD, 2023), established a corporate governance framework for public enterprises. Implementation lagged the law for over a decade (OECD, 2023), and the legal framework now explicitly requires public enterprises to separate ownership rights from regulatory and operational functions. The question of how digital transformation initiatives fit within this revised framework, that is, whether they belong to corporate governance, to a distinct DT governance function, or to operational management, has not been addressed in the literature. It is the conceptual question this paper takes up.

Section 2 reviews the theoretical foundations. Section 3 proposes and defends the three-way distinction between corporate governance, DT governance, and DT management. Section 4 develops the meta-capability framing and identifies five governance dimensions, each derived from the processual characteristics of DT and from a corresponding dynamic capability. Section 5 discusses theoretical contributions and managerial implications, illustrated with cases from the reviewed literature and from the Romanian context. Section 6 concludes with limitations and a research agenda.

2. Theoretical Framework

2.1. Digital Transformation as Process, Not Event

A recurring source of organisational failure in DT is treating transformation as a project: bounded, deliverable-oriented, finite. Vial (2019), in his synthesis of 282 articles, and Verhoef et al. (2021), in their multi-disciplinary review, converge on a processual definition. DT is the use of digital technologies to enable fundamental changes in how organisations create, deliver and capture value. This processual character is now well-established. Hanelt et al. (2021), in a systematic review of 279 articles, document that DT is best understood as an ongoing, non-linear set of changes affecting strategy, structure and operations simultaneously. Wessel et al. (2021) further clarify that DT is distinct from IT-enabled organisational transformation: DT redefines the value proposition itself, not merely the means by which it is delivered.

Three characteristics make DT particularly difficult to govern. First, it is *emergent* rather than fully plannable: objectives, pathways and outcomes cannot be specified in advance but crystallise through iteration and experimentation (Vial, 2019). Second, it is *systemically interdependent*: changes in one organisational dimension propagate through others, generating second-order effects that cannot be managed by isolated functional units (Verhoef et al., 2021). Third, it is *continuous*: organisations cannot finish DT, because the technologies and competitive dynamics that drive it themselves keep evolving (Warner and Wäger, 2019; Hanelt et al., 2021).

The practical significance of these three characteristics is that classical governance instruments, such as compliance frameworks, staged gate reviews, and hierarchical approval processes, are not merely insufficient but actively maladaptive when applied to a phenomenon that is emergent, interdependent and continuous. Markus and Rowe (2023) make a similar point: the literature has yet to fully reckon with the fact that DT differs from prior waves of IT-enabled change in ways that demand new conceptual and organisational tools. The Romanian experience documented by Mureșan (2025) provides indirect empirical support for this concern. Mureșan's analysis of e-government platforms in Romania over two decades shows that institutional fragmentation and the deficit of digital skills limit the impact of reforms even where the technological infrastructure is in place, a finding that points to coordination failure rather than technological inadequacy.

2.2. Dynamic Capabilities: What the Theory Leaves Open

Teece's dynamic capabilities framework (2007; Teece, Pisano and Shuen, 1997) remains the most widely used theoretical resource for analysing organisational responses to rapid technological change. Its tripartite structure, sensing opportunities, seizing them through commitment of resources, and transforming organisational structures and routines, maps onto the demands of DT in an obvious way. Schilke, Hu and Helfat (2018), in their review of two decades of dynamic capabilities research, note that the framework has become a near-default lens for studying technology-driven organisational change.

Where the framework is less helpful is in specifying how the three processes get coordinated, and this matters more in DT than in most other settings. Sensing, seizing and transforming are analytically distinct but organisationally interdependent. Poor sensing produces seizing efforts directed at the wrong opportunities; poor transforming undermines the organisational changes that seizing requires. The

framework is silent on what organisational arrangement holds the three together. Warner and Wäger (2019) explicitly call for research on the meta-processes that integrate dynamic capabilities in digital contexts, and Albannai et al. (2024) reach a similar conclusion from the digital leadership literature: the nine micro-foundations they identify are operationally rich but architecturally orphaned.

Recent empirical work confirms that this coordination gap matters in practice. Andersson et al. (2025), in a study of 150 listed firms, show that the role of the board of directors varies systematically across the three stages of digital transformation distinguished by Verhoef et al. (2021), namely digitisation, digitalisation, and digital maturity. They find that board control is most likely to be misaligned with operational dynamic capability development at the digitalisation stage. The implication is that the architecture connecting governance to capability matters; the same governance structure produces different effects depending on the stage of DT it acts upon.

3. DT Governance: Why the Distinction Matters

3.1. Three Constructs the Literature Treats as One

A consistent observation in systematic reviews of the DT field is that the term governance is used without terminological discipline, encompassing at least three analytically distinct phenomena (Markus and Rowe, 2023; Plekhanov, Franke and Netland, 2022). The first is *corporate governance*, which covers board-level oversight, accountability to shareholders, and compliance with regulatory frameworks (OECD, 2015; Klarner et al., 2022). The second is *IT governance*, which specifies decision rights and accountabilities for IT investments, often associated with frameworks such as COBIT (Van Grembergen and De Haes, 2009; Bharadwaj et al., 2013). The third is the everyday *management of digital initiatives*: programme management, sprint reviews, project portfolio control. The literature on DT frequently uses the same word, governance, to refer to all three.

The corporate governance literature is clear that governance operates at the level of organisational direction-setting and accountability, not execution (OECD, 2015). Bharadwaj et al. (2013) make a similar separation in the digital business context: digital business strategy is the level at which firms decide what kind of digital organisation they want to become, and this is different both from board-level fiduciary oversight above it and from the project-level execution below it. The conflation of these three levels, in our reading, is one of the reasons the DT governance literature has remained conceptually fragmented.

3.2. A Three-Way Distinction and Its Practical Logic

We propose that the field needs to maintain three analytically separate constructs. *Corporate governance* sets the accountability and risk framework within which DT occurs; it is the concern of the board, of audit committees, and of shareholders. *DT governance* sets the strategic direction of digital transformation, allocates authority over digital resources, and ensures coherence between digital initiatives and overall organisational strategy. *DT management* operates below DT governance to plan, execute and control specific digital initiatives, such as projects, products, and platforms.

The practical stakes of this distinction are not trivial. Drawing on patterns documented in the DT literature (Hess et al., 2016; Singh, Klarner and Hess, 2020;

Andersson et al., 2025), we suggest that organisations which conflate DT governance with DT management tend to display one of two failure patterns. In the first, operational concerns crowd out strategic ones: senior bodies constituted as steering committees become venues for status updates and budget approvals, while the genuinely difficult strategic questions, such as what kind of digital organisation are we becoming, and what are we willing to give up to get there, never make it onto the agenda. Hess et al. (2016) document exactly this dynamic in their study of formulating digital transformation strategies. In the second, the opposite occurs: strategic direction is set far above the level of execution, and the organisational distance between the two creates implementation gaps that no amount of project management discipline can close. Andersson et al. (2025) provide indirect empirical support for this concern: they show that boards which exercise control without provision of strategic resources tend to suppress digital maturity development.

Figure 1 maps these three constructs and the broader landscape of related concepts with which DT governance frequently overlaps in the literature. The mapping is not intended as a final taxonomy but as a conceptual orientation.

CORPORATE GOVERNANCE — board, shareholders, compliance, audit, reporting		
DIGITAL TRANSFORMATION GOVERNANCE — strategic digital direction, authority allocation, organisational alignment		
DIGITAL TRANSFORMATION MANAGEMENT — execution, projects, budgets, teams, deliverables		
Digital strategy *Direction and objectives*	**Change management** *Human and cultural transition*	**Programme and portfolio mgmt.** *Multiple initiatives*
IT management *Technical operations*	**Enterprise architecture** *Structures and processes*	**Org. agility and ambidexterity** *Flexibility and innovation*
Dynamic capabilities *Sensing, seizing, transforming*	**Risk management and compliance** *Intersects DT governance*	**Digital leadership** *Vision and mobilisation*
DT GOVERNANCE AS META-CAPABILITY — orchestrates all levels		

Figure 1: *Corporate governance, DT governance, and DT management: related constructs and conceptual boundaries*
Source: authors' own elaboration, drawing on OECD (2015), Bharadwaj et al. (2013), Van Grembergen and De Haes (2009)

4. Governance as Meta-Capability: A Mechanism Model

4.1. Why Meta-Capability?

The term meta-capability has been used in several ways in the strategic management literature. We use it to denote a higher-order organisational capability that does not directly perform a primary activity but creates the conditions under which lower-order capabilities can be exercised in an integrated and strategically aligned way. This usage is consistent with the hierarchy of capabilities articulated by Schilke et al. (2018), who distinguish ordinary capabilities (which perform a task) from dynamic capabilities (which reconfigure ordinary capabilities) from higher-order capabilities (which integrate dynamic capabilities).

Applied to DT, this means that governance does not sense, seize or transform. Those are the dynamic capabilities exercised by digital leaders and their teams (Albannai et al., 2024). What governance does is determine which sensing signals are escalated to strategic attention, what criteria govern decisions about which opportunities to seize, and what organisational reconfigurations are authorised and sequenced. The reframing is consistent with Teece's (2016) own observation that dynamic capabilities are managerial in nature: they require human judgement and organisational authority to function.

The supply chain digitalisation literature provides an instructive parallel. Al Mashalah et al. (2022), in a systematic review of 153 publications, document how firms that successfully digitalise across the full e-commerce supply chain, from smart manufacturing through logistics to last-mile delivery, are characterised not primarily by superior individual technologies but by superior coordination across functional silos. Chidozie et al. (2024), in their empirical study of Industry 5.0 supply chains, reach a complementary conclusion: the firms that integrate digital technologies successfully are those in which strategic intent and operational execution are visibly bridged by an organisational arrangement that sits above projects but below corporate strategy. This is, in our reading, the empirical signature of DT governance functioning as a meta-capability.

4.2. Five Governance Dimensions: Conceptual Logic and Derivation

We identify five dimensions of DT governance. The selection of these five, rather than four or seven, is not arbitrary; it follows a systematic conceptual logic. Each dimension is derived from the joint requirement to (a) respond to one of the processual characteristics of DT identified in Section 2.1 (emergent, interdependent, continuous), and (b) address the integration gap left open by one of the dynamic capabilities (sensing, seizing, transforming). The five dimensions are not sequential stages but parallel functions. Each can be more or less developed in a given organisation, and the overall maturity of DT governance is the joint outcome of all five. Table 1 summarises the derivation.

Table 1: *Derivation of the five DT governance dimensions*

Governance dimension	DT characteristic addressed	Dynamic capability supported	Theoretical anchor
Strategic alignment	Multi-dimensional change	Integration of all three	Henderson and Venkatraman (1993); Bharadwaj et al. (2013)
Decision-making architecture	Emergent, uncertain	Seizing under ambiguity	Weill and Ross (2004); Singh et al. (2020)
Strategic resource allocation	Continuous, resource-competing	Seizing across time	Helfat (1997); Andersson et al. (2025)
Organisational reconfiguration	Depth of structural change	Transforming	Kulichyova et al. (2025); Hanelt et al. (2021)
Organisational learning	Iterative, experimental	Sensing through reflection	Argyris and Schön (1996); Bui, Wickramasinghe and Sharma (2023)

Source: authors' own elaboration

We now develop each dimension in turn, anchored to its theoretical foundation and illustrated, where possible, with examples from the literature reviewed in Sections 2 and 3.

Strategic alignment addresses the multi-dimensional character of DT by establishing and maintaining coherence between digital objectives and overall organisational strategy. The theoretical anchor is the strategic alignment model of Henderson and Venkatraman (1993), who showed that effective IT-enabled transformation depends on the simultaneous alignment of business strategy, IT strategy, organisational infrastructure and IT infrastructure. Bharadwaj et al. (2013) updated this for the digital era, arguing that in a digital business strategy these four no longer exist as separate domains. Strategic alignment, in our framework, is the governance function that maintains this joint coherence over time. An illustrative case from the reviewed literature is documented by Al Mashalah et al. (2022): firms that successfully digitalise their supply chain do so because they manage to keep digital initiatives aligned with the broader strategic intent, avoiding the common trap of accumulating technically successful but strategically incoherent digital projects.

Decision-making architecture addresses the emergent and uncertain character of DT by specifying how authority over digital investment decisions is distributed in the organisation. The key design choice, centralisation versus decentralisation, is not new (Weill and Ross, 2004), but the conditions of digital transformation alter the trade-off significantly. Singh, Klarner and Hess (2020), in their empirical study of 27

German firms, document three distinct chief digital officer (CDO) configurations, each producing a different decision-making architecture. Under DT conditions, decision-making architecture must reconcile two demands: speed (decisions need to be made iteratively as new information emerges) and coherence (decentralised decisions must remain mutually consistent).

Strategic resource allocation addresses the continuity of DT and the chronic competition for scarce organisational resources that this continuity entails. Helfat (1997) argued early on that the dynamic reallocation of resources is a defining feature of organisational adaptation, and Andersson et al. (2025) provide recent empirical confirmation that the strategic role of the board, particularly the provision of long-term resources for transformation, is decisive at the digitalisation stage of DT. The governance function here is to establish principles by which long-term digital investments are protected from the short-term pressures that operational management is correctly designed to respond to.

Organisational reconfiguration addresses the depth of change that continuous DT requires. Many organisations are technically competent at executing digital projects (managing the delivery of new tools or systems) but structurally incapable of changing themselves to use those tools effectively. Kulichyova et al. (2025) document this pattern in their systematic review of 123 articles on DT in large established organisations: reconfiguration is the most frequently identified restructuring dilemma that DT produces. Hanelt et al. (2021) reach a similar conclusion. The governance function is to authorise and sequence structural changes, such as boundary redefinition, role redesign, and decentralisation of authority, that no operational manager has the mandate to initiate.

Organisational learning addresses the iterative, experimental character of DT by institutionalising the capacity to extract strategic learning from transformation experience. The theoretical anchor here is Argyris and Schön's (1996) distinction between single-loop learning (correcting errors within existing norms) and double-loop learning (revising the norms themselves). DT requires both, but double-loop learning, the questioning of the assumptions on which the transformation was originally designed, is the more difficult and the more often neglected. Bui, Wickramasinghe and Sharma (2023), in their systematic review of 128 studies on double-loop learning in organisational contexts, observe that this kind of learning rarely occurs spontaneously: it has to be institutionalised through specific governance mechanisms. The DT governance function is therefore not to do the learning, but to ensure that organisational structures exist for its institutionalisation.

4.3. The Control–Adaptability Tension

Running through all five dimensions is a tension that cannot be resolved, only managed: the tension between governance as a source of stability and governance as a condition of adaptability. This is the classical organisational ambidexterity problem (O'Reilly and Tushman, 2008, 2013; Raisch and Birkinshaw, 2008): exploring new opportunities while exploiting existing ones. In the DT context, the tension is sharper because the time-scales of the two activities are increasingly incompatible with single-mode governance arrangements. The cases documented by Al Mashalah et al. (2022) and Albannai et al. (2024) suggest that the most successful organisations do not resolve the tension; they manage it deliberately by differentiating across the five dimensions. They standardise where standardisation is possible (strategic resource allocation), and preserve flexibility where emergence

demands it (organisational learning, decision-making architecture). The governance task is precisely the calibration of this differentiation.

5. Discussion

5.1. Theoretical Contributions and Their Limits

Three theoretical contributions emerge from this analysis. The first is the proposition that DT governance constitutes a distinct theoretical construct, neither a subset of corporate governance nor a synonym for DT management. This proposition is not entirely new: it is implicit in the writings of Bharadwaj et al. (2013) and partly anticipated by Wessel et al. (2021). Bozintan, Crișan and Pinco (2023) gesture in the same direction when they argue that strategic management has been transformed by DT in ways that conventional managerial practices cannot accommodate. What is new in our contribution is the explicit articulation of the three-way distinction and its grounding in the failure modes that conflation produces.

The second contribution is the meta-capability framing itself. By positioning governance above individual dynamic capabilities, as the integrating and enabling condition for sensing, seizing and transforming, we provide a vocabulary for what Warner and Wäger (2019) called the missing meta-process. This positioning is consistent with, but distinct from, the recent re-reading of the dynamic capabilities literature by Kulichyova et al. (2025): they treat governance as a sub-element of reconfiguring capabilities, while we treat it as a higher-order capability that shapes all three Teece processes.

The third contribution is integrative. By reading dynamic capabilities theory (Teece, 2007; Warner and Wäger, 2019), digital leadership research (Albannai et al., 2024), and supply chain digitalisation research (Al Mashalah et al., 2022; Chidozie et al., 2024) together, we show that all three literatures point toward the need for a coordinating mechanism operating above individual capabilities and below corporate strategy. Naming and structuring this mechanism is the integrative contribution.

These contributions have real limits. The argument is conceptual, not empirical: we have proposed a framework and identified logical relationships, but we have not tested them against new data. The five dimensions need to be operationalised into measurable constructs before causal claims can be made. The framework is also currently a-contextual; we anticipate that the relative importance of the five dimensions varies with sector, firm size, digital maturity, and stage of transformation, as Andersson et al. (2025) suggest. Empirical calibration will be necessary.

5.2. Managerial and Policy Implications

The practical implications of the analysis are easier to state than to implement. The conceptual work of distinguishing DT governance from DT management points to four specific organisational dysfunctions that the literature documents repeatedly:

- Governance bodies constituted as project oversight committees. The result (Hess et al., 2016) is that steering committees become venues for status updates and the difficult strategic questions never make it onto the agenda.
- Ambiguous decision rights for digital investments. This produces one of two failure patterns: either all decisions flow upward for senior approval (creating bottlenecks), or autonomous units make incoherent local decisions (producing fragmentation). Singh et al. (2020) document both.

▪ Governance structures designed once and treated as fixed. Given that DT is continuous and emergent, the structure stops fitting the transformation it was supposed to govern (Hanelt et al., 2021).
▪ Learning captured at operational level only. Sprint reviews, retrospectives and post-mortems generate single-loop learning, but the cross-initiative patterns that would constitute double-loop learning are not systematically fed back into governance (Argyris and Schön, 1996; Bui et al., 2023).

The Romanian institutional context illustrates these dysfunctions and the difficulty of correcting them. The OECD (2023) review of corporate governance in Romanian state-owned enterprises documented a decade-long gap between the legal framework established by Government Emergency Ordinance 109/2011 and its actual implementation, with successive governments undermining board selection through repeated interim appointments. Law 187/2023 closed this gap legislatively, but the boundary between corporate governance, DT governance and operational management is not yet visible in current regulatory practice. Mureșan (2025) reaches a similar conclusion for Romanian public administration: institutional fragmentation and the absence of a coherent digital governance function are the binding constraint on what is otherwise a well-resourced digital transformation programme.

Diagnosing these dysfunctions is not especially difficult once the distinction between DT governance and DT management is in place. The harder problem, and one this paper cannot resolve, is the organisational politics of redistributing authority once the diagnosis is made.

6. Conclusions

6.1. Contribution to Knowledge

The argument developed in this paper can be stated simply: digital transformation fails not primarily because of inadequate technology or insufficient investment, but because organisations lack the governance arrangements needed to translate digital strategic intent into coherent action. The paper contributes to knowledge in three specific ways. First, it offers a conceptual vocabulary, corporate governance, DT governance, and DT management, that clarifies a distinction the literature currently blurs (Bharadwaj et al., 2013; Wessel et al., 2021; Markus and Rowe, 2023). Second, it proposes the meta-capability framing as a bridge between dynamic capabilities theory and organisational design research, addressing the integration gap that Warner and Wäger (2019) flagged. Third, it derives, rather than asserts, five governance dimensions, by anchoring each in a processual characteristic of DT and a corresponding dynamic capability. The reconceptualisation of governance as organisational meta-capability is intended to be useful both theoretically (for researchers seeking a sharper conceptual lens) and practically (for managers and policymakers trying to redesign governance arrangements that no longer fit the transformations they govern).

6.2. Limitations of the Study

The limitations of this analysis are real and should inform how the research agenda proceeds. The argument is conceptual rather than empirical: while we ground claims in published evidence, we do not test them against new data. The five governance dimensions are derived analytically; their operationalisation into measurement

instruments is future work. The framework is also predominantly a-contextual: although the empirical literature we draw upon spans sectors, firm sizes and DT stages, our framework does not yet specify how the relative importance of the five dimensions varies across these contexts. Andersson et al. (2025) suggest, for example, that board involvement matters most at the digitalisation stage; an analogous staged contingency may characterise the other four governance dimensions. Finally, the integrative reading we offer in Section 4 is selective: the framework would also benefit from deeper engagement with the corporate governance literature on board competence and with the IT governance literature on COBIT-style frameworks.

6.3. Future Research Directions

Three research directions seem most pressing. First, operationalising the five governance dimensions into measurable constructs and validating an instrument that can be used in survey research. Second, examining how the relative importance of the five dimensions varies across organisational contexts, building on the staged-contingency logic introduced by Andersson et al. (2025) for board roles. Sector, firm size, ownership structure, and DT maturity are all likely moderators. Romanian state-owned and listed enterprises operating under the revised governance framework introduced by Law 187/2023 offer an informative empirical setting for testing these contingencies. Third, testing the empirical relationship between digital leadership (Albannai et al., 2024), DT governance, and DT outcomes, with DT governance functioning as a mediating variable rather than as a competing explanatory category. These three directions are complementary: together they would convert the conceptual framework into a programmatic empirical research stream.

Declaration on the Use of AI Tools

AI-based tools (Anthropic Claude) were used to support drafting, the identification and integration of relevant sources, language refinement, and the preparation of figures and tables. All conceptual claims, theoretical positions, argumentative structure, and final selection of references were formulated and verified by the human authors, who take full responsibility for the content.

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ORGANISATIONAL CULTURE AND ORGANISATIONAL EFFICIENCY IN THE ROMANIAN CONSTRUCTION SECTOR: A THEORETICAL AND BIBLIOMETRIC ANALYSIS IN THE CONTEXT OF INDUSTRY 5.0

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Abstract: *This paper examines the relationship between organisational culture and organisational efficiency in the construction sector, an industry traditionally characterised by structural fragmentation, operational complexity and resistance to organisational change. The main objective of the study is to analyse the conceptual evolution of this relationship, from traditional management approaches focused on hierarchy and control to the contemporary Industry 5.0 paradigm, which emphasises sustainability, resilience, digital transformation and human-centred development. The study uses a bibliometric methodology based on VOSviewer software to analyse and visualise scientific publications indexed in international databases such as Web of Science and Scopus. This approach enabled the identification of dominant thematic clusters, intellectual structures, co-occurrence networks and emerging research directions in the specialist literature. The findings indicate a shift from conventional efficiency models based mainly on productivity and operational control towards integrated approaches that emphasise organisational adaptability, innovation, occupational safety and technological integration. The study also highlights the relevance of the Competing Values Framework (CVF) for balancing competing organisational priorities such as cost, quality, time, safety and productivity in construction projects. Particular attention is given to the Romanian construction sector, where organisational efficiency is increasingly influenced by digitalisation pressures, labour shortages, hierarchical managerial traditions and the need to align local organisational practices with Industry 5.0 requirements. The paper argues that organisational culture should be understood not merely as a contextual organisational element, but as an organisational mechanism that can influence innovation adoption, organisational resilience and long-term performance. The study contributes to the literature by integrating bibliometric analysis with organisational culture theory and by contextualising international management paradigms within the realities of the Romanian construction industry. The conclusions provide theoretical perspectives and practical implications for managers seeking to support digital transformation and sustainable organisational development in construction companies.*

Keywords: *organisational culture; organisational efficiency; construction sector; Industry 5.0; bibliometric analysis; Competing Values Framework (CVF); Romania*

JEL Classification: *L74; M14*

1. Introduction

Globally, the construction industry is one of the fundamental pillars of economic development. It generates more than 10% of global GDP and remains a central area of concern in international research on productivity and performance (Barbosa et al., 2017). The sector is also one of the largest employers and consumers of resources, with strong links to manufacturing, logistics, transport, architecture, engineering and raw material extraction. Beyond its economic contribution, construction plays a key role in urban development, infrastructure modernisation and the implementation of sustainability objectives.

Despite this strategic importance, the construction sector has historically been associated with relatively low productivity, fragmented operational structures and resistance to organisational and technological change. In this context, organisational culture is increasingly recognised as a factor that can influence organisational efficiency, project coordination, communication processes, employee behaviour and innovation adoption. Although efficiency is often associated with technical resources, technological capabilities or managerial control mechanisms, the literature suggests that shared values, behavioural norms, leadership styles and communication patterns also shape productivity, occupational safety and project outcomes. The relationship between organisational culture and organisational efficiency in construction is therefore multi-layered and closely connected to the capacity of organisations to adapt to technological and economic transformation.

This paper proposes a theoretical and conceptual analysis of the influence of organisational culture on organisational efficiency and project performance in the construction sector. It connects general management paradigms with the sector-specific characteristics of construction, with particular attention to the Romanian context and to the implications of Industry 5.0.

The transition from traditional to digital organisational cultures in the construction sector indicates that Industry 5.0 repositions the human factor at the centre of technological transformation. Digital transformation should not be understood as the mere acquisition of advanced technologies, but as a socio-technical process that reshapes organisational routines, decision-making mechanisms, leadership practices and employee capabilities (Matt, Hess and Benlian, 2015; Vial, 2019; Verhoef et al., 2021). From this perspective, efficiency is no longer assessed exclusively through conventional KPIs, but also through an organisation's ability to learn, adapt and integrate innovation into everyday project practices. In construction, this transition is particularly relevant because technologies such as BIM, collaborative platforms, AI-assisted planning and digital twins can generate value only when they are supported by organisational cultures that facilitate coordination, trust, learning and human-technology collaboration (Tripathi and Jha, 2018; Sacks et al., 2018).

Table 1: Evolution of the Organisational Culture Paradigm

Dimension	Traditional Paradigm	Agile/Digital Paradigm
Role of Culture	Control mechanism: emphasis on hierarchy, rigid procedures and compliance.	Catalyst for innovation: agility, learning and openness to change.
Leadership	Transactional leadership based on rewards and sanctions for achieving short-term goals.	Transformational and digital leadership focused on vision, change management and employee engagement.
Communication	Top-down communication, unidirectional information flows and departmental silos.	Collaborative and transparent communication through integrated platforms such as Common Data Environments.
Relationship with Technology	Technology is perceived as a potential threat to established routines or as an additional operational burden.	Organisational culture supports the integration of AI technologies and Industry 5.0 principles as mechanisms for enhancing human capabilities, collaboration and adaptability.
Key Values	Stability and predictability through established working methods.	Resilience and adaptability through the capacity to navigate uncertainty and integrate digital feedback.

Source: Author

The originality of the research derives from the tension between the structural rigidity of construction processes and the organisational flexibility required by contemporary efficiency models. The study identifies organisational culture as an instrument for supporting long-term organisational adaptability and performance. Research gaps were identified through density and network fragmentation analysis in the co-occurrence map. The analysis suggests a fragmented relationship between organisational culture and the systems used to define efficiency. The distance between the “Organisational Culture” clusters and the “Construction sector” cluster indicates that relatively few studies directly integrate culture, efficiency and advanced digital transformation in construction. Moreover, much of the literature focuses on technical barriers, while less attention is given to the cultural and leadership mechanisms through which organisations absorb change over time. The theoretical and conceptual analysis developed in this paper examines the mechanisms through which organisational culture can influence organisational efficiency in the construction sector, with particular attention to Romania. The Romanian case is relevant not only as a national example, but also as a sector-specific configuration in which traditional managerial practices, labour market constraints, uneven digital maturity and growing European integration pressures interact with global transformations associated with Industry 5.0.
The Romanian construction sector illustrates a sectoral setting shaped by multiple organisational and institutional pressures. According to FIEC (2025), construction accounted for 7.5% of GDP formation in Romania in 2024, while total investment in

construction reached approximately EUR 48 billion. The same report indicates a contraction in overall construction activity, with a substantial decline in residential construction and a more moderate increase in civil engineering works, largely associated with state-led infrastructure projects. These dynamics suggest that organisational efficiency in the Romanian construction sector cannot be analysed only through the lens of output growth. It must also be connected to firms' capacity to manage volatility, resource constraints, project fragmentation and changing investment priorities.

Romania also faces structural challenges that directly affect organisational efficiency. The European Commission (2025) identifies persistent skills shortages, outdated and inadequate infrastructure, weak digital capacity, labour market participation problems and administrative unpredictability as factors limiting productivity and competitiveness. These challenges are especially relevant for construction organisations, where project continuity, safety compliance, site coordination and technological adoption depend heavily on the interaction between formal management systems and informal organisational practices.

From a cultural perspective, studies inspired by Hofstede's cultural dimensions framework indicate that Romanian organisational environments tend to display relatively high power distance, hierarchical decision-making structures and moderate resistance to organisational change (Hofstede, 2010; Văduva et al., 2025). These characteristics may influence leadership practices, communication flows, employee participation, safety behaviour and innovation adoption. However, Romanian organisational culture should not be interpreted deterministically. Significant differences exist between companies depending on organisational maturity, ownership structure, exposure to international markets, managerial professionalisation and participation in European-funded infrastructure projects.

The transition towards Industry 5.0 in the Romanian construction sector should therefore be understood not only as a technological process, but also as a cultural and managerial transformation. The integration of BIM, AI-assisted planning tools, collaborative digital platforms and data-driven performance systems requires organisational cultures capable of balancing hierarchy with participation, operational control with learning and productivity pressures with safety and employee well-being. In this respect, the Romanian case provides a useful setting for examining the connection between general management paradigms and sector-specific organisational realities.

2. Organisational culture and efficiency in the construction sector

From a theoretical and sector-specific perspective, organisational culture has been analysed through several research traditions. Classical management theories emphasised efficiency, hierarchy, administrative coordination and managerial control (Taylor, 1911; Fayol, 1949; Drucker, 1954; Mintzberg, 1979). Later organisational culture research shifted attention towards values, symbols, assumptions, meanings and behavioural patterns within organisations.

The literature on organisational culture and efficiency is extensive and well established. It reflects sustained academic interest in the ways in which culture shapes organisational behaviour, coordination and performance. In the construction sector, this literature is theoretically diverse and can be organised around several analytical directions. Earlier approaches, including Pettigrew's (1979) work on symbolism, ritual and meaning in organisational life, helped establish organisational

culture as a legitimate analytical concept. More recent approaches connect culture with innovation, sustainability, safety and digital transformation. Schein (2010) defines organisational culture as shared assumptions developed through external adaptation and internal integration, later transmitted to new members as appropriate ways to perceive, think and act. This highlights the learned and transmitted nature of organisational culture. Bogale and Debela (2024) also emphasise its multidimensional influence on employee behaviour, workplace interaction, management practices and organisational outcomes. Complementary definitions further clarify the concept. Hofstede (2001) describes organisational culture as collective programming of the mind, while Denison (1990) links it to values, beliefs and management practices. Deal and Kennedy (1982) define culture as "the way things are done" in an organisation, whereas Pettigrew (1979) and Louis (1983) emphasise symbols, rituals and shared meanings. Taken together, these perspectives define organisational culture as a system of shared assumptions and practices that shape coordination and performance. The term "organisational culture" also has a longer intellectual history. Jay (1967) described organisations as social entities with customs, taboos and distinctive behavioural patterns, including authoritarian, democratic, liberal and paternalistic forms. This early use of the concept is relevant because it shows that organisational culture has long been understood as a social and managerial phenomenon rather than merely a symbolic one.

In the construction sector, organisational culture has specific characteristics because work is frequently project-based, temporary and distributed across multiple organisations. Construction organisations operate through temporary coalitions involving contractors, subcontractors, designers, consultants and clients. This increases the relevance of shared meanings, communication routines, trust and coordination across organisational boundaries (Dainty, Green and Bagilhole, 2007; Kagioglou, Cooper and Aouad, 2001).

Within this sector, organisational culture is closely connected to safety, productivity, quality and project performance. This is especially relevant because construction projects involve high operational risks, changing site conditions and multiple stakeholder groups. Choudhry, Fang and Mohamed (2007) define safety culture through shared values, assumptions and behavioural norms that influence workers' compliance with safety practices, while Mohamed (2002) emphasises the role of safety climate in shaping site behaviour. Broader safety research also confirms that shared values, climate perceptions and behavioural routines influence risk management and safety performance in high-risk environments (Cox and Cheyne, 2000; Zhou, Fang and Wang, 2008).

The literature also indicates that organisational culture contributes to organisational efficiency through coordination, leadership, learning and performance management. Dainty, Green and Bagilhole (2007) emphasise the role of people and culture in construction processes, while Kagioglou, Cooper and Aouad (2001) propose a conceptual framework for performance management in construction that links organisational processes with project outcomes. From this perspective, organisational culture cannot be separated from the mechanisms through which construction organisations manage time, cost, quality, safety and productivity. Taken together, these definitions indicate that organisational culture in construction is closely linked to project-based work, risk management, occupational safety and the coordination of human resources. Its main dimensions include safety and quality

orientation, collaboration, communication, rules and procedures, hierarchy, teamwork, adaptability, innovation and performance orientation.
The literature on organisational culture and efficiency in construction can be grouped into three analytical directions. The first is the Competing Values Framework (CVF), which examines tensions between stability and flexibility, internal cohesion and external competitiveness (Cameron and Quinn, 1999). This model is useful for construction because project-based organisations must combine procedural discipline with adaptive capabilities. The second direction is safety culture research, which links shared assumptions, leadership commitment and communication patterns with safety behaviour and operational performance (Mohamed, 2002; Choudhry, Fang and Mohamed, 2007; Fang, Wu and Wu, 2015; Zahoor et al., 2017). The third direction concerns digital transformation and technological adoption, showing that technology contributes to efficiency only when organisations also develop cultural readiness, managerial commitment and employee acceptance (Ajzen, 1991; Tripathi and Jha, 2018; Sacks et al., 2018; ISO, 2018; Matt, Hess and Benlian, 2015; Vial, 2019).
The analysis of organisational efficiency in the Romanian construction sector requires an integrated approach based on three mutually reinforcing dimensions: organisational structure, safety culture and digital transformation. The first dimension is supported by the CVF, which provides a useful lens for analysing the balance between hierarchical control and flexibility (Cameron and Quinn, 1999). The second dimension is safety culture, which is essential in a field marked by high operational risks and where employee behaviour, communication and leadership commitment influence both safety outcomes and project continuity (Mohamed, 2002; Choudhry, Fang and Mohamed, 2007; Liang, Lin and Zhang, 2023). The third dimension is digital transformation, which requires the integration of BIM, data-driven decision-making and collaborative technologies into organisational routines (Sacks et al., 2018; Tripathi and Jha, 2018).
Within this framework, the long-term performance of construction companies in Romania depends partly on management's ability to align these three dimensions. Excessively rigid structures may limit digital transformation, while accelerated digitalisation without safety culture, employee involvement and clear coordination mechanisms may create new organisational vulnerabilities. Organisational efficiency therefore emerges from the alignment between structural control, safety-oriented values and digital adaptability.
International and national studies highlight the relationship between culture and performance. Cameron and Quinn (1999) show that organisational cultures differ according to their emphasis on hierarchy, market orientation, clan cohesion and adhocracy-oriented innovation. In construction, this framework is useful because firms must balance cost, time, quality, safety and innovation under conditions of uncertainty and project fragmentation. Recent studies also show that innovative and sustainability-oriented cultures may support performance in construction firms (Afzal, Lim and Prasad, 2022; Bamgbade et al., 2022).
This paper examines cultural mechanisms that strengthen organisational efficiency, including leadership by example, communication, feedback, coaching, learning and rewards. These mechanisms matter because culture is reproduced through everyday managerial practices, not formal declarations alone. In construction, leadership influences safety compliance, information sharing, technology adoption and problem-solving (Fang, Wu and Wu, 2015; Xia et al., 2023).

From a research perspective, organisational efficiency can be operationalised through a coherent set of key performance indicators:

- cost, understood as resource optimisation;
- time, understood as the duration of operational cycles;
- quality, understood as compliance and customer satisfaction;
- safety, understood as the reduction of incidents and occupational risks;
- productivity, understood as the output/input ratio.

In the context of Industry 5.0, these indicators should be integrated into a broader socio-technical logic rather than assessed only through automation and technical efficiency. Digital technologies, including artificial intelligence, collaborative robotics and data analysis, can reshape authority structures, decision-making and collaboration. Industry 5.0 therefore requires a balance between technological performance and human capital, promoting a people-oriented culture in which well-being, creativity and social responsibility contribute to efficiency (Alves, Lima and Gaspar, 2023; Rajumesh, 2023; Townsend and Romme, 2024). Organisational performance is thus understood as the interaction between advanced digital systems and an adaptive, inclusive and sustainable organisational culture. Recent literature suggests that implementing Industry 4.0 and Industry 5.0 principles depends not only on technical infrastructure, but also on organisational readiness, digital capabilities, managerial commitment, employee qualification and openness to change (Müller, Kiel and Voigt, 2018; Frank, Dalenogare and Ayala, 2019; Sony and Naik, 2020). In construction, digital technologies contribute to efficiency only when embedded in coherent organisational routines, supported by leadership practices and accepted by project teams.

Table 2: Evolution of Research Paradigms

Dimension	**Traditional Research Focus**	**Emerging Research Directions**
Core Technology	Static BIM, mainly used for 3D modelling and clash detection.	Digital twins and Industry 5.0: dynamic models powered by real-time data and IoT sensors.
Operational Objective	Efficiency and cost: waste reduction and productivity optimisation on site.	Sustainability and resilience: low-emission buildings and infrastructure capable of adapting to climate change.
Human Factor	Management and performance: hierarchical control and performance measurement through rigid indicators.	Transformational leadership: focus on organisational culture, AI ethics and employee well-being.
Data Analysis	Statistical analysis: classical methods, such as PLS-SEM, used to validate theoretical models.	AI and machine learning: predictive algorithms for risk management and decision support.
Collaboration	Lean construction: optimising workflows between contractors and subcontractors.	Blockchain and smart contracts: transparency and payment automation in the supply chain.

Source: Author

The transition from the Industry 4.0 technology paradigm to the human-centred model promoted by Industry 5.0 marks a shift from technological efficiency alone towards the integration of sustainability, resilience and employee well-being into the performance equation. Industry 5.0 seeks to reconcile automation with human creativity, so that technology amplifies human potential rather than replacing it. Organisational culture is therefore evolving towards a participatory model oriented towards co-creation, social responsibility and a balance between economic performance and social impact.

3. Bibliometric Analysis Methodology

To strengthen methodological rigour, bibliometric mapping of the specialist literature was carried out to identify the transition from general management paradigms to construction-sector-specific research directions. The chronological analysis (1975–2026) indicates a shift from traditional construction management perspectives towards increasingly digital and human-centred approaches. Research has gradually moved from static BIM-oriented modelling towards dynamic simulations, Digital Twin applications, IoT-based monitoring and machine learning algorithms for risk prevention in construction management.

According to the bibliometric analysis, the evolution from classical efficiency models to Industry 5.0 can be structured into three main stages. The consolidation stage (1975–2010) is associated with Total Quality Management (TQM), cost reduction, performance improvement and labour productivity in construction firms (Pheng and Teo, 2004). The digitisation stage (2011–2020) is associated with the Building Information Modelling (BIM) paradigm, in which organisational culture increasingly becomes a facilitator of technology adoption. The visionary stage (2021–2026), reflected in the more recent clusters, introduces new concepts and trends such as:

- Sustainability and Green Culture, where efficiency is measured through reductions in carbon emissions;
- Industry 5.0;
- Digital Twin;
- Cyber-Physical Systems, which promote human-robot collaboration; and
- Dynamic Capabilities, which refer to organisations' capacity to respond to new global trends.

The analytical challenge is to connect these bibliometric trends with a resource-based and dynamic-capabilities perspective on organisational efficiency. From this perspective, digital technologies do not automatically generate competitive advantage. They become valuable only when they are integrated into organisational resources, managerial capabilities, employee skills and adaptive routines (Barney, 1991; Vial, 2019; Warner and Wäger, 2019). In construction, this interpretation is particularly relevant because productivity improvement depends not only on technological modernisation, but also on collaboration, human capital development, process integration and cultural readiness for change (Barbosa et al., 2017; Tripathi and Jha, 2018). Recent research therefore increasingly examines how modern technologies, organisational learning and safety-oriented management practices can reduce operational risks and improve project performance.

3.1. Co-occurrence Analysis and Overlay Visualisation

As shown in Figure 1, the core of the keyword co-occurrence network is defined by the intersection between organisational culture and organisational efficiency, which represent the central terms of the analysis. Organisational culture acts as a bridge between clusters, suggesting that efficiency-related interventions depend not only on formal rules, regulations and standards, but also on organisational norms, values and informal practices. The main thematic clusters are organised around safety culture, implementation, framework, innovation and competitive advantage. This structure indicates that contemporary efficiency research increasingly integrates safety, cultural dynamics and technological change.

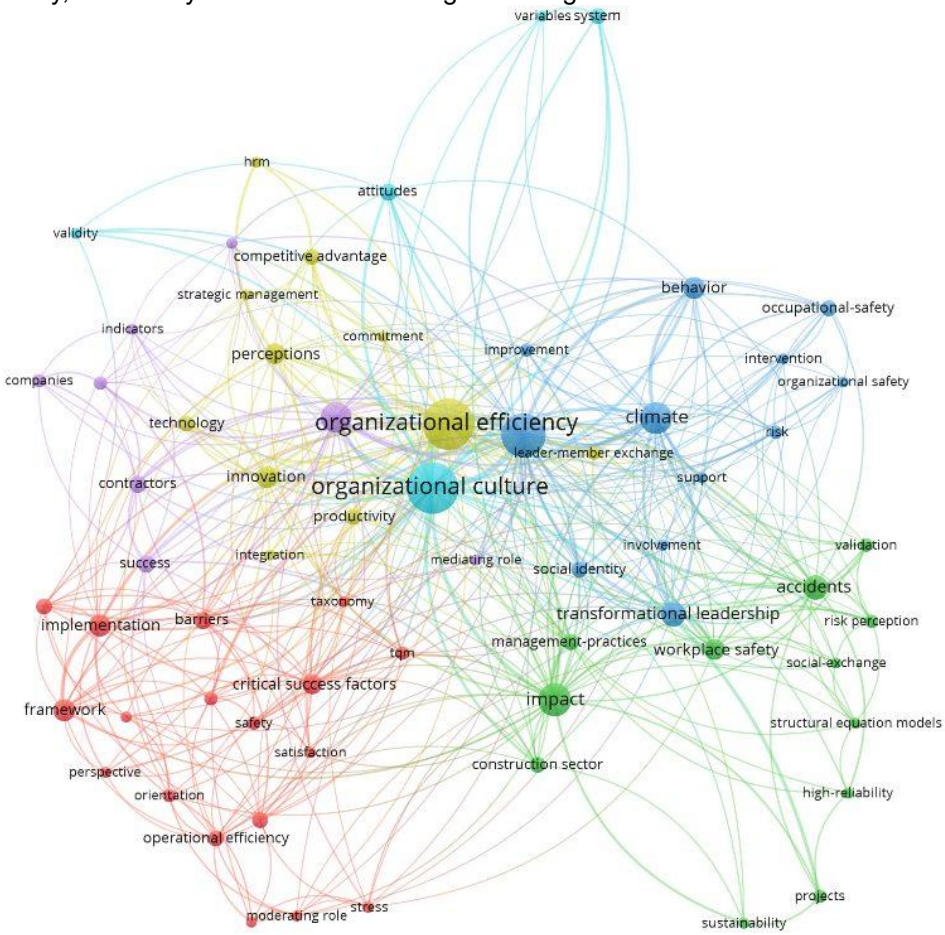


Figure 1: Keyword co-occurrence network of organisational culture, efficiency and construction-related terms

Source: Author's processing in VOSviewer based on the Web of Science and Scopus dataset.

Figure 2 provides the overlay visualisation of the same keyword network. The colour gradient indicates a movement from earlier studies focused on “perceptions” and “attitudes” towards more recent themes such as “digital transformation” and “sustainability” in the latest segment of the analysed dataset.

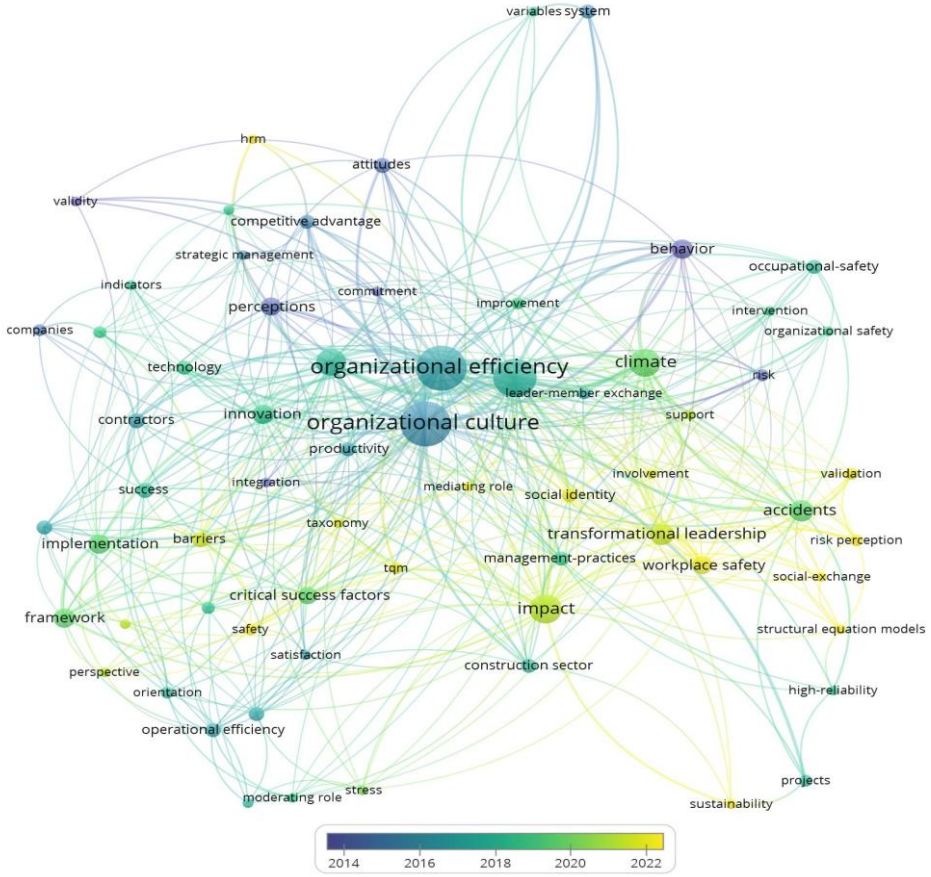


Figure 2: Overlay visualisation of keyword co-occurrence by average publication year

Source: Author’s processing in VOSviewer based on the Web of Science and Scopus dataset.

The overlay map also supports the interpretation that workplace safety is no longer treated merely as a technical issue, but as an outcome partly shaped by organisational culture, leadership and shared behavioural routines. Recent research increasingly seeks to identify frameworks that combine transformational leadership, innovation and safety-oriented practices to improve efficiency and reduce accidents.

3.2. Analysis of Citations and Intellectual Structure

Figure 3 presents the citation network and highlights a central conceptual triad: safety climate (Mohamed, 2002), safety culture (Choudhry, Fang and Mohamed, 2007) and human resource management (Lingard and Cooke, 2012). These

contributions support models linking safety climate, employee behaviour and performance in construction. They also frame safety culture as part of organisational culture, emphasising shared responsibility and psychological factors that influence workers' compliance with safety rules.

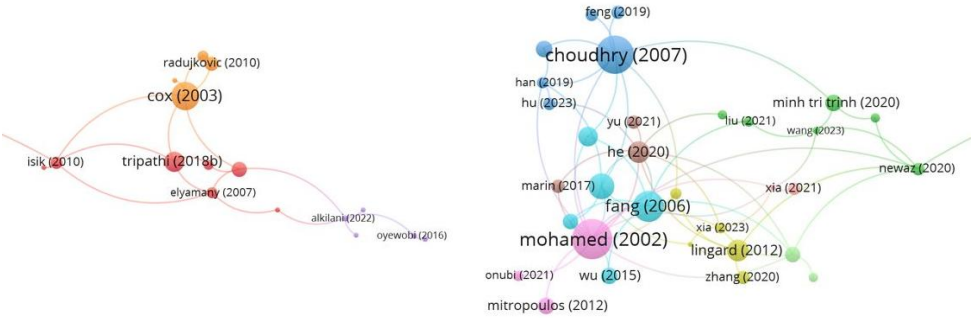


Figure 3: Citation network of key contributions in construction safety and organisational culture
Source: Author's processing in VOSviewer based on the Web of Science and Scopus dataset.

Figure 4 shows the co-authorship network. Authors such as Fang and Lingard appear as relevant nodes because of their contribution to integrating safety culture into construction management and to connecting safety-related research with broader organisational performance debates.

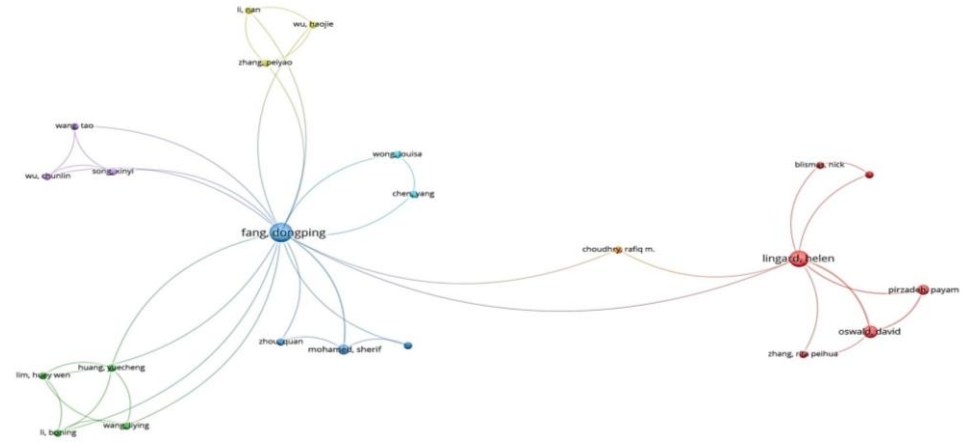


Figure 4: Co-authorship network of authors in the analysed dataset
Source: Author's processing in VOSviewer based on the Web of Science and Scopus dataset.

Figure 5 presents the co-citation structure of the analysed literature. The map highlights the progressive development of research on organisational culture in construction, with a strong focus on safety, performance and project management. Unlike many other economic sectors, construction has a specific profile, characterised by high operational risk, clear hierarchical structures and temporary

projects. These characteristics are directly reflected in the intellectual structure of the literature.

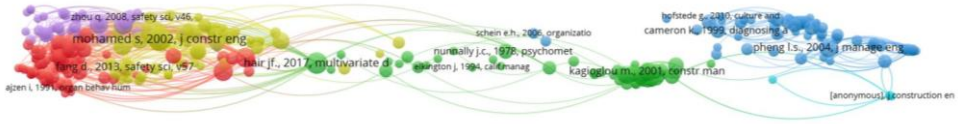


Figure 5: Co-citation network showing the intellectual structure of the analysed literature
Source: Author's processing in VOSviewer based on the Web of Science and Scopus dataset.

3.3. Bibliographic coupling

Figure 6 presents the bibliographic coupling map. Recent research (2020–2026) increasingly focuses on "Industry 5.0" and "Construction 5.0", marking a new phase of efficiency based on human-technology symbiosis. Studies such as He et al. (2020), Xia et al. (2023) and Patyal and Koilakuntla (2020) use quantitative research methodologies to examine relationships between culture, risk and organisational impact. The network is characterised by dense connections within the main clusters and by bridging links between different schools of thought. This indicates bibliographic continuity, with recent authors building on the foundations established by earlier research.

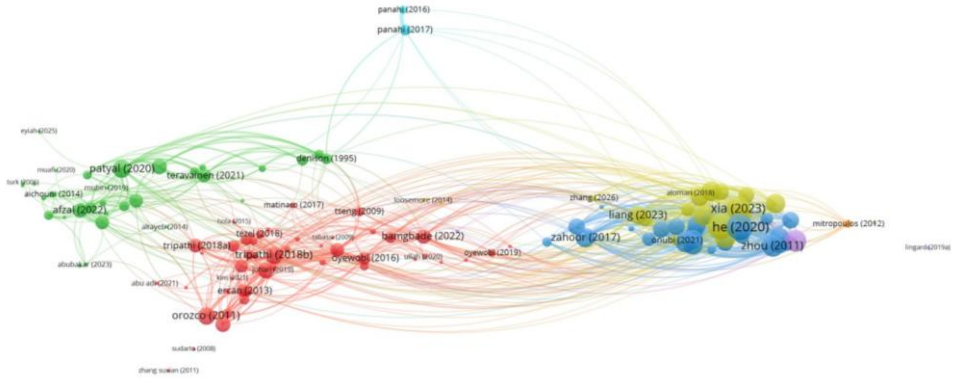


Figure 6: Bibliographic coupling map of recent publications in the analysed dataset
Source: Author's processing in VOSviewer based on the Web of Science and Scopus dataset.

Sustainability and innovation themes are beginning to appear on the periphery of the co-occurrence map, signalling future directions for research expansion. This analysis confirms an increase in recent publications exploring "Construction 5.0" and the impact of key KPIs in digitised environments. Current bibliometric trends show growing interest in connecting organisational culture with Industry 5.0-related themes, including digital transformation, sustainability and performance in construction and related sectors.

Based on the bibliometric maps and the conceptual structure analysed, the theoretical conclusions of the article support the transition from traditional management to integrated management in the Industry 5.0 era.

4. The Relationship Between Culture and Efficiency in the Construction Sector

The construction sector requires a sector-specific analytical approach because its project-based structure shapes both the development and manifestation of organisational culture. Construction projects involve temporary collaboration between main contractors, subcontractors, suppliers, consultants and regulatory authorities. This creates a multi-actor organisational setting in which values, practices and objectives may differ across participating entities. Sectoral efficiency therefore depends partly on the capacity to align these differences within a functional collaborative framework.

The theoretical contribution of this study lies in connecting classical approaches to organisational culture with emerging perspectives that link culture to organisational efficiency, digital transformation, safety and Industry 5.0. The literature has gradually moved from the isolated analysis of employee attitudes towards more integrated models in which organisational culture supports innovation absorption, safety performance and project coordination. In this context, efficiency is not defined exclusively through financial indicators, but through the capacity of organisations to combine operational performance with adaptability, technological learning and safety-oriented behaviour.

The theoretical analysis indicates that the impact of culture on efficiency is mediated by three main dimensions:

- the Competing Values Framework;
- safety-productivity synergy; and
- adaptability and digital transformation.

The Competing Values Framework is useful for balancing the need for stability and hierarchical coordination with the need for flexibility and innovation in complex projects. Safety culture also plays a central role, as robust safety practices can reduce operational losses and support project continuity. Organisational culture further influences the implementation of digital solutions because digital transformation requires changes in routines, capabilities and decision-making processes, not only technology acquisition (Matt, Hess and Benlian, 2015; Vial, 2019; Verhoef et al., 2021). Without adequate managerial commitment, digital skills, employee qualification and organisational readiness, technologies such as BIM, AI-assisted planning tools and integrated project management platforms may remain underused or generate only limited performance gains (Müller, Kiel and Voigt, 2018; Frank, Dalenogare and Ayala, 2019; Tripathi and Jha, 2018).

The bibliometric results indicate a gradual integration of organisational culture into research on change management, innovation and digital transformation. Rather than being treated as a merely descriptive concept, culture is increasingly conceptualised as a dynamic mechanism involved in sustainability, inclusion, technological adoption and organisational adaptability. This transition is supported by research on Industry 4.0 implementation, which shows that technological adoption is shaped by organisational resources, managerial attitudes, workforce capabilities, company size and the ability of firms to align innovation with existing business processes (Müller, Kiel and Voigt, 2018; Frank, Dalenogare and Ayala, 2019). For construction companies, especially small and medium-sized enterprises, digital transformation

may be constrained by limited financial resources, insufficient digital skills and the absence of formalised change-management structures. Similar concerns are reflected in research on lean construction barriers, which shows that organisational culture can either support or constrain continuous improvement and process innovation in construction environments (Romo et al., 2025).

The Romanian construction sector makes this relationship especially clear because organisational efficiency is shaped by the simultaneous presence of traditional coordination mechanisms and emerging digital transformation pressures. On the one hand, construction projects require hierarchical control, procedural discipline and clear responsibility structures in order to manage cost, time, quality and occupational safety. On the other hand, contemporary efficiency increasingly depends on collaborative communication, digital coordination, cross-functional learning and the capacity to integrate technological innovation into everyday project routines.

This tension can be interpreted through the Competing Values Framework. In the Romanian construction sector, hierarchical culture remains relevant because it provides procedural stability, compliance orientation and managerial control in high-risk environments. However, excessive reliance on hierarchy may reduce flexibility, limit employee participation and slow down innovation adoption. Clan-oriented cultural elements are also relevant because labour shortages and employee retention challenges make trust, mentoring, team cohesion and informal knowledge transfer increasingly significant. Adhocracy-oriented cultural traits support experimentation, BIM adoption, digital collaboration and Industry 5.0 readiness, while market-oriented traits remain necessary for cost discipline, productivity and competitiveness (Cameron and Quinn, 1999; Kagioglou, Cooper and Aouad, 2001).

Organisational efficiency in the Romanian construction sector should therefore not be reduced to technical productivity indicators alone. It emerges from the interaction between cultural values, leadership practices, safety routines, digital maturity and project governance mechanisms. In this respect, organisational culture functions as a mediating mechanism between global efficiency paradigms and local sector-specific constraints. A construction company may have access to digital technologies, but their effective use depends on whether employees trust these systems, whether managers encourage learning, whether site teams communicate transparently and whether organisational routines support data-driven decision-making.

At the national level, these arguments are consistent with broader digitalisation challenges identified by the European Commission (2024), including the relatively low share of Romanian SMEs meeting basic digital intensity criteria and the limited level of basic digital skills. Rather than repeating the Romanian sectoral constraints in detail, this section emphasises their theoretical implication: digital transformation in construction requires organisational cultures that support learning, employee involvement, trust in data and adaptive leadership.

Within this framework, safety culture remains a central component of organisational efficiency. Construction is characterised by high operational risk, temporary site teams, subcontracting chains and changing work environments. Studies on safety culture in construction show that shared assumptions, communication patterns and leadership commitment influence safety behaviour and operational outcomes (Choudhry, Fang and Mohamed, 2007; Fang, Wu and Wu, 2015; Zahoor et al., 2017). For Romanian construction companies, safety culture should therefore be

treated not only as a compliance requirement, but also as an efficiency-related cultural capability.

5. Characteristics and Organisational Implications of the Romanian Construction Sector

The Romanian construction sector presents several structural, managerial and cultural characteristics that justify a sector-specific discussion of the relationship between organisational culture and organisational efficiency. The sector is economically significant, yet its performance is marked by volatility, uneven development across construction segments and strong dependence on infrastructure investment. According to FIEC (2025), construction represented 7.5% of GDP formation in Romania in 2024, while total investment in construction reached approximately EUR 48 billion. At the same time, the volume of construction works decreased overall, with residential construction registering a substantial contraction, while civil engineering works increased more moderately, mainly because of state-led infrastructure projects. These trends indicate that efficiency in the Romanian construction industry cannot be interpreted only in terms of expansion. It should also be understood as the capacity to maintain project performance, resource coordination and organisational adaptability under unstable market conditions.

The first characteristic of the Romanian construction sector is its exposure to fragmented project structures. Like construction industries in other European countries, Romanian construction activity is organised around temporary projects involving contractors, subcontractors, suppliers, designers, consultants and public authorities. This fragmentation creates coordination challenges and increases the importance of shared organisational values, clear communication routines and trust-based collaboration. In such an environment, organisational culture becomes a mechanism through which project participants align expectations, interpret responsibilities and coordinate decisions across organisational boundaries. As project environments become more fragmented, cultural alignment becomes increasingly important for reducing delays, misunderstandings and inefficiencies.

The second characteristic concerns labour shortages and skills mismatches. The European Commission (2025a) notes that Romania continues to face shortages of both skilled and non-skilled workers, partly associated with people leaving the country to work abroad, low tertiary education attainment and mismatches between education and labour market needs. Romanian firms, particularly small and medium-sized enterprises, continue to identify inadequate skills as a barrier to growth. For construction companies, these shortages directly affect productivity, project continuity, safety performance and knowledge retention. From an organisational culture perspective, labour scarcity increases the importance of employee engagement, mentoring, learning-oriented leadership and retention-oriented managerial practices.

The third characteristic concerns uneven digital maturity. Earlier studies on the evolution of the Romanian construction industry also indicate the relevance of macroeconomic fluctuations and GDP-related construction dynamics for understanding sectoral performance (Nițu and Gasparotti, 2020). The European Commission (2024) shows that the share of Romanian SMEs meeting basic digital intensity criteria remains substantially below the EU average, while the level of basic digital skills among the population is also low. These national digitalisation constraints are especially relevant for construction organisations, where the adoption of BIM, integrated project management platforms, Common Data

Environments, AI-assisted planning tools and digital twin technologies requires financial investment, technical competence and cultural readiness for change. In this context, digital transformation should not be interpreted as a purely technical issue. It is also a cultural process involving learning, trust in data, openness to new workflows and the capacity to modify established routines.

The fourth characteristic concerns the role of public investment, public procurement and infrastructure development. Civil engineering works in Romania are closely connected to state-led infrastructure projects, including motorways, railways and public facilities (FIEC, 2025). Recent real estate and construction market surveys also indicate that investor confidence, financing conditions and regional market expectations remain relevant contextual factors for understanding construction-related activity in Romania and Central Europe (Deloitte Romania and Reff & Associates | Deloitte Legal, 2025). At the same time, the European Commission (2025a) highlights administrative capacity problems, insufficient competition in public procurement and policy predictability issues as factors affecting the business environment. These conditions influence construction companies by increasing uncertainty, intensifying pressure on delivery capacity and requiring stronger organisational resilience. In such a context, efficiency depends on internal managerial competence as well as on organisations' ability to respond to external institutional constraints.

The relevance of organisational culture becomes clearer when these Romanian sector-specific characteristics are connected to the Competing Values Framework. Hierarchical cultural traits may support compliance, safety discipline and procedural control, which remain necessary in complex construction projects. However, when hierarchy becomes excessively centralised, it may slow down communication, reduce initiative and limit innovation adoption. Clan-oriented cultural traits may support employee retention, mentoring, trust and informal coordination, which are especially relevant in a labour-constrained environment. Adhocracy-oriented traits may facilitate experimentation with BIM, digital platforms and Industry 5.0 technologies, while market-oriented traits support productivity, cost control and competitiveness. Organisational efficiency in the Romanian construction sector therefore depends on the capacity to balance these competing cultural orientations rather than privileging only one of them.

The transition towards Industry 5.0 further reinforces this need for balance. In the Romanian construction sector, human-centred digital transformation, resilience and sustainability must be interpreted in relation to existing organisational realities and European performance expectations. Digital transformation is therefore unlikely to succeed through technology acquisition alone. It requires cultural transformation, including leadership practices that support learning, communication mechanisms that reduce site-level fragmentation and organisational values that encourage safety, collaboration and innovation acceptance.

The Romanian case therefore functions as an analytical bridge between the general theoretical framework and the specific organisational constraints of a transitional, fragmented and unevenly digitalised construction market. It illustrates a specific form of organisational tension: the need to preserve operational stability while simultaneously developing adaptive capacity. Traditional managerial structures may provide predictability and authority in complex projects, but Industry 5.0 requires more participatory, learning-oriented and digitally enabled organisational cultures. The challenge is not necessarily to abandon hierarchy, but to transform it into a

framework that supports responsibility, mentoring, coordination and innovation rather than rigid control.
Consequently, the main conclusion derived from the Romanian sector discussion is that organisational culture mediates the relationship between structural constraints and efficiency outcomes. Sectoral pressures do not automatically determine inefficiency. Their impact depends on how organisations interpret them, how managers communicate change, how employees participate in problem-solving and how firms integrate safety, learning and technological innovation into everyday routines.
For Romanian construction companies, the practical implication is that efficiency strategies should move beyond narrow cost-time control and incorporate integrated cultural capabilities. These include safety culture, digital learning, collaborative leadership, employee retention, transparent communication and KPI systems that connect productivity with quality, safety, sustainability and resilience. In this sense, the Romanian construction sector confirms the broader theoretical argument of the article: organisational culture is not merely a contextual variable, but a mechanism through which efficiency is produced, constrained or transformed.

6. Research Gaps in the Romanian Construction Sector

The analysis of conceptual maps and literature highlights several identifiable gaps in the Romanian construction sector. These gaps limit the sector's capacity to align with global trends in organisational culture, efficiency and Industry 5.0.

- *Technological and cultural gap*

  Although international research increasingly emphasises Industry 4.0, Industry 5.0 and the integration of digital technologies into construction processes, the Romanian construction sector continues to face a combined technological and cultural gap. This gap should not be understood solely as the absence of digital tools. It also concerns limited digital skills, insufficient organisational readiness, fragmented managerial practices and resistance to changes in established routines. Studies on Industry 4.0 adoption show that implementation barriers are frequently organisational and cultural, including limited strategic clarity, insufficient employee involvement, lack of skills, uncertainty regarding the benefits of technological change and difficulties in aligning digital technologies with existing organisational processes (Dikert, Paasivaara and Lassenius, 2016; Müller, Kiel and Voigt, 2018; Frank, Dalenogare and Ayala, 2019; Sony and Naik, 2020). In this respect, digitalisation in Romanian construction requires investment in BIM, integrated data platforms and AI-assisted planning tools, but also a cultural transition towards learning, collaboration and trust in data-driven decision-making.

- *Underuse of CVF models*

  Another relevant gap is the absence of applied studies using established models for diagnosing organisational culture, such as the Competing Values Framework, in the analysis of Romanian construction companies. The lack of a systematic assessment of cultural typologies limits understanding of the relationship between organisational culture and project performance. It also restricts the development of scientifically grounded managerial interventions.

- *Fragmentation of KPIs*

  In local management practice, performance indicators are often treated separately and sometimes antagonistically. Safety and productivity may be

perceived as competing objectives rather than as components of an integrated performance framework. This approach contrasts with the conclusions of international literature, which emphasises the interdependence between risk management, quality of execution and operational efficiency.
In this article, "Culture 5.0" is understood as an organisational culture aligned with Industry 5.0 principles, namely human-centred digital transformation, sustainability, resilience, collaboration and responsible innovation.

- *Absence of a sustainability-oriented 5.0 culture*
  Despite European pressure for green transition and the circular economy, the Romanian sector still shows a gap between external sustainability requirements and internal organisational values. Organisational culture does not yet sufficiently prioritise environmental responsibility and sustainable innovation. This limits companies' ability to adopt a "Culture 5.0" paradigm focused on the balance between economic performance, technology and social impact.

An additional research gap concerns the limited availability of empirical studies examining the direct relationship between organisational culture and organisational efficiency indicators within Romanian construction companies. International literature provides well-established models for analysing organisational culture, safety culture, digital transformation and performance management. However, the Romanian academic context remains underdeveloped in terms of integrated empirical research combining these dimensions. In particular, there is a lack of quantitative studies applying the CVF, safety culture assessment tools, digital maturity indicators and KPI-based efficiency models to Romanian construction firms.

This gap is especially relevant because the Romanian construction sector presents a combination of conditions that may significantly influence the culture-efficiency relationship: labour shortages, migration of skilled workers, uneven SME digitalisation, project fragmentation, public procurement dependency and hierarchical managerial traditions. Without empirical validation, it is difficult to determine which cultural dimensions most strongly influence productivity, safety behaviour, employee retention, innovation adoption and project performance in Romanian construction organisations.

Future studies should therefore move beyond descriptive sectoral analyses and develop integrated research designs capable of measuring the interaction between organisational culture, safety culture, digital maturity and organisational efficiency. Such studies could combine survey-based organisational culture diagnostics, interviews with managers and site personnel, KPI analysis and case studies of construction companies with different levels of digital maturity. This would allow researchers to identify whether Romanian construction firms are predominantly characterised by hierarchical, clan, market or adhocracy-oriented cultures, and how these cultural profiles affect efficiency outcomes.

Another relevant gap concerns the absence of longitudinal studies on Industry 5.0 readiness in Romanian construction. Existing research tends to describe digital transformation as an expected direction, but less attention is paid to the organisational processes through which companies absorb, resist or reinterpret digital technologies. Longitudinal research would be particularly useful for understanding how BIM adoption, AI-assisted planning tools, collaborative platforms and sustainability-oriented practices become embedded in organisational routines over time.

Finally, there is a need for comparative research between Romanian construction companies and firms operating in more digitally mature European markets. Such comparisons would help distinguish between challenges that are general to the construction sector and those that are specific to the Romanian institutional, cultural and managerial environment. This would strengthen future research and provide more precise managerial recommendations for adapting international efficiency models to the Romanian construction sector.
These gaps confirm the need for a theoretical and bibliometric synthesis capable of connecting organisational culture, efficiency and Industry 5.0 within the Romanian construction sector.

7. Conclusions and Future Directions

The present study contributes to the literature by examining the relationship between organisational culture and organisational efficiency in the construction sector through a theoretical and bibliometric perspective, with specific contextualisation in the Romanian construction industry. The analysis shows that organisational culture should not be interpreted as a secondary organisational variable, but as an organisational mechanism that can influence productivity, project coordination, occupational safety, digital transformation, innovation adoption and long-term organisational resilience.
The bibliometric analysis indicates a clear shift in the literature. Earlier approaches tended to associate efficiency mainly with hierarchical control, productivity, cost reduction and operational discipline. More recent research increasingly connects efficiency with sustainability, safety culture, digitalisation, organisational adaptability, employee well-being and Industry 5.0 principles. This transition suggests that organisational efficiency in construction can no longer be explained only through technical or financial indicators. It should instead be understood as the result of interaction between technological systems, managerial practices, cultural values and human capabilities.
The study also highlights the relevance of the Competing Values Framework for interpreting the cultural tensions specific to construction organisations. Construction firms must simultaneously ensure stability and flexibility, control and innovation, procedural discipline and collaborative learning. In high-risk project environments, hierarchy remains necessary for safety compliance and operational coordination. However, excessive centralisation may limit communication, reduce initiative and slow down digital adoption. The paper's theoretical contribution lies in showing that organisational efficiency emerges from the capacity to balance these competing cultural orientations rather than privileging only one of them.
The Romanian construction sector provides an appropriate context for this analysis. It is economically significant, yet marked by volatility, labour market pressures, uneven digital maturity, public procurement complexity and managerial fragmentation. Recent research on Romanian organisational resilience also supports the relevance of strategic human resource management and organisational culture for long-term adaptability (Georgescu et al., 2024). These characteristics create a sectoral context in which general management paradigms cannot be applied mechanically. International models of organisational culture and efficiency must therefore be adapted to the Romanian context, where hierarchical managerial traditions coexist with growing pressures for digitalisation, sustainability, EU-funded infrastructure development and Industry 5.0 readiness.

The expanded discussion of the Romanian sector demonstrates that the relationship between organisational culture and efficiency is mediated by concrete sector-specific constraints. Labour market pressures increase the importance of employee retention, mentoring and knowledge transfer, while uneven digital maturity makes learning-oriented cultures and adaptive leadership necessary for BIM, AI-assisted planning and integrated project management adoption. Fragmented project structures increase the relevance of communication routines, trust and collaborative coordination, whereas public procurement and infrastructure dependency intensify the need for organisational resilience and managerial predictability. These findings support the argument that organisational culture functions as a mechanism through which Romanian construction firms respond to structural and technological pressures.

From a managerial perspective, the study suggests that Romanian construction companies should move beyond narrow efficiency models based exclusively on cost, time and short-term productivity. A more suitable approach would integrate traditional KPIs with indicators related to safety, quality, digital maturity, employee engagement, sustainability and organisational adaptability. Resistance to change should not be interpreted solely as an individual behavioural problem, but also as a reflection of uncertainty, insufficient communication, skill gaps, weak trust in new systems and limited organisational readiness. Addressing these factors requires cultural transformation in parallel with technological investment.

The study has several limitations. Its design is predominantly theoretical and bibliometric and does not include direct empirical validation through surveys, interviews or field-based case studies. The study therefore provides a conceptual interpretation of the relationship between organisational culture and organisational efficiency, rather than causal empirical evidence. Another limitation concerns the limited availability of Romania-specific empirical studies on organisational culture in construction compared with the broader international literature.

Future research should focus on empirical testing of the proposed conceptual relationships within Romanian construction companies. Quantitative studies could examine the correlation between CVF cultural profiles and efficiency indicators such as productivity, cost performance, time performance, safety outcomes and employee retention. Qualitative studies could explore how managers and site workers perceive organisational culture, digital transformation and resistance to change. Mixed-methods research would be especially valuable for understanding how formal managerial systems interact with informal site-level practices.

Future research directions may also include comparative analyses between Romania and other European construction markets, longitudinal studies on Industry 5.0 implementation and the development of integrated KPI systems capable of measuring not only cost and productivity, but also resilience, safety, sustainability, employee well-being and innovation capacity. Such research would strengthen both the theoretical understanding of organisational culture in construction and the practical capacity of Romanian firms to align with emerging European and global standards.

In conclusion, the article shows that organisational culture represents a key explanatory factor for organisational efficiency in the construction sector. In the Romanian context, this relationship is shaped by the coexistence of hierarchical structures, labour market pressures, uneven digitalisation and the need for adaptive, human-centred and sustainability-oriented management. The transition towards

Industry 5.0 therefore requires not only new technologies, but also organisational cultures capable of transforming structural constraints into sources of learning, coordination and long-term competitiveness.

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HUMAN RESOURCE MANAGEMENT IN THE DIGITAL ERA: CHALLENGES AND SOLUTIONS FOR ROMANIA AND THE EU

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Abstract: *Digitalisation has become one of the main forces reshaping Human Resource Management. This paper examines how Artificial Intelligence, e-recruitment and HR Analytics are changing the way organisations attract, assess, develop and retain talent, with particular attention to the situation in Romania.*
Based on an integrative literature review of academic and institutional sources, the study analyses four key areas: the benefits and limitations of AI in HR decision-making, the impact of digital recruitment and online interviews on candidate experience, the factors influencing the adoption of HR Analytics, and approaches to reducing digital skills gaps while promoting inclusion.
The findings indicate that these technologies can generate significant improvements in efficiency, speed and consistency. At the same time, they introduce notable risks – algorithmic bias, privacy concerns, perceived surveillance and the potential to widen inequalities when digital competencies vary widely.
The paper argues that successful digital HRM in Romania goes well beyond the simple adoption of new technologies. Real progress depends on sound governance, effective human control, sustained investment in digital skills and genuine inclusion measures, all aligned with European standards.

Keywords: *Digital HRM; Artificial Intelligence; HR Analytics; E-Recruitment; Digital Skills; Inclusion*

JEL Classification: *M12; M15; O33*

1. Introduction

Human Resource Management is currently undergoing a significant transformation. This shift goes well beyond simply introducing digital tools into existing routines. The changes are deeper: they are altering how organisations view their employees, structure their processes and reach decisions that shape people's careers and daily working lives.

Recruitment, performance appraisal, training, workforce planning and retention now rely increasingly on digital platforms, algorithms and automated systems. These tools sort, compare, predict and sometimes recommend specific actions. As a result, HR has moved beyond routine administrative tasks such as record-keeping and compliance. It is gradually evolving into a strategic function capable of shaping competitiveness, adaptability and organisational culture (DiRomualdo et al., 2018).

This growing reliance on technology raises difficult questions. Who ultimately controls these algorithmic mechanisms? Who assumes responsibility when they produce flawed or biased results? And how can the human side of work be protected as processes become more automated?

Digital HRM has been widely discussed as a transformation of traditional HR practices through information technologies, digital platforms and data-driven systems (Bondarouk & Ruël, 2009; DiRomualdo et al., 2018).

At EU level, digitalisation forms a central element of broader policy objectives around productivity, innovation, resilience, inclusion and data protection. Yet beneath the modernisation drive, real tensions exist. Faster processes do not automatically produce fairer outcomes. Standardised decisions are not necessarily more equitable. And systems built mainly for efficiency can, without proper governance, generate distrust, opacity and unintended exclusion.

Romania offers a particularly relevant case because enterprise digitalisation and digital skills still lag behind broader EU targets (European Commission, 2025; Eurostat, 2025). Competitive pressures and the push to align with European standards are encouraging many organisations to move quickly. At the same time, levels of preparedness remain very uneven. Some companies are already testing advanced solutions, while others continue to work with fragmented procedures, inconsistent infrastructure and widely different digital competencies among staff. This produces a paradoxical situation: the same technologies can drive genuine progress in digitally prepared organisations but widen gaps elsewhere.

This paper contributes to the literature in three ways. First, it brings together research on AI-enabled HR systems, e-recruitment and HR Analytics into one analytical framework centred on responsible digital HRM. Second, it links these debates to the Romanian context, where digital transformation is shaped by uneven organisational maturity, digital skills gaps and the need to align with European standards. Third, it proposes a practical action framework that connects technological adoption with governance, human oversight, digital skills development and inclusion.

The paper explores how digitalisation is reshaping Human Resource Management, with special emphasis on Artificial Intelligence, online recruitment and HR Analytics. It addresses four main questions: To what extent do AI-driven systems improve both efficiency and the quality of HR decisions? How do digital recruitment tools and virtual interviews affect candidate experience? What explains organisations' readiness or reluctance to adopt machine learning-based HR Analytics? And what kinds of interventions are needed to close digital skills gaps and support genuine inclusion in Romanian organisations working under European expectations?

The central argument of this paper is that digitalisation in HR creates lasting value only when technological capabilities are accompanied by proper governance, managerial accountability and employee trust. Speed and efficiency alone are not sufficient. The systems also need to be understandable, legitimate and subject to real human oversight.

2. Conceptual Background: Digital HRM and the Changing Role of HR

Digital HRM refers to the application of digital technologies to support, redesign or fundamentally transform traditional human resource management activities. It covers a wide range of tools – applicant tracking systems, online assessment platforms, predictive analytics, AI-assisted screening, automated communication

and digital learning environments. What sets the current phase apart is the growing ability of these systems not only to store and organise data but also to analyse large volumes of information, spot patterns, generate recommendations and actively shape decisions.

Digital HRM has been widely discussed as a transformation of traditional HR practices through information technologies, digital platforms and data-driven systems (Bondarouk & Ruël, 2009; DiRomualdo et al., 2018).

This evolution has clear consequences for the place of HR inside organisations. For many years, HR was mainly seen as an administrative function focused on keeping records, handling contracts, ensuring compliance and managing day-to-day personnel matters. Today, however, HR is increasingly expected to take a strategic role – anticipating workforce needs, identifying skills gaps, reducing turnover risks and helping the organisation stay agile. Digital technologies make this shift possible, but they also demand new skills from HR professionals: they must combine traditional people-management expertise with technological literacy, data interpretation and change management.

This shift confirms the broader argument that HR functions are moving from administrative support roles toward strategic, technology-enabled organisational functions (DiRomualdo et al., 2018).

Digital tools also create tension between standardisation and personalisation. They enable consistent criteria across recruitment, onboarding and performance monitoring, which can reduce variability and some forms of bias. At the same time, advanced platforms can offer more tailored experiences through adaptive learning or predictive models. Yet this same duality can increase surveillance and give employees the impression that their behaviour is being watched in opaque ways.

However, people analytics and digital monitoring may also create risks related to surveillance, opacity and employee resistance (Giermindl et al., 2022).

In the European context, discussions about Digital HRM are shaped by wider concerns around data privacy, algorithmic fairness and human dignity at work. Because HR decisions affect people's access to jobs, career progression and sense of belonging, they carry significant ethical implications. That is why evaluating digital solutions cannot focus only on efficiency or cost savings. A full assessment must also consider their impact on equality, autonomy, trust and alignment with legal and ethical standards.

3. Research Methodology

This study uses an integrative literature review methodology to examine how digital transformation is reshaping Human Resource Management, with particular attention to AI-enabled HR systems, e-recruitment, HR Analytics and digital inclusion. This approach was selected because the topic cuts across several disciplines and is developing too quickly for conventional empirical studies to keep pace. Integrative literature reviews are suitable for synthesising fragmented research fields and for developing conceptual understanding across multiple disciplines (Torraco, 2005; Whittemore & Knafl, 2005).

The review followed four stages: identification of relevant literature, screening of sources, thematic classification and analytical synthesis. Sources were drawn from peer-reviewed journals, academic books and institutional reports published mainly between 2015 and 2025. Priority was given to studies addressing digital HRM, AI in

recruitment and selection, people analytics, employee reactions to digital systems, algorithmic governance, digital skills and inclusion.

The search strategy combined keywords such as “digital HRM”, “electronic HRM”, “AI in HR”, “AI recruitment”, “e-recruitment”, “online interviews”, “HR Analytics”, “people analytics”, “algorithmic management”, “digital skills”, “digital inclusion”, “Romania” and “European Union”.

Inclusion criteria focused on relevance to the research questions, academic or institutional credibility, conceptual contribution and applicability to the Romanian or European context. Sources were excluded when they dealt with digitalisation only in a general technological sense without clear HRM links, when they lacked analytical depth, or when they did not contribute to the four main themes of the paper.

The reviewed material was organised around four analytical dimensions: the benefits and limitations of AI in HR decision-making; the effects of e-recruitment and online interviews on candidate experience; the organisational conditions influencing the adoption of HR Analytics; and the role of digital skills and inclusion in responsible HR digitalisation.

The study does not claim to provide a systematic review of every available publication. The aim is to synthesise relevant theoretical, empirical and policy evidence in order to develop a structured interpretation of the digital HRM challenges facing Romanian organisations.

4. AI-Enabled HR Systems: Efficiency and Decision Quality

Efficiency is frequently cited as one of the main reasons organisations adopt AI in HR. Screening CVs, scheduling interviews, sending messages to candidates or running initial assessments can now be handled with much less manual effort. This frees HR teams to focus on more strategic work such as workforce planning and real organisational development. In larger companies handling thousands of applications, the time savings can be substantial.

Many also expect AI to bring greater consistency to decision-making. Human decision-makers may be influenced by fatigue, time pressure or unconscious preferences. A well-designed system, at least in theory, applies the same criteria to everyone and produces more predictable outcomes.

AI-enabled HR systems are increasingly used in recruitment, screening, assessment and decision support processes (Rodgers et al., 2023; Horodyski, 2023).

This expectation needs to be approached with caution. Algorithms learn from historical data, and that data often carries the marks of past biases and unfair practices. When this occurs, the system can reproduce those problems more systematically – and in ways that are harder to detect. Sometimes the appearance of neutrality actually makes the situation more difficult to challenge.

Since algorithmic systems often learn from historical data, they may reproduce or amplify previous organisational biases (Rodgers et al., 2023).

Meaningful human oversight therefore remains essential. Decisions that have a major impact on someone’s career should not be left entirely to the algorithm. A human-in-the-loop approach is recommended, where managers keep real accountability and can review, question or override algorithmic suggestions. Without this, organisations risk abdicating responsibility behind technological outputs.

Transparency and explainability are equally critical, especially under the GDPR and the new EU AI rules. Candidates and employees have the right to understand how

decisions about them were reached and to challenge outcomes that may involve discrimination. In practice this requires high-quality data, regular bias audits, staff training and clear governance rules about responsibility when adverse outcomes occur.

These concerns are particularly relevant in the European context, where automated decision-making, data protection and AI governance are regulated through the GDPR and the EU AI Act (European Parliament and Council, 2016; European Parliament and Council, 2024).

In Romania, these challenges are intensified by the uneven development of internal governance structures and digital competencies. Many organisations are bringing in advanced tools while internal governance and digital competencies are still catching up. As a result, AI is sometimes adopted more as a symbol of modernity than as a carefully managed instrument.

Overall, AI can support better HR decisions only when it remains an assistive tool backed by managerial accountability, transparent processes and ethical safeguards.

5. E-Recruitment, Online Interviews and Candidate Experience

Recruitment is one of the areas where digitalisation has changed HR practice most visibly. Organisations now rely heavily on job platforms, applicant tracking systems, online assessments and video interviews. These tools help reach a wider pool of candidates, cut costs and speed up the hiring cycle.

E-recruitment and digital selection methods have become central components of contemporary HRM, influencing both organisational efficiency and candidate perceptions (Folger et al., 2022; Horodyski, 2023).

Candidates may value the practical advantages of digital recruitment. Applying online is quicker and more convenient, and remote interviews save time and travel expenses. This can be particularly helpful for people living outside major cities or those with family responsibilities.

Nevertheless, the overall candidate experience is frequently less positive than hoped. Many processes feel cold and impersonal. Automatic replies, long waits for feedback, unclear scoring and highly standardised interviews can leave applicants feeling processed rather than genuinely considered. Over time this can damage employer branding – a poor digital experience shapes how the organisation is viewed by future talent.

Research shows that applicant reactions to digital selection tools are shaped by perceived fairness, transparency, feedback quality and procedural justice (Folger et al., 2022).

Accessibility and inclusion raise another important concern. Candidates do not start from equal digital conditions. Digital skills gaps, disabilities, unstable internet connections or living in rural areas can create real barriers. What appears modern and efficient from the employer’s perspective may unintentionally exclude capable individuals who struggle with the technological format.

The growing use of chatbots and automated recruitment communication can improve speed, but may also reduce the perceived human quality of the process (Koivunen et al., 2022).

The most effective strategies are therefore likely to be hybrid. Digital tools work best when they are combined with genuine human contact – timely feedback, clear explanations and the possibility of personal interaction. Only this kind of balance builds both efficiency and trust while keeping the process inclusive.

6. HR Analytics and the Willingness to Adopt Data-Driven HR Tools

HR Analytics represents one of the most ambitious dimensions of digital transformation in HRM. Its central purpose is to use workforce data to spot patterns, anticipate future needs and support better decisions – from predicting turnover and tracking absenteeism to identifying skills gaps and evaluating training. In advanced cases, machine learning can generate predictions that help managers allocate resources more strategically.

HR Analytics refers to the systematic use of workforce data to support evidence-based decisions regarding talent management, performance, retention and workforce planning (Mayo, 2018; McIver et al., 2018).

Adoption, however, remains uneven. Having the right software is rarely enough on its own. Success also depends on data quality, organisational culture, managerial openness and employee trust. In many organisations HR data are scattered across different systems or recorded inconsistently, which reduces the reliability of analytical insights. Even when the technology exists, managers often hesitate if they do not fully understand the indicators or how to interpret the results.

Prior research shows that the success of HR Analytics depends not only on technology, but also on data quality, organisational culture, managerial capability and strategic alignment (McIver et al., 2018).

The willingness to use these tools is strongly shaped by how people perceive them. Employees and managers tend to support analytics when they see it improving planning and reducing arbitrary decisions. Resistance grows, however, when the same tools are perceived as instruments of surveillance or hidden control. The identical system can therefore be experienced as helpful support or as a source of anxiety, depending on how it is introduced.

People analytics may generate resistance when employees perceive it as a mechanism of surveillance or hidden control rather than as a legitimate decision-support tool (Giermindl et al., 2022; Milanez et al., 2025).

Trust is a central condition for the effective use of data-driven HR tools. For data-driven HR to work well, people need confidence that information is collected responsibly, interpreted fairly and used for legitimate purposes. Where trust is low – especially in more hierarchical settings – analytics can easily create fear instead of acceptance.

In Romania the obstacles are even more pronounced. Many organisations still lack qualified data specialists, integrated systems and managers who feel comfortable turning analytical outputs into action. There is a genuine risk that HR Analytics becomes only a superficial label of modernisation without the internal capacity needed for meaningful use.

Successful adoption therefore requires more than technical readiness. It also needs social legitimacy, clear explanations, employee participation and strong ethical safeguards. Without these, even sophisticated tools risk being underused, misunderstood or actively resisted.

7. Digital Skills, Inclusion and the Human Side of Transformation

The digitalisation of HR assumes that employees and managers across the organisation can work confidently with new systems. In reality, digital skills are distributed very unevenly – both between organisations and within them. This gap affects operational staff, line managers and HR professionals alike. A digital strategy

may therefore fail not because of technological limitations, but because users lack the capabilities required to apply it effectively.
These skill shortages create several practical problems. They reduce the effectiveness of new systems, increase resistance to change, especially when training feels inadequate, and can widen internal inequalities. Digitally confident employees may advance more easily, while others risk being marginalised.
This challenge is closely tied to workplace inclusion. Real digital inclusion goes beyond simply providing access to devices or platforms. It means employees from different backgrounds can actually participate meaningfully. Age, education, location, job role and socioeconomic situation all influence how people experience digital change.
In Romania, the issue of digital skills is particularly important. Recent European data show that Romania remains below the EU average in terms of basic digital skills and enterprise digitalisation (European Commission, 2025; Eurostat, 2025). This means that HR digitalisation cannot be treated only as a technological upgrade, but must also be approached as a process of capability development and inclusion. These disparities are especially relevant for SMEs, public institutions and organisations outside major urban centres, where digital infrastructure, managerial expertise and access to specialised HR technologies may be more limited.
Organisational modernisation in Romania often happens against a background of uneven development. Urban companies may adopt tools quickly, while public institutions, smaller firms and organisations in less developed regions face bigger constraints. Without deliberate action, digital HRM risks reinforcing existing inequalities instead of reducing them.
The literature points to several practical ways forward. Continuous, role-specific training is essential and must be supported by the organisation. Inclusion improves when implementation is participatory and employees feel their concerns are heard. In the end, digital competence should not be seen only as an individual responsibility – organisations have a duty to design systems that are accessible, understandable and fair for a diverse workforce.

8. Ethical, Legal and Governance Challenges in Digital HRM
As digital technologies become central to Human Resource Management, ethical, legal and governance questions have moved from peripheral concerns to central organisational issues. When algorithms start influencing hiring, performance evaluation, promotion or retention, organisations can no longer evaluate these tools solely through efficiency or cost criteria. Fairness, accountability and individual rights become unavoidable.
Three dimensions are particularly important. The first concerns personal data protection. Digital platforms and analytics systems collect and process large volumes of sensitive information, which immediately brings in GDPR requirements around lawful basis, purpose limitation, data security and individuals' rights. In the European Union, the processing of personal data in employment-related contexts must comply with the principles of lawfulness, transparency, purpose limitation, data minimisation and accountability established by the GDPR (European Parliament and Council, 2016).
The second-dimension concerns fairness and non-discrimination. Many AI tools are trained on historical data that already contain past biases. They can therefore reproduce or even amplify inequalities while appearing neutral.

The EU AI Act further strengthens the governance relevance of AI systems, especially where such systems may affect access to employment, selection, evaluation or career opportunities (European Parliament and Council, 2024).

The third dimension involves transparency and the right to contest decisions. Employees and candidates often lack meaningful explanations about how automated systems reached conclusions that affect their professional lives.

At the governance level, the main challenge is making sure technological possibilities do not outrun organisational responsibility. Clear mechanisms for human oversight, review procedures, accountability chains and regular algorithmic audits are needed. Without them, managerial accountability can easily become diluted behind complex technical systems.

These risks are consistent with wider concerns in the literature regarding algorithmic bias, opacity and unequal treatment in data-driven HR systems (Rodgers et al., 2023; Giermindl et al., 2022).

This issue is particularly relevant in Romania. Many organisations are moving fast on digital solutions while governance structures, internal expertise and regulatory familiarity lag behind. In such conditions, the push for modernisation can easily create imbalances if ethical and legal safeguards are not developed at the same pace.

Responsible digital HRM therefore cannot be reduced to technological adoption. It requires the parallel development of a coherent framework that protects fairness, transparency and trust. Only on this foundation can the practical recommendations in the next section be put into practice effectively.

9. An Action Framework for Romania

Drawing on the reviewed literature and on Romania-specific evidence regarding uneven digitalisation and digital skills gaps, this section proposes a practical action framework tailored to the Romanian context (European Commission, 2025; Eurostat, 2025). The central premise is that acquiring digital tools represents only the initial stage of digital HRM transformation. The decisive issue is creating the organisational conditions that let these tools be used responsibly and effectively.

Four strategic directions are especially important. First, organisations need clear governance structures for digital HRM. This involves defining who is responsible for selecting and evaluating tools, how decisions are made, and what happens when employees or candidates want to challenge an outcome. AI-supported decisions cannot stay completely opaque.

Second, human oversight must remain essential. Technology can support screening and predictions, but decisions with major career impact must always involve real human judgement and accountability. A human-in-the-loop approach is recommended, where managers can review, question or override automated recommendations. This recommendation is consistent with the broader need to preserve managerial accountability in AI-supported HR decisions (Rodgers et al., 2023; European Parliament and Council, 2024).

Third, developing digital skills should be treated as a genuine strategic priority. Romania still has significant gaps in this area, especially between large companies and smaller ones, or between urban centres and other regions. Training programmes need to go beyond basic technical skills and help HR professionals and managers interpret data, recognise ethical risks and manage change. Partnerships

with universities, professional associations and public institutions can play a useful role.
Fourth, organisations should actively monitor digital inclusion. Simply declaring the process inclusive is not enough. Companies need practical indicators on access to tools, participation in training, employee feedback and outcome differences across groups. Regular checks can catch problems before they become structural.
A phased approach is also recommended. Starting with pilot projects in selected departments lets organisations test tools in real conditions, identify unexpected effects and make adjustments before wider rollout. Continuous monitoring and periodic reviews should become standard practice.
The framework is designed for Romania's current realities – uneven digital maturity, resource constraints in many organisations and the pressure to meet European standards. Rather than copying the most advanced models from highly digitalised countries, Romanian organisations would benefit from a more balanced path that combines technological progress with institutional learning and genuine attention to people. Only this kind of approach can create lasting value for both organisations and employees.

10. Discussion

This study highlights a central tension in contemporary Human Resource Management. Digital technologies such as Artificial Intelligence, e-recruitment and HR Analytics can improve efficiency, consistency and strategic decision-making. At the same time, they create real risks around fairness, transparency, accountability and the possibility of increasing inequalities – especially where digital maturity is uneven.
The benefits of these tools do not emerge automatically. Success depends heavily on the quality of governance, employee trust, existing digital competencies and the organisation's ability to handle the wider social implications. In Romania this tension is particularly visible. Organisations need to modernise quickly, stay competitive and align with European standards while dealing with persistent skills and infrastructure gaps. There is often a temptation to treat technology as an immediate solution for deeper structural problems. Yet the literature suggests that digital tools rarely compensate for weak organisational culture or poor communication – and in many cases they can actually amplify existing organisational weaknesses.
The main contribution of this paper is to show that responsible digital HRM cannot be reduced to the adoption of advanced technologies. It requires the simultaneous development of governance capacity, digital skills, employee trust and inclusion mechanisms. This is particularly relevant for Romania, where digital transformation is shaped by both European policy pressure and uneven organisational readiness.
From a theoretical perspective, the paper contributes by showing that digital HRM should be understood not only as a technological shift, but as a broader managerial and institutional transformation shaped by governance quality, human capabilities and regulatory alignment. Romania offers a relevant case study for other countries facing similar patterns of uneven digitalisation.
Several limitations should be mentioned. As an integrative literature review, the study relies on the quality and availability of existing research, much of which comes from more highly digitalised economies. The rapid pace of technological change also means some conclusions may need updating as new tools and regulations appear. Another limitation is that the paper relies mainly on secondary sources and does not

include interviews or survey data from Romanian organisations. Future studies should therefore test the proposed framework empirically.

In the end, the future of digital HRM will not be decided by technological sophistication alone. It will depend on how successfully organisations integrate these powerful tools into a responsible, transparent and human-centred management model.

11. Conclusions

Digital transformation is changing Human Resource Management across Europe and, increasingly, in Romania. Artificial Intelligence, online recruitment and HR Analytics are reshaping how organisations attract, evaluate, develop and retain talent. These technologies clearly offer opportunities for faster processes, more consistent decisions and better planning.

At the same time, they raise serious concerns about bias, privacy, surveillance, exclusion and resistance. This paper has shown that the opportunities and the risks need to be considered together. An effective digital HR strategy cannot focus only on efficiency. It also needs trust, transparency, human oversight and inclusive implementation.

The paper contributes by linking the literature on AI in HR, e-recruitment and HR Analytics with the specific challenges of Romanian organisations operating within the European digital and regulatory framework. This balanced approach matters especially for Romania, where digitalisation often happens in conditions of uneven preparedness. The review suggests that Romanian organisations should adopt these tools in ways that strengthen employee confidence and organisational legitimacy rather than weaken them.

Transparent governance, human-in-the-loop mechanisms, investment in digital skills, measurable inclusion and strong data accountability should form the foundation.

From a practical point of view, these findings point to the need for coordinated efforts that go beyond simply adopting technology and also address the human and institutional side of change. As this study is an integrative literature review, its conclusions naturally depend on the existing research. Future empirical research should examine how Romanian employees, managers and HR professionals actually experience AI-supported recruitment, HR Analytics and digital monitoring in practice.

In the end, the future of HRM in the digital era will depend not only on what technology can do, but on the values and safeguards that organisations choose to preserve. When guided by responsibility and fairness, digitalisation can create real value. When driven mainly by speed and control, it risks undermining the human dimension that HR is supposed to defend.

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PEOPLE BEHIND THE DEAL: A LITERATURE REVIEW OF HR PRACTICES ACROSS M&A PHASES

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Abstract: *Mergers and acquisitions (M&A) are a key strategic tool for corporate growth, diversification and gaining a competitive advantage. Research findings indicate that a significant rate of these transactions fail to achieve the expected results, often due to the inadequate management of human factors. For this very reason, the strategic importance of the HR function in the M&A process is becoming increasingly prominent. Despite growing academic and practical interest in the subject, the relevant literature typically examines the role of HR only in certain stages of M&A processes, which limits the interpretation of HR practices across the entire process. This conceptual gap justifies the adoption of an approach that examines all stages of an M&A transaction within a unified framework. This study examines human resource management practices applied during the planning, integration and implementation phases of mergers and acquisitions, with the aim of identifying which HR tools support the success of organisational integration in each phase. The research employs a qualitative, theoretical approach, the methodological basis of which is a review of the international literature. Based on the findings, the planning phase is dominated by HR and cultural due diligence, risk analysis, human capital audits, and the development of integration, communication and training plans. In the integration phase, the focus shifts to the integration of structures, cultures and people, the establishment of knowledge transfer, the management of employee resistance, and targeted communication and training. In the implementation phase, the consolidation of new structures, workforce optimisation, managed redundancies, retraining, succession planning and employer branding become key HR interventions. The study highlights that communication and training are HR practices that span the entire M&A process but appear with different content and focus on each phase. The HR interventions applied in the three phases build on one another, and their common strategic goal is to increase employee engagement, reduce turnover and retain key employees. The study's academic contribution lies in interpreting the role of HR within a unified, process-oriented framework, thereby filling an identified gap in the literature and laying the groundwork for future empirical research.*

Keywords: *mergers and acquisitions; human resource management; HR practices; M&A phases.*

JEL Classification: *G34; M12; M14; M54*

1. Introduction

As a result of globalisation and intensifying market competition, companies are increasingly using mergers and acquisitions (hereinafter M&A) as a strategic tool to achieve growth, diversification and a competitive advantage (Gomes, 2020). M&A essentially covers two distinct phenomena: mergers and acquisitions. We speak of a merger when two or more companies, as equal partners, pool their resources and form a single legal entity. In contrast, an acquisition involves a dominant company gaining ownership and management control over another organisation, whose autonomy is partially or completely lost (García-Nieto *et al.*, 2024). Although a growing global trend can be observed in the M&A market, research highlights that a significant percentage of these transactions fail to achieve the expected results, due to the inadequate management of human factors (Bangura, Chitamba and Ngidi, 2025). The literature emphasises that human resource management plays a key role in the success of the M&A process (Rodríguez-Sánchez, Mora-Valentín and Ortiz-de-Urbina-Criado, 2018; Tarba *et al.*, 2020; Bangura, Chitamba and Ngidi, 2025). HR no longer functions merely as an administrative department, but acts as a strategic partner (Dajnoki and Héder, 2017), actively contributing to the successful management of the M&A process (Bruneau De La Salle and Thomas, 2021). HR's involvement is of paramount importance even during the preparatory stages of the transaction, through HR due diligence, the identification of key competencies and talent pools, and the analysis of organisational cultures and HR systems (Rodríguez-Sánchez, Mora-Valentín and Ortiz-de-Urbina-Criado, 2020; Lattuch and Ruppert, 2022). Following the completion of the transaction, HR plays a key role in harmonising organisational structures and processes, ensuring the succession of leadership and talent retention, and maintaining employee engagement (Rodríguez-Sánchez, Mora-Valentín and Ortiz-de-Urbina-Criado, 2018). Research highlights that well-designed HR practices, such as effective communication (Hasmin, 2025), talent retention strategies (Holland and Scullion, 2021) and programmes supporting cultural integration (Tukuboya, Ibrahim and Irawan, 2024) contribute significantly to a smooth transition and the maintenance of organisational performance during the M&A process.

2. Research question and objective

The central research question of this study is to identify which human resource management practices can be identified in the various stages of mergers and acquisitions, such as the planning, integration and implementation phases, and how these contribute to the success of organisational integration. The aim of the research is to explore and systematise, through a review of the international literature, those HR tools and interventions that play a decisive role in the various phases of the M&A process, placing the findings within a unified, process-oriented framework. While previous literature typically examines human resource management in isolated stages of the M&A process, the primary academic contribution of this study is the development of a comprehensive, integrated framework. This novel approach bridges existing conceptual gaps by explicitly mapping how specific HR practices not only function within individual phases such as planning, integration, and implementation but also how they transition and build upon one another across the entire M&A lifecycle. By providing this holistic perspective, the study offers both theoretical clarity and actionable insights for managerial practice.

3. Research methodology

The research adopts a qualitative, theoretical approach, the methodological basis of which is a literature review, within the framework of which relevant international empirical and theoretical studies are analysed and synthesised to ensure a comprehensive examination of the topic under investigation. To ensure academic rigour and transparency, the literature review was conducted following a structured approach. The primary databases used for source selection included Scopus, Web of Science, and Google Scholar. The search strategy utilised specific keywords and their combinations, such as “mergers and acquisitions”, “M&A”, “human resource management”, “HR practices”, “M&A phases”, and “post-merger integration”. The review predominantly focused on recent literature published between 2015 and 2026 to capture the most current trends and challenges in the field. Inclusion criteria were strictly limited to peer-reviewed academic journal articles, empirical studies, and established theoretical frameworks. Non-academic articles, opinion pieces, and reports lacking rigorous methodological foundations were excluded from the analysis. This systematic selection process ensures a comprehensive and reliable synthesis of the investigated topic.

4. The stages of M&A and their human resource challenges

According to the literature, the process of mergers and acquisitions can be divided into three successive stages: the planning, integration and implementation stages (Rodríguez-Sánchez, Mora-Valentín and Ortiz-de-Urbina-Criado, 2018). In the international literature, these are often referred to as the pre-merger (pre-merger integration; pre-integration; pre-M&A), during-merger (during M&A; transaction phase), and post-merger (post-merger integration; post-integration; post-M&A) phases. For the sake of clarity, we will henceforth use the terminology employed by Rodríguez-Sánchez et al. (2018), namely the planning, integration and implementation phases. *Figure 1* summarises the HR challenges and tasks associated with the various phases of an M&A transaction.

Planning *pre-M&A*	**Integration** *during M&A*	**Implementation** *post-M&A*
HR challenges		
Selecting the right partner Cultural and structural compatibility	Employee resistance Cultural differences	Conflicts of interest Parallel positions Voluntary resignations
HR tasks		
HR due diligence Cultural due diligence Preliminary assessment of potential risks Early identification of key talent	Change management Integration of tasks, people and culture Harmonisation of structures, systems and strategies Managing employee resistance	Retaining talent Managing redundancies Consolidating the new structure, strategy and culture

Figure 1: HR challenges and tasks at each stage of M&A
Source: Own compilation (2026)

The planning phase is the stage preceding the merger or acquisition, which takes place before the agreement is finalised. The main challenge at this stage is selecting the right partner and assessing cultural and structural compatibility between the organisations. At this stage, HR's role involves HR due diligence, cultural due diligence, preliminary assessment of potential risks, early identification of employees of value to the organisation, and laying the foundations for integration (Rodríguez-Sánchez, Mora-Valentín and Ortiz-de-Urbina-Criado, 2020; Lattuch and Ruppert, 2022).

The integration phase follows the signing of the agreement, when the preparatory activities preceding the M&A transaction have been completed and the process of actually merging the two organisations begins. In this phase, the greatest challenge lies in overcoming employee resistance arising from adaptation to new structures and processes, as well as cultural differences. The primary task of HR is change management, which encompasses the integration of roles, people and culture, the harmonisation of new structures, systems, strategies and policies, and the appropriate management of employee resistance (Rodríguez-Sánchez, Ortiz-de-Urbina-Criado and Mora-Valentín, 2019).

Finally, the implementation phase covers the sustained period following the transaction, which is most often characterised by conflicts of interest, tensions arising from the overlap of parallel positions, and voluntary resignations. In this phase, the role of HR is to retain talent, manage redundancies through fair and supportive programmes, and consolidate the new structure, strategy and culture (Rodríguez-Sánchez, Mora-Valentín and Ortiz-de-Urbina-Criado, 2018).

5. HR practices applied during the various stages of M&A

The following section presents the most important HR practices identified during the planning, integration and implementation phases of mergers and acquisitions. The aim of the study is to provide a comprehensive overview of how the role and focus of HR changes as the M&A process progresses, through a literature review of the tools and interventions used in each phase.

5.1. Planning phase

The planning phase of mergers and acquisitions is of critical importance from a human resource management perspective, as it is during this phase that the human and organisational factors which fundamentally determine the success of the M&A can be identified. Rodríguez-Sánchez et al. (2020) point out that only 22% of organisations involve HR in this phase, whilst human resource-related challenges such as cultural incompatibility, employee uncertainty or the departure of key personnel begin as early as the planning phase, even before the transaction is announced. Therefore, research consistently asserts that the early involvement of HR in the M&A planning phase is essential for the success of the transaction (Rodríguez-Sánchez, Mora-Valentín and Ortiz-de-Urbina-Criado, 2020; Lattuch and Ruppert, 2022; Ranajee, Naik and Iyengar, 2025).

Table 1 summarises the HR practices identified during the planning phase, their objectives and their impact on employees.

One of the most important HR practices at this stage is an *HR due diligence review*, which involves a systematic assessment of the target company's human resources, employment contracts, remuneration schemes and HR processes. The aim of this is

the early identification and appropriate management of hidden labour risks (Rodríguez-Sánchez, Mora-Valentín and Ortiz-de-Urbina-Criado, 2020; Lattuch and Ruppert, 2022). Closely linked to HR due *diligence* is *cultural due diligence*, which involves comparing the cultures, values and norms of the two organisations with the aim of preventing subsequent integration problems arising from a lack of cultural fit and laying the foundations for the development of a shared organisational culture (Denison and Ko, 2016; Warter and Warter, 2017; Ashiedu *et al.*, 2024).

Table 1: HR practices during the planning phase

HR practice	Objective	Impact
HR due diligence	Identifying human resources and labour risks	Reduces uncertainty arising from hidden labour risks
Cultural due diligence	Early identification and prevention of cultural fit issues	Mitigates conflicts and tensions arising from cultural incompatibility
Risk analysis	Ranking of integration risks based on probability and impact	Enables proactive management of risks affecting employees
Human capital audit	Identification of key personnel, identification of skills gaps	Facilitates the early retention of key employees and the identification of development needs
Development of an integration plan	Defining the steps and timetable for harmonisation	Ensures a transparent process, reduces role uncertainty
Preparing a communication plan	Reduces uncertainty and prevents rumours	Increases loyalty and reduces stress in the early stages of the transaction
Developing training plans	Laying the foundations for targeted training programmes	Supports adaptation and increases openness to change

Source: Own compilation (2026)

Risk analysis also plays a key role in the planning phase, during which potential risks identified through cultural and HR due diligence that threaten the success of integration are prioritised based on their likelihood of occurrence and their impact on employees (Vertakova, Vselenskaya and Plotnikov, 2021; Routhu and Krishna, 2024).

Another HR practice crucial for successful integration is the *human capital audit*, during which the company assesses the knowledge, skills and capabilities of the current workforce prior to the transaction, in order to identify key personnel, uncover competence gaps and lay the groundwork for subsequent effective integration decisions (McKinney et al., 2017; Budhiraja, Thakur and Yadav, 2024).

A fundamental HR practice during the planning phase is *the development of an integration plan*, which sets out the steps, responsible parties and timetable for harmonising processes, thereby facilitating a smooth transition (Rodríguez-Sánchez, Mora-Valentín and Ortiz-de-Urbina-Criado, 2020). In parallel, it is also necessary to prepare a *communication plan* that sets out the timing, channels and key messages for informing employees (Rodríguez-Sánchez, Mora-Valentín and Ortiz-de-Urbina-Criado, 2020). Research highlights that early, honest communication reduces feelings of uncertainty and stress among employees, helps prevent the spread of rumours, and increases employees' loyalty to the organisation

(Marmenout and Mignerat, 2015; Rodríguez-Sánchez, Mora-Valentín and Ortiz-de-Urbina-Criado, 2020; Asdar, 2023; Hasmin, 2025).
The final steps of the planning phase involve *the development of training plans and systems*, in which those responsible for knowledge sharing, the educational platforms and systems, and the content of training and competence development programmes are defined, thus enabling the launch of various targeted training programmes in parallel with the start of integration, which support employees' adaptation to the new organisational environment (Rodríguez-Sánchez, Mora-Valentín and Ortiz-de-Urbina-Criado, 2020; Budhiraja, Thakur and Yadav, 2024).

5.2. Integration phase

The integration phase of mergers and acquisitions is one of the most critical stages of the transaction, during which organisations must not only align structures and processes, but also manage the human factors arising from uncertainty, employee resistance and cultural differences. Research emphasises that the success of integration largely depends on the extent to which HR can support this complex process and manage change effectively (Rodríguez-Sánchez, Ortiz-de-Urbina-Criado and Mora-Valentín, 2019; Bangura, Chitamba and Ngidi, 2025).

Table 2 summarises the HR practices identified during the integration phase, their objectives and their impact on employees.

Table 2: HR practices during the integration phase

HR practice	Objective	Impact
Harmonisation of new structures and policies	Alignment of organisational structure, systems and internal regulations	Reduces uncertainty and the sense of unfairness arising from duplication
Integrating tasks, people and cultures	Redefining roles, reorganising teams, establishing a shared value system	Strengthens the sense of belonging and reduces cultural clashes
Establishing knowledge transfer	Preserving and sharing knowledge across organisations	Supports adaptation and the realisation of synergies
Managing employee resistance	Active involvement in decision-making, providing regular opportunities for feedback	Reduces alienation and increases openness to change
Targeted internal communication	Communicating the reasons for, objectives of and impact of changes	Builds trust and reduces uncertainty
Training and mentoring programmes	Supporting adaptation to new systems, roles and expectations	Develops the necessary skills and increases openness to change
Leadership development	Strengthening leadership guidance and trust-building	Maintains employee commitment and motivation

Source: Own compilation (2026)

During integration, the first and most important task *is the harmonisation of new structures, systems, strategies and policies*, which involves aligning the organisational structures, infrastructure, information systems, objectives and internal regulations of the two companies (Tukuboya, Ibrahim and Irawan, 2024; Hemanth, 2025). This is crucial, as differing operating models can lead to duplication, uncertainty and a sense of injustice among employees (Bansal, 2019). This occurs

simultaneously with *the integration of tasks, people and cultures*, which involves redefining roles and responsibilities, reorganising teams, as well as harmonising different organisational cultures and establishing a shared value system (Van Oorschot *et al.*, 2023; Tukuboya, Ibrahim and Irawan, 2024; Horton *et al.*, 2025). To support this, HR tools are required, such as organising cultural integration programmes and workshops, developing shared values and a vision, and setting up integration teams; these measures promote cooperation and reduce cultural clashes (Marmenout and Mignerat, 2015; Rodríguez-Sánchez, Ortiz-de-Urbina-Criado and Mora-Valentín, 2019; Tukuboya, Ibrahim and Irawan, 2024).
The next key HR practice is *the establishment of knowledge transfer*, which ensures the preservation and sharing of knowledge between organisations, for example through mentoring programmes or joint projects, thereby supporting the realisation of synergies (Zhou, Fey and Yildiz, 2020; Lee *et al.*, 2023; Budhiraja, Thakur and Yadav, 2024).
Managing *employee resistance* is of paramount importance during integration, as the uncertainty associated with change can trigger negative emotions in staff, which may lead to alienation (Al Hosani *et al.*, 2020). Research highlights that actively involving employees in decision-making, providing regular opportunities for feedback, and developing a resilient workforce capable of adapting to change reduces resistance during integration (Cooke *et al.*, 2021; Bangura, Chitamba and Ngidi, 2025). *Targeted internal communication* plays a key role in the integration process, ensuring that employees understand the reasons for, the aims of, and the impact of the changes (Thakur and Yadav, 2025). In this context, HR practices such as regular management briefings, two-way communication channels and targeted internal communication platforms emerge, which strengthen trust and reduce uncertainty (Bangura, Chitamba and Ngidi, 2025).
Finally, successful integration is supported by the provision of *training and mentoring programmes***,** which help employees adapt to new systems, roles and expectations (Bangura, Chitamba and Ngidi, 2025). These programmes not only develop the necessary competencies but also increase openness to change (Budhiraja, 2021; Pubodhya and Rajapakshe, 2025). Closely linked to this is *leadership development* as a critical HR practice, as leaders are the ones who provide guidance, build trust and support employees during times of change, thereby maintaining commitment and motivation among staff (Fülep, Dajnoki and Barizsné Hadházi, 2023; Pubodhya and Rajapakshe, 2025).

5.3. Implementation phase

The implementation phase of mergers and acquisitions is the stage following the completion of the M&A transaction, during which HR plays a key role in stabilising the integrated organisation and ensuring the company's long-term viability.

Table 3 illustrates the HR practices identified during the implementation phase, their objectives and their impact on employees.
In this phase, one of the most important HR practices is *the consolidation* and continuous review of *new structures, systems and policies* (Liu *et al.*, 2021; Hemanth, 2025). This involves the regular auditing of consolidated HR processes and their conscious integration into daily practice, to ensure that the changes introduced are sustainably embedded into the organisation's day-to-day operations.

Workforce optimisation is also essential at this stage, as M&A transactions often involve the elimination of duplicate roles, during which HR must make decisions regarding retention, redeployment or redundancy (McKinney *et al.*, 2017). Each of these three decision paths requires a distinct HR practice. In the case of employees facing redundancy, providing *outplacement* becomes crucial; this encompasses both the financial and non-financial elements of the redundancy package, such as enhanced severance pay, job-search assistance, exemption from work duties, or career counselling. Lawful and people-centred redundancy not only supports the employees who are made redundant, but also strengthens the confidence of those remaining in the organisation and helps to preserve the company's reputation (Anuradha, 2017).

Table 3: HR practices during the implementation phase

HR practice	Objective	Impact
Consolidation of new structures and guidelines	Sustained integration of implemented changes into day-to-day operations	Reduces role uncertainty and strengthens organisational stability
Optimisation of the workforce	Making decisions regarding retention, redeployment or redundancy	Ensures a transparent decision-making process and reduces tensions
Outplacement	Providing financial and non-financial support to redundant staff	Strengthens the confidence of those remaining in the organisation and protects the company's reputation
Providing retraining	Developing the skills required for new roles	Supports adaptation and reduces resistance
Succession planning and career development	Retaining critical knowledge and establishing clear career paths	Reduces staff turnover and increases the commitment of key employees
Continuous training and development	Long-term support for adapting to new systems	Strengthens organisational stability and employee competencies
Transparent, two-way communication	Reduces uncertainty and maintains employee engagement	Strengthens trust and organisational commitment in the long term
Employer branding	Strengthens internal commitment and attracts external talent	Strengthens the organisation's internal and external reputation, supports retention and attracts talent

Source: Own compilation (2026)

In the case of redeployed employees, providing *retraining* is crucial, as developing the competencies required for new roles supports adaptation and reduces resistance (Anuradha, 2017; Bangura, Chitamba and Ngidi, 2025). Regarding key personnel to be retained, *succession planning and career development* ensure the preservation of critical knowledge and long-term organisational stability, especially in the digitalised economy, where continuous upskilling and digital competency development are essential for both individual career growth and organisational competitiveness (Arany and Popovics, 2025). Research indicates that clear career paths and talent management systems play a key role in reducing staff turnover and retaining critical competencies during M&A processes (Anuradha, 2017; Holland

and Scullion, 2021). Furthermore, the early identification of career needs has a positive impact on employee satisfaction and retention (Gergely and Pierog, 2018). Closely linked to this are continuous *training and development*, as well as the use of transparent, two-way communication, which are HR practices that should be maintained even in the post-integration period, as they strengthen organisational stability and trust in the long term. Training and development activities ensure adaptation to new systems (Anuradha, 2017), whilst continuous, open communication reduces uncertainty and supports employee engagement (Hasmin, 2025).

Finally, *employer branding* helps to stabilise the organisation's internal and external reputation, supports talent retention and the attraction of new employees, whilst fostering the development of a shared organisational identity and increasing employee commitment within the integrated organisation (Andhany and Arief, 2024).

6. Findings

A combined interpretation of the HR practices identified in the various stages of mergers and acquisitions highlights that, although the focus and toolkit of human resource management differ by stage, the practices employed build upon one another and form a coherent, process-oriented logic. A critical evaluation of the identified HR practices reveals a significant dichotomy in their application. Practices can be distinctly categorised into two groups: phase-specific interventions and cross-phase (continuous) practices. While phase-specific practices are strictly bound to particular milestones and cannot be delayed without jeopardising the transaction, cross-phase practices act as the critical connective tissue that prevents the fragmentation of the M&A process.

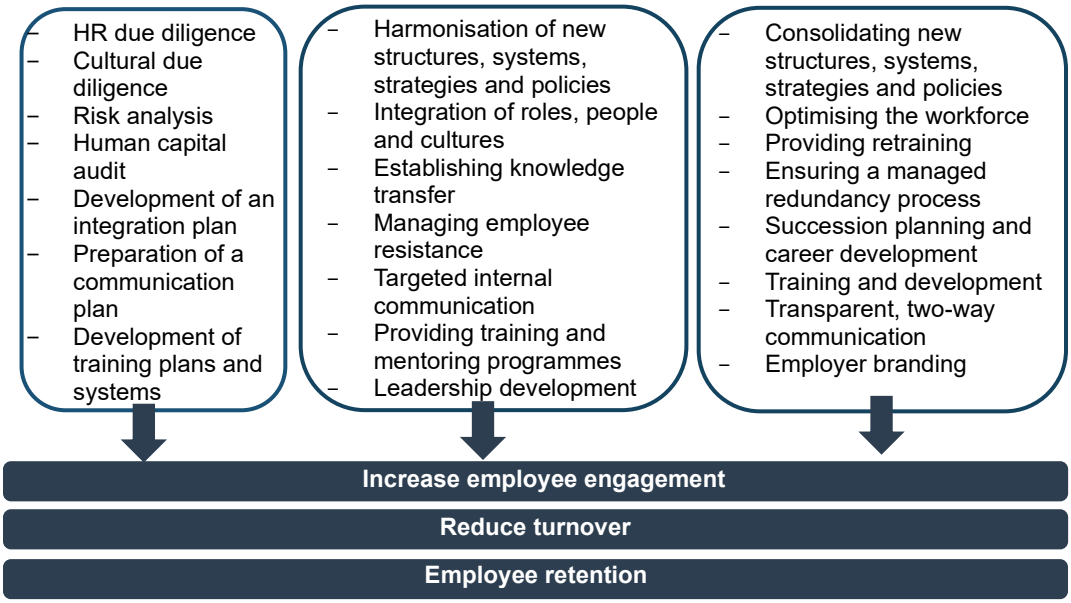


Figure 2: An integrated interpretation of HR practices in the M&A process
Source: Own compilation (2026)

The success of organisational integration depends not only on executing isolated tasks but on managing the dynamic interplay between these two categories. *Figure 2* summarises the HR practices applied during mergers and acquisitions.

Phase-specific HR practices

Planning phase: In the planning phase, HR's primary task is the preliminary identification of human and organisational risks associated with the transaction, the key tools for which are HR and cultural due diligence, risk analysis and human capital audits. These practices lay the groundwork for subsequent integration decisions and enable the company to identify key personnel, identify skills gaps and manage risks arising from cultural differences even before the transaction takes place. In addition, this phase involves the development of the integration and communication plans, which provide the structural framework for the process. Crucially, these planning practices are strictly phase-specific. A critical failure often observed in unsuccessful M&As is the attempt to conduct cultural or HR due diligence retrospectively during the integration phase. If these foundational, phase-bound assessments are neglected, subsequent integration efforts are essentially built on hidden risks, making cultural clashes inevitable.

Integration phase: During the integration phase, HR's focus shifts to aligning different structures and cultures and managing change. Harmonising new structures, systems and policies, integrating roles, people and cultures, and establishing knowledge transfer become key priorities in this phase. Managing employee resistance also plays a particularly important role, as this is at its most intense during this period due to organisational uncertainty and drastic changes. HR seeks to address this through targeted initiatives, such as cultural integration programmes, training, mentoring schemes and leadership development, which simultaneously develop the necessary competencies and foster openness to change. Unlike the analytical approach of the planning phase, integration practices are highly reactive. The critical aspect of these phase-specific interventions is timing: if change management and cultural harmonisation are delayed, employee resistance tends to become institutionalised. At this stage, HR must act rapidly to prevent uncertainty from transforming into active alienation and talent drain.

Implementation phase: In the implementation phase, the focus shifts to the long-term embedding of changes and the stabilisation of the organisation. At this stage, HR must simultaneously consider consolidating the changes introduced during the integration process and ensuring the organisation's long-term viability. HR's task is to continuously review the new structures, systems and policies and consciously integrate them into day-to-day operations. Workforce optimisation is also a critical task in this phase due to redundancies, during which HR must make decisions regarding retention, redeployment or redundancy. In the case of redundancies, a considerate redundancy process is critical; in the case of redeployment, retraining is key; whilst in the case of retention, career development and succession planning become critical HR tasks. At the same time, employer branding is also necessary, as it supports internal commitment and the attraction of external talent within the integrated company.

Cross-phase HR practices

However, a combined examination of the individual phases also highlights that, although with different focuses, certain HR practices must function as continuous,

cross-phase practices. One such practice is communication, which plays a key role throughout the entire transaction process by building employee trust and reducing uncertainty. During the planning phase, early, proactive information sharing and the development of a communication plan are key. The aim is to avoid uncertainty and rumours before the transaction is announced. During the integration phase, targeted internal communication takes centre stage, conveying the reasons for, objectives of, and expected impact of the changes to employees, thereby strengthening trust and reducing resistance. In the implementation phase, continuous, two-way communication and the provision of regular feedback opportunities become crucial. The aim is to maintain employee engagement in the long term and support organisational stability. Similarly, training and development are critical HR practices at every stage of M&A. During the planning phase, the primary task is to develop training plans and systems, as well as to design educational platforms and training content. During the integration phase, the focus shifts to developing the competencies required for new roles and systems, as well as resilience-building training. During implementation, the emphasis will be on ensuring continuous training and development, as well as retraining redeployed employees.

An integrated interpretation of HR practices across the various stages of M&A also highlights that the entire M&A process is guided by three main strategic objectives. The first of these is to increase employee engagement, which can be strengthened through transparent communication, cultural integration programmes, and training and development. The second is reducing staff turnover, which is supported by a range of HR practices, from the early identification of key personnel through talent retention programmes to a considerate redundancy process. The third objective is to retain key employees, regarding those possessing critical knowledge and competencies, whose departure fundamentally jeopardises the success of integration. Together, these three objectives form the strategic framework within which HR shapes its practices at each stage of the transaction.

7. Conclusions and recommendations

Based on the findings of this study, it can be concluded that the strategic involvement of HR is of critical importance at every stage of the M&A process; however, it also highlights that only a fraction of organisations involves HR in the planning phase, even though challenges arising from human factors begin even before the transaction is announced. For this very reason, it is recommended that companies involve the HR function as a strategic partner as early as the planning stage, so that, through HR and cultural due diligence, they can identify any human risks associated with the transaction and develop appropriate integration, communication and training plans in a timely manner. Based on the literature reviewed, it is also clear that during the integration phase, change management, employee resistance and the harmonisation of new processes and cultures prove to be the most critical HR tasks. The integration of structures, cultures, tasks and people is a complex, parallel process, the success of which depends largely on conscious HR intervention. Organisations are therefore advised to implement targeted cultural integration programmes, internal communication platforms, change management and resilience-building training during this phase. During the implementation phase, HR must simultaneously manage the differing needs of employees who are being made redundant, redeployed, and retained. Decisions

relating to workforce optimisation should therefore be prepared in advance as part of the integration plan. During redundancies, it is critical to adopt a caring, people-centred approach; in the case of redeployment, to ensure retraining; and for key employees to be retained, to properly structure succession planning and career development. The research also highlights that communication and training are HR practices that span the entire M&A process. It is important, however, that companies apply these not as one-off, reactive interventions, but as consciously planned, ongoing practices. It is therefore recommended that these practices be considered as early as the planning stage, and that their content be tailored to the needs of employees arising in each phase. Overall, the results of the literature review suggest that the success of M&A does not lie in a single HR practice, but in the deliberate, integrated application of practices employed across the various phases.

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RESEARCH TRENDS IN WORK ADAPTABILITY AND TURNOVER INTENTIONS: A BIBLIOMETRIC REVIEW WITH IMPLICATIONS FOR GENERATION Z

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Abstract: *In the context of a work environment characterized by increased dynamism and unpredictability, adaptability has become an essential individual resource for the effective management of continuous organizational and technological changes. Workplace adaptability can be defined as the ability of the individual to respond adequately to new professional requirements, role changes, and various occupational contexts, thus contributing to improved performance and long-term career sustainability. In parallel, staff turnover intention remains a relevant indicator for organizations, given its consistent association with actual employee turnover, organizational costs, and the level of internal stability. Although the specialized literature has extensively analyzed both workplace adaptability and staff turnover intention, the relationship between these two constructs remains insufficiently explored from an integrative perspective. Moreover, existing studies are fragmented, focusing predominantly on certain organizational contexts or employee categories, without paying systematic attention to the particularities of Generation Z. In addition, there is a lack of bibliometric analyses that provide an overview of the evolution of research, the main thematic directions, and the existing gaps in this field. Against this background, the present study aims to carry out a bibliometric analysis of the scientific literature on the relationship between workplace adaptability and staff turnover intention, with a specific focus on Generation Z. In particular, the research aims to: (1) examine the evolution over time of scientific production, (2) identify Influential contributors, core journals, and countries with the highest research activity, (3) analyze the dominant research focuses and clusters, and (4) highlight existing gaps and future research directions. Through this approach, the paper contributes to strengthening the understanding of the relationship between adaptability and staff turnover intention in the context of a new generation of employees. The Scopus database was selected due to its extensive and relevant coverage of recent, interdisciplinary literature.*

Keywords: *individual adaptability to work; turnover intention; Generation Z; bibliometric study.*

JEL Classification: *A23; M20*

1. Introduction

Amid profound labor market transformations driven by technological innovation that fundamentally reshape the nature of work, adaptability has emerged as a central topic of discussion (Kundi, Lo Presti, and Khan, 2025). Compared to previous generations, Generation Z employees tend to value flexibility, personal development, and meaningful work experiences, and they demonstrate greater openness to career

mobility. This combination makes them both adaptable and, paradoxically, more likely to leave organizations when expectations are not met. Therefore, understanding the relationship between workplace adaptability and turnover intention among this generation is crucial. Work adaptability, broadly defined as the ability to adapt effectively to new tasks, roles, and working conditions, is increasingly recognized as a key competency in the modern workforce. At the same time, turnover intention, the conscious and deliberate desire to leave an organization, remains a persistent challenge for employers, particularly among younger employees. This generation is often characterized by a strong desire for flexibility, meaningful work, and rapid career development, which may influence both their adaptability and their propensity to change jobs. Therefore, understanding the relationship between work adaptability and turnover intention among this group is of increasing importance to both researchers and practitioners. Although both constructs have been extensively explored in the literature, research addressing their interconnection, especially in relation to Generation Z, remains relatively sparse. Moreover, the rapid growth of publications in this field requires a structured and comprehensive synthesis of existing knowledge. In this context, bibliometric analysis serves as a valuable methodological approach, allowing the identification of publication trends, influential contributions, and the intellectual structure of the field. Bibliometric analysis provides a systematic and quantitative approach to mapping the intellectual structure of a research field, identifying key trends, influential authors, and emerging themes. By applying bibliometric methods, this study seeks to offer a comprehensive examination of the existing research on job adaptability and turnover intention, with a particular focus on Generation Z. Therefore, this paper aims to analyze the evolution of scientific production, highlight the main research clusters, and identify potential gaps in the literature. Scopus was selected as the primary database due to its broad coverage of peer-reviewed journals and its suitability for bibliometric analyses. Therefore, bibliometric analysis is not only appropriate but also necessary for achieving the objectives of this study, as it allows for a systematic, transparent, and data-driven examination of the literature on work adaptability and turnover intention, with a specific focus on Generation Z.

2. Theoretical Background

Against the backdrop of a work environment characterized by increased dynamism and unpredictability, adaptability has become an essential individual resource for the effective management of continuous organizational and technological changes. In its simplest form, work adaptability is understood as a person's ability to adapt to new work conditions. Individual work adaptability (IAW) is defined as "an individual's ability to adapt to new and changing environments, conditions, and situations at work" (Ployhart and Bliese, 2006). Why are we interested in individual adaptability to work (AIM) among young people? First of all, young people represent the future and tend to change more quickly when certain external conditions change. At the same time, it is important to know how cognitively, behaviorally, and emotionally capable young people are today in order to anticipate something about their career path and, by extension, the future of society. In the European Union's understanding, young people are those aged between 15 and 29 (Eurostat, 2026), and as a result belong to Generation Z (Seemiller and Grace, 2016). Generation Z is familiar with digitalization, as a result of using digital technology from an early age (Levit, 2018), and companies tend to automate business processes more and more; it can be

assumed that Gen Z adaptability can bring various benefits to a company. Generation Z wants to feel that their work has meaning and a positive impact on society (Dobrowolski, Drozdowski, Panait, 2022). Therefore, from an organizational management perspective, investigating the values, priorities, and adaptability at work of different generations takes on particular importance, given that the optimal use of human resources is a determining factor of organizational efficiency and achieving the desired performance. Turnover intention is defined as an" individual's conscious and deliberate desire to leave their current job or organization within a specific timeframe" (Lazzari, Alvarez, and Ruggieri, 2022). This intention is defined as the autonomous" behavior of withdrawal from the current position, associated with the individual's lack of identification with the work performed" (Bothma and Roodth, 2012). In this context, employee retention and strengthening the attachment to the organization represent major strategic objectives for decision-makers in the field of human resources. The in-depth study of the intention to leave the workplace responds to a real need of organizational management, that of developing effective policies for maintaining staff and reducing their fluctuation. " Turnover intention is a precursor to turnover" (Apriani and Siregar, 2023). In conclusion, the theoretical framework presented highlights the importance of individual work adaptability and turnover intention, providing a solid foundation for understanding the relationship between these constructs and their implications for organizational outcomes.

3. Research Methodology

Bibliometric analysis was used in this study because it provides an overview of existing research, facilitating the identification of trends, significant contributions, and underexplored directions. Thus, this method supports a better-founded understanding of the analyzed field. Therefore, bibliometric analysis is not only appropriate but also necessary for achieving the objectives of this study, as it allows for a systematic, transparent, and data-driven examination of the literature on work adaptability and turnover intention, with a specific focus on Generation Z. The Scopus database was selected for its broader journal coverage and strong representation of recent publications in management and organizational behavior. To answer our research questions, we selected 166 Scopus articles.

Data collection: The research process followed the following steps according to the PRISMA approach. A search was performed in Scopus by Topic in March 2026, using the following keywords: ("career adaptability" OR "employee adaptability" OR "work adaptability" OR "individual adaptability") AND ("turnover intention" OR "intention to leave" OR "quitting intention" OR "employee turnover") AND ("Generation Z" OR "Gen Z" OR "young employees" OR "young workers" OR "early career employees"). The initial data set included 246 documents identified in the Scopus database. Applying the temporal criterion (2020–2025) led to a reduction of the sample to 203 documents. In the next stage, only "article" and "review" publications were included, resulting in 178 papers. Subsequently, a thematic filter was applied, selecting exclusively documents falling within the areas of Business, Management and Accounting; Social Sciences; Psychology; and Economics, Econometrics and Finance, which led to a final sample of 166 documents used in the analysis. After data collection, the search results were imported into the R package bibliometrix. This tool allows for complex and integrated bibliometric analyses, being considered superior to other similar software solutions in this field (Aria and Cuccurullo, 2017). For the analysis of the data extracted from Scopus, the

Biblioshiny graphical interface was used, corresponding to the R package bibliometrix, which facilitates the performance of bibliometric analyses in an interactive and accessible way. Before starting the analysis, several scientific databases were evaluated to identify the most appropriate source for data collection. In the end, the Scopus database (Mongeon and Paul-Hus, 2016) was selected exclusively, due to its extensive coverage of literature from diverse fields, including social sciences, exact sciences, and humanities. The choice was also justified by the high-quality standards of the indexed publications, which ensure the credibility and validity of the sources included in the analysis, as well as the advanced search and filtering functions (document type, language, time range), which allow for a precise selection of relevant literature.
In addition, Scopus is compatible with Biblioshiny, the tool used for bibliometric analysis and data visualization, facilitating the identification of trends and the synthesis of results in a clear and easy-to-interpret format.

3. Results and Discussion

During the period analyzed (2020–2025), a clear upward trend in the number of articles published annually is highlighted. Thus, if in 2020 only 4 articles were recorded, in 2021 their number doubled (8 articles), followed by a significant increase in 2022 (19 articles) and 2023 (26 articles). The upward trend is maintained in the following years, with 39 articles in 2024, reaching a maximum of 70 articles in 2025. This evolution suggests a constant intensification of interest in the analyzed field, as well as a progressive development of research activity during the studied period.

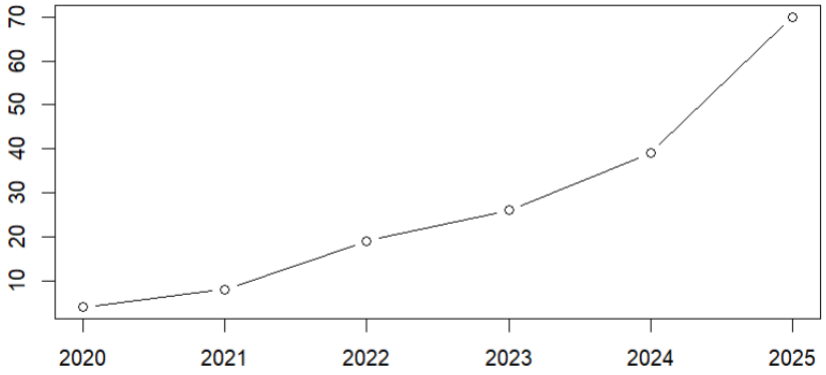


Figure 1: Evolution of publications (2020-2025)
Source**:** created by the author, based on data extracted from Scopus

The upward trend in publications suggests increasing scholarly attention to the topic. Nevertheless, the specific relationship between individual work adaptability and Generation Z employees' turnover intention remains insufficiently investigated in the current literature. The analysis of the 166 papers included in the sample highlights that the most frequently used keywords are career adaptability, turnover intention, and job satisfaction, followed by concepts such as perceived organizational support, proactive personality, and career commitment, indicating the main thematic directions of research in this field.
The keyword co-occurrence network (Figure.2) reveals several distinct color-coded clusters: the green cluster centers on career development, job satisfaction, and

adaptive performance, while the red cluster highlights job performance, career adaptability, emotional intelligence, and employee engagement. The purple cluster is associated with work engagement, job burnout, career commitment, and organizational career management. In contrast, the blue cluster reflects proactive personality, person–environment fit, perceived organizational support, and training. The blue cluster highlights predominantly positive aspects but also includes turnover intention. Overall, the structure suggests that individual and organizational resources are closely interconnected with well-being and turnover-related outcomes.

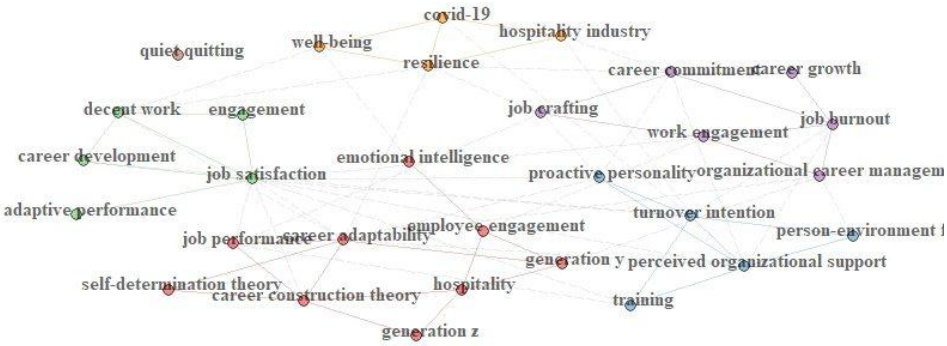


Figure 2. Keyword co-occurrence network (Scopus)
Source**:** created by the author, based on data extracted from Scopus

The thematic map shows that research on work adaptability and turnover intentions is mainly focused on themes such as “turnover intention,” “work engagement,” and “COVID-19,” which appear as central and well-developed topics in the literature. At the same time, “career adaptability” is identified as an important basic theme, highlighting its strong connection with employee well-being, engagement, and retention, especially in the context of Generation Z and the changing labor market.

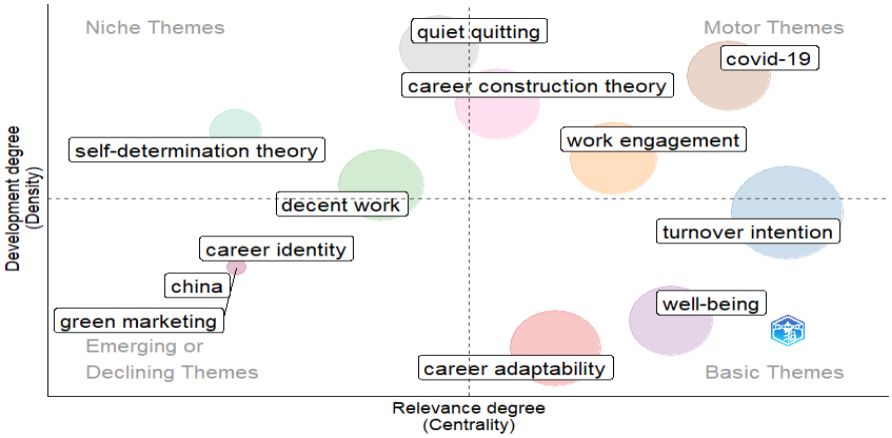


Figure 3. Thematic map (Scopus)
Source**:** created by the author, based on data extracted from Scopus

Furthermore, “self-determination theory” is positioned as a niche theme, indicating that although it is conceptually well developed, it remains relatively specialized and less connected to the central research stream. Overall, the thematic structure suggests that future studies on Generation Z should increasingly explore the relationship between career adaptability, employee well-being, work engagement, and turnover intentions in order to better understand how organizations can retain young employees in dynamic work environments.

The analysis of authors’ productivity reveals a relatively dispersed distribution of publications, with a small number of authors contributing a limited but noticeable share of the total output. The most productive author is Li Y. (n = 5), followed by Zhang J. (n = 4). A group of authors, including Kushwaha B.P., Su X., Wang D., and Zhang Y. (n = 3 each), also show moderate productivity within the dataset. The remaining authors, such as Akkermans J., Akosa F., Akram U., and Ali Abadi H. (n = 2 each), contribute a smaller but still relevant number of publications. Overall, the results suggest the absence of a single dominant author, pointing instead to a relatively fragmented research landscape. At the same time, this distribution may reflect a growing and evolving field, where contributions come from multiple research groups rather than being concentrated around a few leading scholars.

Table 1: Top authors by publication output

Nr. crt.	Authors	Frequency
1.	LI Y.	5
2.	ZHANG J.	4
3.	KUSHWAHA BP.	3
4.	SU X.	3
5.	WANG D.	3
6.	ZHANG Y.	3
7.	AKKERMANS J.	2
8.	AKOSA F	2
9.	AKRAM U	2
10.	ALI ABADI H	2

Source**:** created by the author, based on data extracted from Scopus

The analysis of the most relevant sources indicates a clear concentration of publications within a small number of high-impact journals. The Frontiers in Psychology (n = 10) represents the leading source in the dataset, followed by the International Journal of Contemporary Hospitality Management (n = 8) and the Journal of Vocational Behavior (n = 7). These results suggest that research on the topic is primarily disseminated through journals in psychology, management, and organizational behavior, highlighting the interdisciplinary nature of the field. The prominence of these journals also indicates their strong focus on workplace behavior, employee attitudes, and occupational outcomes.

Table 2: Top-most relevant sources

Nr. crt.	Sources	Frequency
1.	Frontiers in Psychology	10
2.	International Journal of Contemporary Hospitality Management	8
3.	Journal of Vocational Behavior	7
4.	Acta Psychologica	6
5.	European Journal of Training and Development	6
6.	Journal of Hospitality and Tourism Insights	4
7.	Journal of Hospitality, Leisure, Sport & Tourism Education	4
8.	Career Development International	3
9.	Current Psychology	3
10.	Journal of Career Assessment	3

Source**:** created by the author, based on data extracted from Scopus

The assessment of the most influential authors in terms of citations shows that Hirschi A. (n = 273) has the highest citation impact in the dataset, followed by Koen J. (n = 221) and Zada M. (n = 171). This indicates that these authors are the most influential contributors in the field, with their work being extensively referenced in the literature. Their high citation counts suggest that their research plays a key role in shaping theoretical frameworks and empirical approaches related to career development, adaptability, and work-related behavioral outcomes. Although Araya-Castillo L. (n = 127) and Ariza-Montes A. (n = 127) rank at the lower end of the top 10 most cited authors, their citation levels still indicate a significant scholarly contribution. Their presence in this ranking suggests that their work remains widely recognized and integrated into the literature, despite having fewer citations than the leading authors in the dataset.

Table 3: Top cited authors

Nr. crt.	Authors	Citations
1.	HIRSCHI A.	273
2.	KOEN J.	221
3.	ZADA M.	171
4.	FORRIER A.	157
5.	DE CUYPER N.	133
6.	DE VOS A.	133
7.	FUGATE M.	133
8.	VAN DER HEIJDEN B.	133
9.	ARAYA-CASTILLO L.	127
10.	ARIZA-MONTES A.	127

Source**:** created by the author, based on data extracted from Scopus

The most cited publications in the dataset highlight a strong emphasis on topics such as career development, employability, employee retention, and turnover-related outcomes. The leading article by Hirschi and Koen (2021) records the highest number of citations (n = 221), as well as the highest average citations per year (44.20), indicating a sustained and significant impact on the field. Similarly, studies by Fugate et al. (2021) and Ghani et al. (2022) show high annual citation rates (26.60 and 31.75, respectively), suggesting that research on employability and employee retention continues to attract considerable scholarly attention. Interestingly, more recent publications, such as Vleugels et al. (2023) and Akkermans et al. (2024), also display relatively high citations per year (24.00 and 26.00), despite having had less time to accumulate total citations. This pattern may indicate emerging research directions and a growing interest in topics like person–environment fit and career transitions.

Table 4: Top cited publications

Nr. crt.	Publications	Citations	Citations per year
1.	Hirschi, A., Koen, J., (2021)	221	44,20
2.	Fugate, M., et al., (2021)	133	26,60
3.	Ghani, B., et al., (2022)	127	31,75
4.	Ampofo, E., T., Karatepe, O., M., (2022)	82	20,50
5.	Bozionelos, N., Lin, C., Lee, K., (2020)	82	13,67
6.	Vleugels, W., et al., (2023)	72	24,00
7.	Vaziri, H., et al., (2022)	59	14,75
8.	Pelit, E., Katircioglu, E., (2022)	54	13,50
9.	Akkermans, J., et al., (2024)	52	26,00
10.	Zhu, D., et al., (2021)	49	9,80

Source**:** created by the author, based on data extracted from Scopus

Table 5 presents an overview of the top 10 most cited articles retrieved from Scopus, summarizing their main contributions in order to capture the essence of the most influential studies in a concise manner. To provide a deeper perspective, these articles were further analysed in terms of their research focus, methodological approaches, and overall relevance to work adaptability and turnover intentions. Overall, it provides a clearer understanding of the key contributions that have shaped the field. This study holds particular importance as it addresses a relatively underexplored relationship in the literature, namely the impact of individual work adaptability on turnover intention. While prior research has extensively examined factors such as job satisfaction, leadership, and employee engagement, limited attention has been given to how adaptability shapes employees' intentions to leave, especially in the context of the emerging workforce. This gap becomes even more relevant when considering Generation Z, whose expectations, values, and career dynamics differ significantly from previous cohorts. By focusing on this relationship, the present study contributes to a deeper understanding of contemporary workforce behavior. It offers valuable insights for both researchers and practitioners seeking to improve employee retention strategies in a rapidly changing work environment. The following section outlines the main conclusions derived from the bibliometric analysis. **Table 5:** Summary of the top 10 articles retrieved from Scopus

Articles	Type of study	Key Focus	Relevance to Work Adaptability & Turnover Intentions	Main contributions
Hirschi, A., Koen, J., (2021)	Systematic review (33 articles)	Career self-management	Indirect relevance to work adaptability through proactive career behaviors and self-management; no direct focus on turnover intentions	Highlights the role of proactive behaviors in career self-management
Fugate, M., et al., (2021)	Literature review (641 articles)	Employability	Strong conceptual link to work adaptability (employability as a core component); indirect relation to turnover intentions via job mobility and perceived opportunities	Develops an employability framework
Ghani, B., et al., (2022)	Literature review (48 articles)	Employee retention	Direct relevance to turnover intentions (retention perspective); indirect link to adaptability through organizational strategies	Identifies retention strategies
Ampofo, E., T., Karatepe, O., M., (2022)	Empirical - quantitative (27 selected small-sized hotels in Greater Accra, the regional capital of Ghana.	Job embeddedness	Direct relevance to turnover intentions; indirect connection to adaptability via engagement and embeddedness mechanisms	Shows the impact of job embeddedness on turnover intentions
Bozionelos, N., Lin, C., Lee, K., (2020)	Empirical - quantitative ((334 salespersons working for a large retail organization in Hong Kong)	Career sustainability	Indirect relevance to work adaptability through skill development and learning; no direct focus on turnover intentions	Emphasizes training and support
Vleugels, W., et al., (2023)	Systematic review (40 papers)	Person–environment fit	Indirect relevance to adaptability (adjustment to environment) and turnover intentions (misfit leading to exit)	Explores fit dynamics over time at work
Vaziri, H., et al., (2022)	Meta-analysis (113 articles)	Work–family balance	Indirect relevance to turnover intentions (imbalance as predictor);	Identifies key antecedents of

Articles	Type of study	Key Focus	Relevance to Work Adaptability & Turnover Intentions	Main contributions
			weak/indirect link to adaptability	work–family balance
Pelit, E., Katircioglu, E., (2022)	Bibliometric analysis (156 papers)	HRM research trends	Indirect relevance to turnover intentions via HRM practices; no direct link to adaptability	It provides an overview of the main trends and themes in HRM research in tourism.
Akkermans, J., et al., (2024)	Literature review (93 quantitative studies)	Career transitions	Strong relevance to work adaptability; indirect link to turnover intentions through career mobility and transitions	Proposes a career transition framework
Zhu, D., et al., (2021)	Meta-analysis (1.404 articles)	Career commitment	Indirect relevance to turnover intentions (commitment reduces intention to leave); indirect link to adaptability	Explains drivers of career commitment

Source**:** created by the author, based on data extracted from Scopus

The results show that the most influential publications are mainly centred around themes such as career sustainability (Bozionelos, N., Lin, C., Lee, K., 2020), employability (Fugate, M., et al., 2021), and employee retention (Ghani, B., et al., 2022). Methodologically, the field is dominated by literature reviews (Hirschi, A., Koen, J., (2021); Akkermans, J., et al., (2024)), meta-analyses (Vaziri, H., et al., (2022)), and quantitative studies (Bozionelos, N., Lin, C., Lee, K., 2020); Ampofo, E., T., Karatepe, O., M., 2022), suggesting a strong emphasis on both theoretical development and empirical validation. At the same time, the analysis highlights an important pattern in the literature. Although work adaptability and turnover intentions are highly relevant in today's work context, they are rarely examined together within the same studies. Instead, they tend to be approached indirectly through related constructs. For example, work adaptability is often reflected in concepts such as employability, career self-management, or career transitions, which capture how individuals respond to change and manage their professional paths. In parallel, turnover intentions are frequently linked to variables such as job embeddedness (Ampofo, E., T., Karatepe, O., M., 2022), career commitment (Zhu, D., et al., 2021), or work–family balance (Vaziri, H., et al., 2022), even when they are not explicitly addressed. This suggests that the literature remains somewhat fragmented, with limited integration between these two important constructs. However, the presence of these adjacent concepts also provides valuable insights and creates a foundation for connecting different research streams.

Overall, the findings highlight a clear gap in the literature and underline the need for more integrative research that brings together work adaptability and turnover intentions, particularly in the context of Generation Z, where career dynamics and mobility patterns are rapidly evolving. From this perspective, examining work adaptability and turnover intentions is particularly relevant in the context of an increasingly dynamic and uncertain work environment. This is especially important for Generation Z, as they are gradually becoming a dominant force in the labor market and will play a key role in shaping future organizations and societies. At the same time, the motivation for addressing these topics is not only academic, but also practical. A clear understanding of what drives employees to stay or exit is fundamental for organizations seeking to retain their workforce. The results of the bibliometric and thematic analysis indicate that the recent literature is in a process of transition from general approaches to employment to the investigation of psychological and behavioral factors that influence employee retention. In this context, the study of individual adaptability as a predictor of turnover intention becomes particularly relevant for understanding the professional dynamics specific to Generation Z.

5. Conclusions

In the context of today's rapidly changing and increasingly uncertain work environment, understanding how individuals adapt to their professional roles and why they decide to remain in or leave an organization has become more relevant than ever. This study contributes to the existing literature by bringing together two closely related, yet often separately examined constructs, namely work adaptability and turnover intentions, and by emphasizing the importance of a more integrated perspective on the behavior and expectations of Generation Z employees. The use of bibliometric analysis as the primary methodological approach was driven by the need to explore and synthesize the literature in this field. This approach not only allows for a structured overview of the field but also helps to identify the main research directions and gaps that are not always visible in traditional literature reviews. The results indicate that research on work adaptability and turnover intentions remains relatively fragmented, with most studies focusing on related constructs such as employability, career development, job embeddedness, organizational commitment, and job satisfaction. Understanding how employees adapt to their roles and what influences their job satisfaction and decisions to stay or leave is essential not only for organizations but also for creating more stable and meaningful professional experiences. The literature review from 2020 to 2025 highlights that the relationship between individual adaptability at work and intention to leave has not been directly investigated in existing studies. The identified research mainly addresses related concepts, such as career adaptability, professional flexibility, or intention to leave the workplace, without a clear focus on Generation Z. At the same time, recent literature pays increased attention to young adults and organizational behaviors specific to new generations, but the psychological mechanisms that influence Gen Z employee retention remain insufficiently explored. This aspect is relevant in the context in which Generation Z is characterized by an orientation towards flexibility, rapid adaptation to change, and high professional mobility. Trends indicate a growing research interest in the relationship between work adaptability and turnover intentions, highlighting emerging directions for future studies focused on understanding Generation Z behavior in the contemporary

organizational environment. Finally, future research should continue to explore the intersection between work adaptability and turnover intentions, while also taking into account emerging trends in the literature, such as dynamic career paths, generational differences, and evolving employment expectations. Overall, the findings reinforce the idea that the relationship between work adaptability and turnover intentions remains underexplored, highlighting an important gap in the literature and supporting the need for more integrative research, particularly in the context of Generation Z.

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A BIBLIOMETRIC REVIEW OF THE LITERATURE ON TEAM COACHING IN THE BUSINESS WORLD

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Abstract: *In the context of increasingly dynamic organizational environments, characterized by frequent changes in how teams are structured, operate, and perform, interest in team coaching as a strategic organizational intervention in the business world has grown significantly. This paper provides an analytical analysis of the scientific literature on team coaching in the business world. This paper examined 329 publications indexed in the Web of Science database between 1994 and 2025, using quantitative and bibliometric analyses and a range of methodologies. These included citation, co-citation, and keyword co-occurrence analyses. The aim of this analysis was to identify patterns of knowledge production and the intellectual structure within the field. The findings highlight the most influential journals, authors, and articles, as well as the key relationships among research topics. Moreover, as the paper indicates, emerging trends and gaps in the literature were identified. Furthermore, offering a structured and accessible overview of the evolution and current state of team coaching in organizations, and how it can support academics in advancing theoretical development and guide practitioners in applying evidence-based coaching interventions. The paper also underscores future research priorities in the relevant literature.*

Keywords: *team coaching; business coaching; literature review; bibliometric analysis; citation analysis; co-occurrence analysis.*

JEL Classification: *M12; M53; M14*

1. Introduction

A systematic literature review has proven advantageous across all areas of study. Therefore, it is essential to consider the field's past evolution, current status, and potential future developments *(Demeter, Szász and Kő, 2019).* Teams are an essential component of an effective organization *(Mathieu et al., 2017).* As the organizational environment continues to change to become more effective, there is a growing need to take a holistic approach to teams. Consequently, in recent years, several researchers have analyzed the efficacy of team development and learning interventions *(Klein et al., 2009).* Due to the overlapping nature of these types of learning with team coaching in business environments, there has been confusion in the literature, which is caused by a lack of clarity regarding the definition and conceptualization of the notion of team coaching *(Jones, Napiersky and Lyubovnikova, 2019),* which impedes theoretical and empirical research *(Kohler, Landis and Cortina, 2017).*

However, there has been a significant increase in research over the last period, with several research areas explored. While some studies focus on team effectiveness

(Cannon and Edmondson, 2001; Edmondson, Roberto and Watkins, 2003; Schaubroeck et al., 2016), others concentrate on defining concepts, competencies, and intervention models *(Hackman and Wageman, 2005; Rezania and Lingham, 2009*).

The growing connection between team coaching and leadership is supported by an increasing number of researchers in this field. Some researchers focus on individual leadership *(DeRue, Barnes and Morgeson, 2010; Farh and Chen, 2018; Morgeson (2005*), while others focus on collective leadership *(Carson, Tesluk and Marrone, 2007; Eva et al., 2019; Salvato and Corbetta, 2013)* or on empowering leaders through coaching (*Arnold et al., 2000; Joo, Park and Lim, 2016*). This study conducts a bibliometric and analytical analysis of the scientific literature on team coaching in the business world. Edmondson (1999) remains a benchmark work on psychological safety within teams and its influence on team effectiveness. Edmondson, Roberto and Watkins (2003) explain how management teams handle complex tasks.

With these studies, we want to answer the following research questions:

RQ1. *What are the most influential articles and authors, and how do they relate to the field of team coaching research in business?*

RQ2. *What are the most highly ranked publications, and how can they be grouped into categories on team coaching in the business world?*

RQ3. *What are the most interesting topic clusters for team coaching in the business world, and what are the main future research directions?*

The paper includes a literature review of coaching and team coaching in business, an explanation of the research methodology used to achieve the study's objectives, a section detailing the research findings, and a conclusion outlining limitations.

2. Literature review on team coaching in the business world

We found only a limited number of literature reviews on team coaching in the business world. The study conducted by Hackman (2005) offers a succinct overview of prior literature and formulates a novel model that explicates its functions, the time required for the desired impact to be felt, and the circumstances that either aid or hinder performance. Based on the literature review, the authors categorize existing research and theories into 4 models: eclectic interventions (largely atheoretical), process consultation, the behavioral model, and developmental coaching. In addition, the article presents a conceptual model outlining the links among coaching interventions, team processes, and team performance. Although it is a 2005 work, over 21 years old, it remains the most-cited in the literature. The author considers team coaching a form of leadership that facilitates a collective effort toward a common goal.

Dwyer (2019) analyzes 25 years of research on leadership self-efficacy (LSE). The study found that executive coaching, mentoring, cognitive modeling, and training were effective in enhancing LSE.

Widdowson et *al.* (2020) conducted a research review using an interpretive qualitative methodology and highlighted that existing research on team coaching has focused primarily on defining team coaching, identifying effectiveness factors, and investigating its effectiveness. However, further research is needed on the theoretical framing of team coaching competencies. Hagen (2010) examines the literature on process improvement, quality, leadership, and management coaching to illustrate how training in management coaching for Six Sigma belts would positively impact knowledge accumulation within an organization.

Based on Duff, A.(2013) study, the author develops a conceptual study that examines the relationships among performance management, servant leadership, and leader gender, drawing on a literature review. Because the theory of team coaching suggests differential leader task delivery at various points in the coaching process, this research paper concludes that servant leadership is suitable for team coaching, particularly in the execution of performance management coaching.
On the other hand, the study by Scholtens et *al.* (2023) offers a systematic overview of the current empirical evidence on the effectiveness of the systemic constellation method as an organizational intervention. The study also examines the key factors influencing the effectiveness of this methodology, which is increasingly used in team coaching. This study does not stop at the concept of general team coaching. Technical term abbreviations, such as "organizational intervention," are explained when first used.
Reich, Gemino and Sauer (2010) conducted a literature review to identify the coaching roles that contribute to its effectiveness. They identified five coaching roles: consultant, supervisor, trainer, facilitator, and mentor. The authors also highlighted the relationship between coaching and leadership in the literature and the limitations of existing quantitative research: a lack of clarity in terminology and reliance on self-administered questionnaires, which are highly susceptible to response bias and interpretation *(Werth, Markel and Förster, 2006).* Quantitative survey studies often analyze the correlation between team leadership and team performance, but with high variability *(Stewart, 2006*). If we apply the findings of these studies in practice, we still face the task of determining what a particular team leader ought to do in a specific situation *(Kayworth and Leidner, 2001*). Conversely, research by Bryman (2004) and Jones and Wallace (2005) highlights the growing need for qualitative research.
None of these studies aimed to conduct a literature review of team coaching in the business world. Instead, they focused on analyzing the literature on other specific concepts within team coaching. Additionally, no bibliometric analyses have been found in the literature to determine which keywords exert the greatest influence, their groupings, the relationships among authors, and who is most frequently cited. We were also unable to identify the most significant journals or research topics.

3. Research methodology

The proposed research involves quantitative methods, including content and bibliometric analyses of the literature on team coaching. While bibliometric analysis is commonly employed in business research *(Chang and Lin, 2021; Ramos-Rodríguez and Ruíz-Navarro, 2004; Demeter, Szász and Kő, 2019),* no bibliometric literature searches have been conducted in this particular field. To obtain the most precise results, we conducted research following the steps outlined in Figure 1.
The first step was to identify a relevant database for the research. For this study, we chose the Web of Science database, a well-known resource that includes five additional databases and renowned scientific journals (*Ropret and Aristovnik, 2019).*

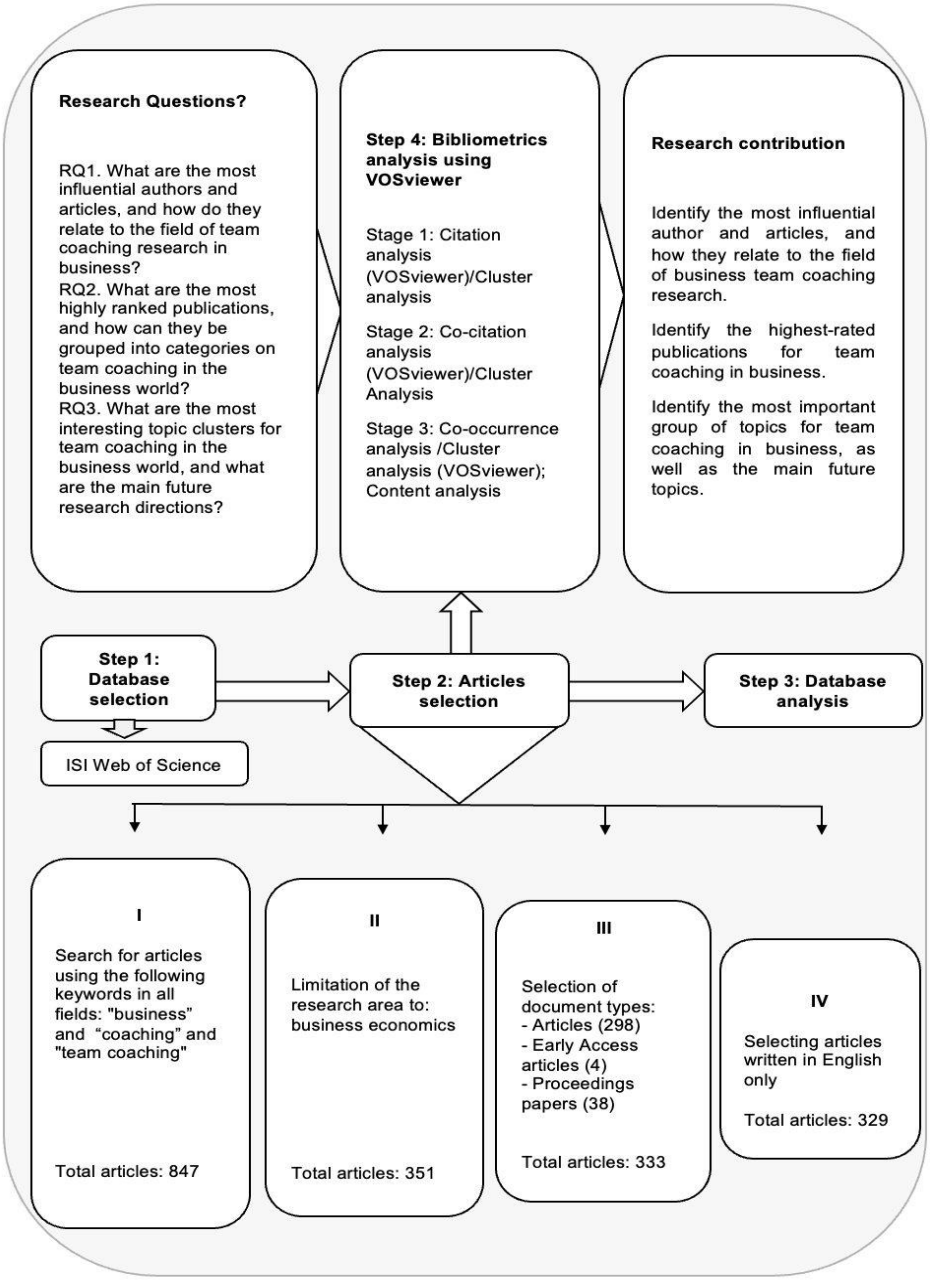


Figure 1: *Research methodology*
Source: Authors, own research results/contribution

The second step involved identifying the most relevant articles in this database. We applied four filters in four stages, as follows. The first filter involved selecting articles on the keywords “business,” “coaching,” and “team coaching” from 1994 to 2025 via the advanced search option. To identify the articles most relevant to our research in

the business world, we used the conjunction “and” between the selected keywords. Following this selection, we identified 847 articles that met the selected criteria. In the next step, from the list of filters available on the platform under the “research fields” option, we selected “business economics” as the most relevant. This search term was used to narrow the database to specific topics in the field of “business economics,” yielding 351 articles. In the third step, under the “document type” filter, we selected the options “articles,” “early access articles,” or “proceedings papers.” To avoid compromising the relevance of the articles, we excluded the other options, resulting in a total of 333 papers. Finally, in the fourth step, to ensure a complete understanding of the information, English was selected from the “languages” filter, resulting in 329 articles, with 3 articles in Spanish and 1 article in French excluded.

To get an initial overview of the database, in step 3 (database analyses), we exported the database to Excel, selecting records 1–329 and the following columns: title, year of publication, and keywords. The resulting database was analyzed with respect to the number and average number of articles per author, the distribution of publications by citation count over the entire period from 1994 to 2025, and the distribution of articles by publication.

Finally, in step 4 of the bibliometric analysis using VOSviewer, the database was exported in a “tab-delimited file” format to meet the software’s requirements. The selected options were “articles 1 to 329” and “full record and cited references.” A bibliometric analysis was performed on this exported database using Citation Analysis, Co-citation Analysis, and Co-occurrence Analysis.

First, the identified and exported articles were subjected to citation analysis. This type of analysis enabled us to assess academic impact by identifying the most influential author and article in the field. In the second stage, co-citation analysis was performed on the database. This method involved identifying pairs of authors whose works were frequently cited together. Thus, Small (1973) used this method to investigate contextual similarities among several publications in the field of research under study. Co-citation analysis is a bibliometric method that assesses the frequency with which two articles are cited together by other articles (*Gmür, 2003*).

Finally, a co-occurrence analysis was performed to map and understand the structure within the document (*Leydesdorff and Vaughan, 2006).* All keywords were grouped into clusters based on the identified interconnections between them and presented in the corresponding mapping.

We use VOSviewer, a software tool designed to generate bibliometric views for various databases *(Van Eck and Waltman, 2010),* which is widely regarded as a neutral, representative, and objective dataset for conducting literature reviews. By employing the automated text extraction feature, VOSviewer identifies words or word sequences that comprise nouns and adjectives from the database using a POS system *(Demeter, Szász and Kő, 2019)*. The purpose of using this software was to identify the pivotal authors, articles, and key terms employed in academic journals.

For the citation analysis, we imported the Web of Science (WoS) database and generated a bibliometric map using VOSviewer. The objective of the bibliometric mapping was to identify the most influential author and article based on citation analysis.

For this, under the “Type of analysis” option, we selected “citation,” and under the “Unit of analysis” option, we selected “documents.”

To ensure relevance, only articles with at least 15 citations were included in the analysis; we set the “Minimum number of citations per document” to 15, resulting in

97 articles. Among them, only the largest connected component, consisting of 18 items, was represented graphically by selecting the “networking visualization” option. Thus, the size of the circles indicates the number of citations, and the lines represent the connections between them.

For the co-citation analysis, we generated a bibliometric map using the selected database. Under the "Type of Analysis" option, we selected "Co-citation." We employed the full counting method by selecting "Full Counting" from the "Counting Method" option, and we focused on cited references by selecting "Cited References" from the "Unit of Analysis" option. In the visualization, we included only articles with at least 10 citations to ensure their significance, selecting 10 as the “minimum number of citations for a cited reference.” Of the original 14321 articles, only 14 remained. The size of the circles indicates the number of citations, while the lines and their distance emphasize the strength of the connections between them. Additionally, they are grouped into clusters and visually differentiated by color in a network visualization map.

Using co-occurrence analysis, a bibliometric map was generated that highlights the most significant keywords in the specialized literature. For this analysis, the same database was used to generate a bibliometric map that highlights the most significant keywords in the specialized literature. A filter requiring at least 10 occurrences was applied to the database. As a result, 1,679 keywords were identified in the search, of which only 25 met the filter criteria. The diagram was created using identical network visualization parameters.

5. Results and discussion

5.1. Results of the database analysis

The WoS database includes 329 academic papers published in 65 journals, consisting of 88,48% scientific articles, 11,41% proceedings papers, and 1,20% early access articles. 201 authors (TA) were responsible for 324 articles (Ta). Only four authors, Coetzer G, Peter Seemann, Vveinhardt J, and Washington M., published 3 articles, while 42 authors published 2 articles each. The Ta/TA calculation indicates that the authors published an average of 1.63 articles. This suggests a lack of interest among researchers in pursuing further studies in this field. Database analysis has been approached in various ways. Also, this end, we investigated the publication’s chronological distribution in the database for the entire period from 1994 to 2025, as depicted in Figure 2. The figure shows a rising trend in publications, with peaks in 2016, 2019, 2022, and 2024. The International Coaching Federation, the world’s largest professional association in the field of coaching, introduced specific certifications for team coaches alongside individual certifications, reflecting increasing interest in the field *(International Coaching Federation, 2019)*, which can be linked to a constant interest in research in this field, as we can notice in the figure. There has been a growing interest among researchers in this field, especially since 2016.

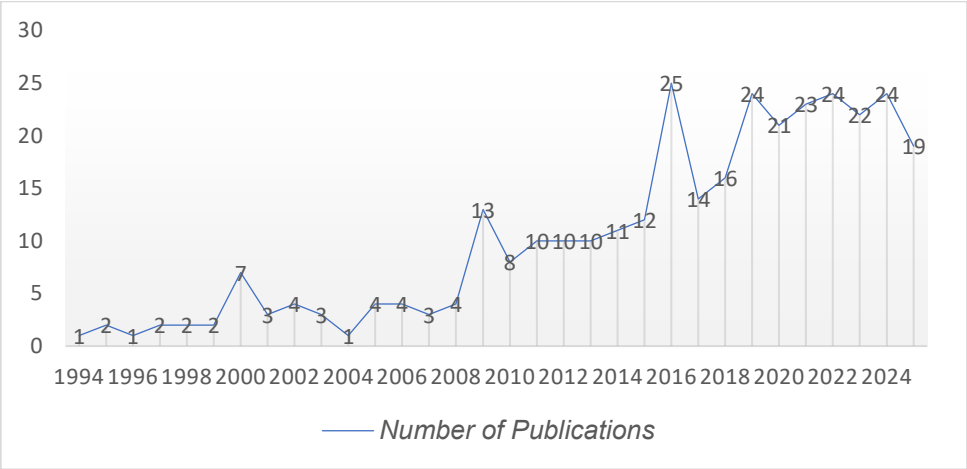


Figure 2: *Distribution of publications 1994 - 2025*
Source: Authors, own research results/contribution

Secondly, we analyzed the distribution of publications by citation count for the entire period from 1994 to 2025, as shown in Figure 3. We observed a steady increase in citation counts throughout the analysis period, indicating a corresponding rise in research efforts on this topic. In 2023, we saw a slight decrease from 852 to 746 citations, but in the following two years, the number of citations rose again to 892 and 924. This is an exception, as the overall trend remains one of steady growth over the years.

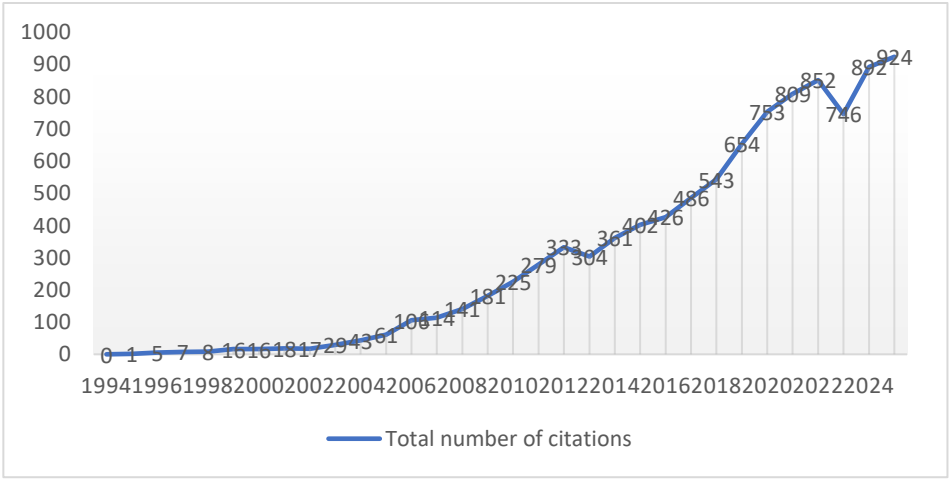


Figure 3: *Citation Distribution 1994 - 2025*
Source: Authors, own research results/contribution

Third, we analyzed the number of articles published in various journals, as shown in Figure 4. Out of 329 articles, we selected 205 journals representing the 29 most relevant publications, with 3 articles each, to ensure relevance and visibility. “Harvard Business Review” published 18 articles and remains the journal that garners the most interest among researchers, based on the number of publications.

The “European Sport Management Quarterly” published 16 articles, the “Journal of Sport Management” published 12 articles, the “Journal of Sport Economics” published 7 articles, and the “Sport Management Review " published 5 articles.

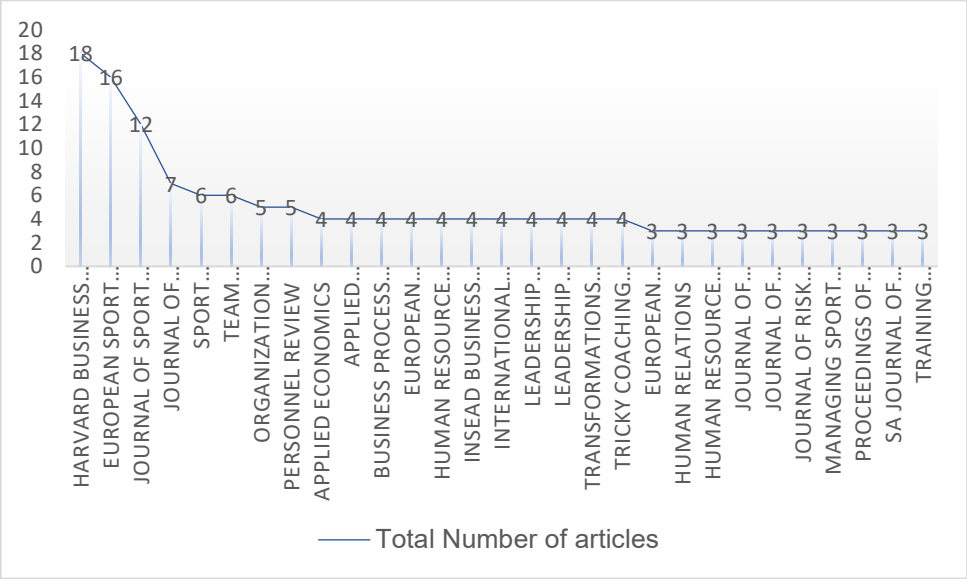


***Figure 4**: Distribution of articles on Publications*
Source: Authors, own research results/contribution

These four sports journals, with a total of 41 articles, showed a strong interest in sport management as it relates to coaching and team coaching as a concept, but do not indicate a genuine interest in the study of organizational interventions involving team coaching in sport. The large number of articles is due to confusion over terminology.

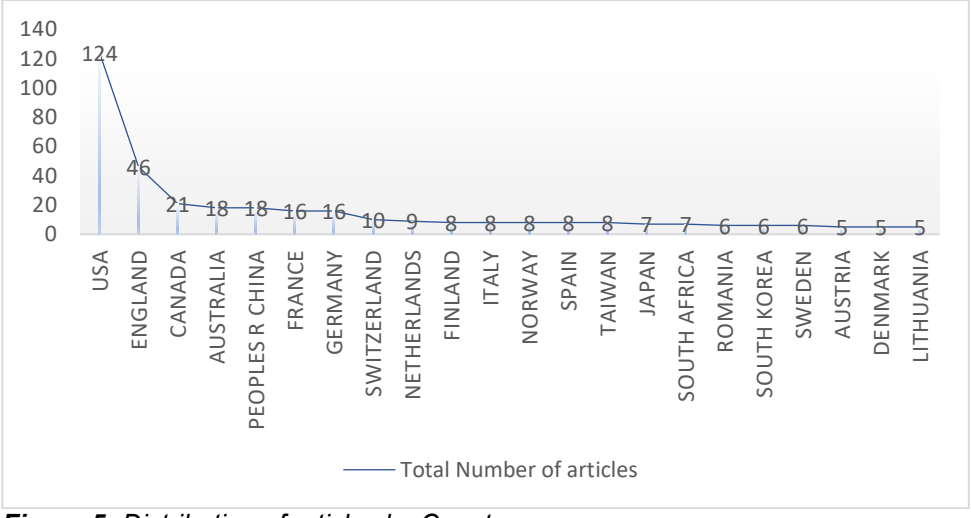


***Figure 5:** Distribution of articles by Country*
Source: Authors, own research results/contribution

In sports, the terms “coaching” and “team coaching” refer to the instruction a coach provides during training sessions and competitions. Therefore, a clarification of terminology in the specialized literature is necessary to avoid confusion and prevent inappropriate analyses regarding the term “team coaching.” Continuing the database analysis, Figure 5 presents the regional distribution. Of the 51 countries included in the analysis, we have included only 22 with more than 5 articles to avoid overcrowding the chart, as these are the most relevant. The data indicate that the USA has the highest number of publications during the study period, with 124, followed by England with 46, Canada with 21, Australia and China with 18 each, and France and Germany with 16 each. Interest is evident across all continents, with North America recording the highest number of studies in this field, followed by Europe; Romania is also represented, with 6 articles.

5.2. Results of the citation, co-citation and co-occurrence analysis

5.2.1 Results of the Citation Analysis

The VOSviewer software was used to conduct a bibliometric analysis of the database.

The results are presented in Figure 6, which shows a map of the most significant authors and articles, grouped into distinct clusters identified by different colors. The size of the circles reflects the significance of the articles (number of citations), while the lines between articles represent their connections and vary in color. It is evident that Edmondson, Roberto and Watkins (2003) are the most-cited author and journal in the field, followed by Carson, Tesluk and Marrone (2007) and Arnold et *al.* (2000).

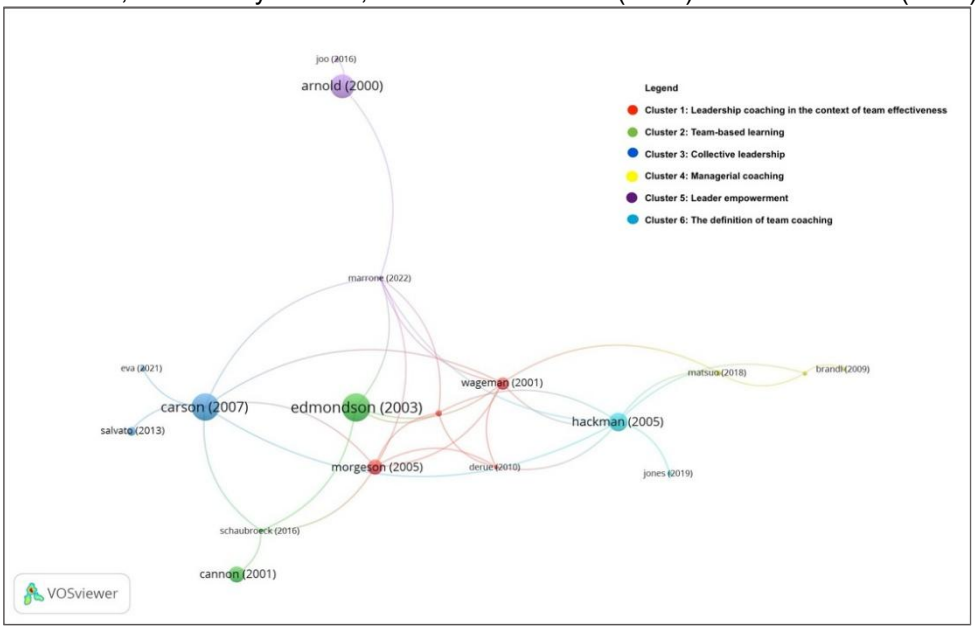


***Figure 6**: The map of the most influential articles in team coaching in the business world*

Source: Authors, own research results/contribution

On the map, we can see the works of Hackman (2005), Cannon and Edmondson (2001), and Wageman (2001). After analyzing the six clusters based on their central themes, they were coded as follows: *"leadership coaching in the context of team effectiveness", "team-based learning", "collective leadership", "managerial coaching", "leader empowerment",* and *"the definition of team coaching*". The first cluster, colored red, includes the works of Wageman (2001), Morgeson (2005), Farh and Chen (2018), and DeRue, Barnes and Morgeson (2010), D. Scott et al. (2010), and was labeled "*leadership coaching in the context of team effectiveness*". DeRue, Barnes and Morgeson (2010), D. Scott et al. (2010) compare the effectiveness of the coaching leadership style with the directive leadership style and conclude that coaching leadership is more effective in teams where members have high self-efficacy and the leader uses charisma. Morgeson (2005) analyzes the impact of coaching on external leadership and self-managing teams, while Farh and Chen (2018) investigate the role of a leader's voice in influencing team performance. Wageman (2001) shows that the way leaders organize their teams and the quality of hands-on coaching they provide influence both the team's self-management and the quality of relationships among members, as well as their satisfaction, but only leaders' design activities affect team task performance.

Cluster 2, in green, titled "*team-based learning"* includes Cannon and Edmondson (2001); Edmondson, Roberto and Watkins (2003) and Schaubroeck et *al.* (2016). Edmondson, Roberto and Watkins (2003) are the most influential authors on effectiveness in active teams, whose framework is constantly changing. Cannon and Edmondson (2001) examine how teams learn from failure and the factors that influence this learning. Schaubroeck *et al.* (2016) explain the self-learning process that leaders undergo through coaching.

The blue cluster, number 3, labeled the *"collective leadership"* cluster, consists of 3 items and includes 3 authors. Carson, Tesluk and Marrone (2007) is the second-most-influential author by citation. They examine shared leadership from both practical and theoretical perspectives and its impact on performance. Eva et *al.* (2019) go further by focusing on the theoretical aspects to clearly define shared leadership as part of leadership development. Salvato and Corbetta (2013), on the other hand, studied the role of the advocate in leadership change and its support for the effectiveness of the integration process. Cluster 4 (yellow) was labeled "*managerial coaching"* It includes Matsuo (2018) study, which examines how managerial coaching directly influences the learning process at the team and individual levels; Nyfoudi *et al.* (2023) study explains how managerial coaching competencies relate to team performance, and the article by Brandl, Madsen and Madsen (2009) which highlights the importance of line managers' perceptions of the human resources department's responsibility.

The purple cluster number 5, labeled "*leader empowerment*" consists of the following authors: Arnold *et al.*(2000) who developed the EQA questionnaire, a new measurement tool for assessing leader empowerment behavior; Joo, Park and Lim (2016) a study conducted in South Korea that investigated the personal (learning goal orientation LGO), contextual (empowering leadership), and work-related (psychological empowerment) antecedents of psychological well-being (PWB) that help empower leaders; and Marrone *et al.*(2021) which highlights the importance of coaching for leaders to support them in today's rapidly changing context.

The last cluster, number 6, is light blue and labeled "*team coaching definition.*" It functions, the time required for the desired impact to be felt, and the circumstances

that facilitate or impede performance. On the other hand, Jones, Napiersky and Lyubovnikova (2019) provide an analysis and literature review of the term's definition and characterization in the team coaching literature.

5.2.2 Results of the Co-Citation Analysis

Figure 7 presents a graphical representation of the most influential articles used as the basis for research studies in this area. We have labeled the articles exactly as they appear in the reference list, using co-citation analysis. We note that Edmondson(1999) paper is the most influential. It is followed by Hackman (2005) and Podsakoff et *al.* (2003).

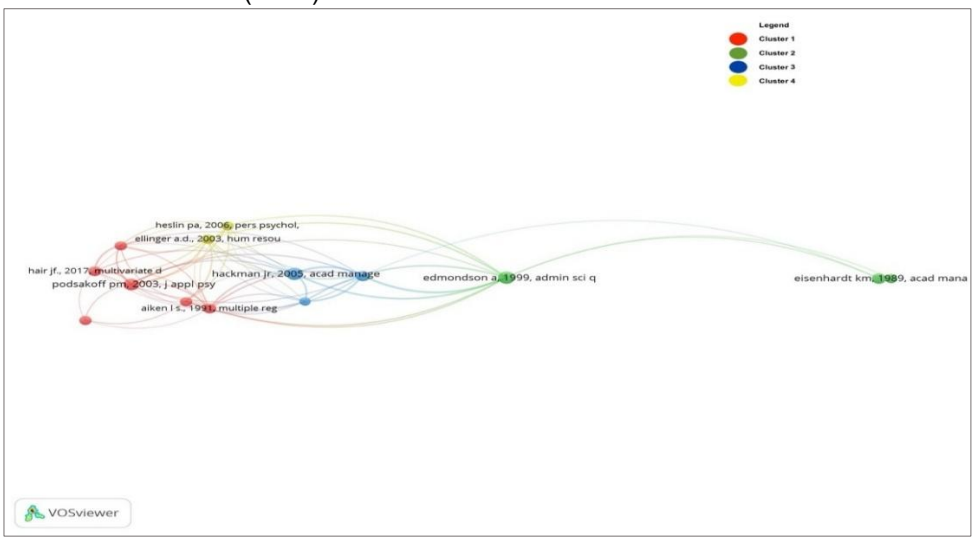


Figure 7*: The key articles map in the field of team coaching in the business world (Co-citation map)*
Source: Authors, own research results/contribution

The most representative study in Cluster 1 is Dirks (2000), which examines trust in leaders and its influence on performance, along with five other papers on research methodologies, including Podsakoff *et al.*(2003) and presents a literature review on research methods showing that, without controlling for common method bias, many results from behavioral research can be misleading; Aiken (1991) on multiple regression; Fornell and Larcker (1981), which evaluates structural equation models with unobservable variables and measurement error in research methodology; Hair *et al.*(2017), which study the Partial Least Squares structural equation modeling (PLS-SEM) method in research; and James, Demaree and Wolf (1984) which study methods for aggregating data at the group level in research. This cluster centers on several research methodologies, with Dirks (2000) as a central reference.
Cluster 2, marked in green, contains Edmondson (1999), a seminal paper on psychological trust within teams, and two papers on research methodologies: Eisenhardt (1989), one of the most important guides for case study-based research, and Miles, Huberman and Saldaña (2014*)* a practical guide for qualitative data analysis. Therefore, the central study in this cluster remains Edmondson (1999).

Blue cluster 3 includes Hackman (2005) on team failure due to poor team design and ineffective management; Wageman (2001) on the leader's contribution to team performance through appropriate design; and Marks, Mathieu and Zaccaro (2001) on team processes over time. In this cluster, all three studies focus on the same central theme: team performance in organizations and the factors that influence it.
Finally, the yellow Cluster 4 includes the study by Heslin, Vandewalle and Latham (2006) on managers' beliefs about the extent to which people can change through their coaching and employee development behaviors, and the study by Ellinger and Bostrom (2003) on the importance of managers' coaching behaviors in organizations. The central idea of this cluster is that managers' coaching skills are necessary for team growth.

5.2.3. Results of the co-occurrence analysis

Co-occurrence data provide valuable insights for mapping and understanding the structures within document sets *(Leydesdorff and Vaughan, 2006).* Figure 8 shows a scientific map generated with VOSviewer. This map highlights the most important research topics related to this field.

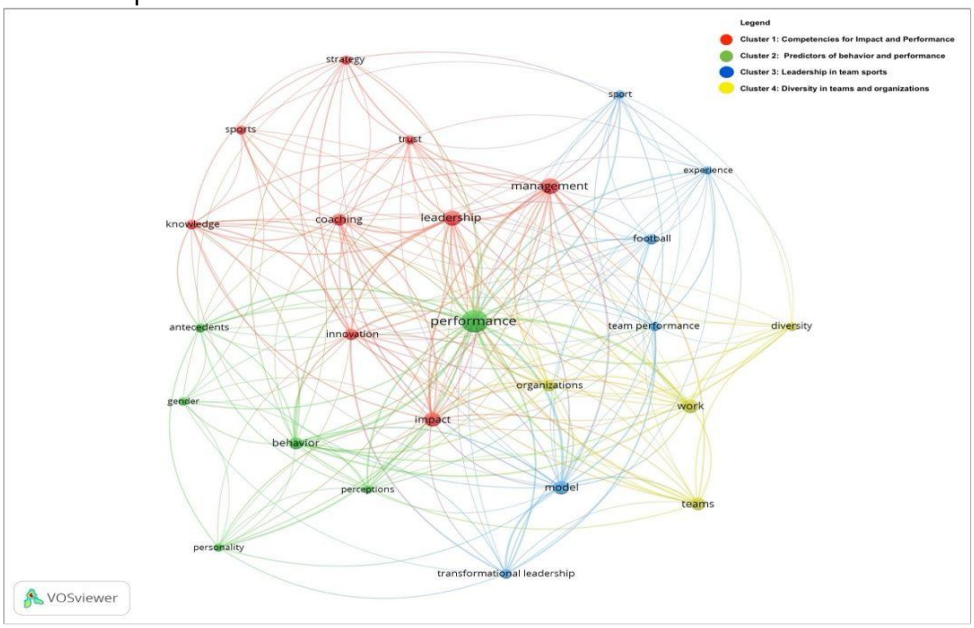


Figure 8: *The co-occurrence map of keywords in the field of team coaching in the business world*
Source: Authors, own research results/contribution

The keywords have been grouped into five clusters, highlighted in different colors, just as in the citation analysis. The size of the nodes indicates the total number of times each keyword appears, and the links in the map highlight connections between them. Thus, the term "performance" is the most frequently used and interconnected term in the specialized literature, followed by "management", "leadership", "work", "teams", and "behavior". They are grouped into 4 clusters, represented by 4 different colors as follows: cluster number 1, the red one with 9 items: "coaching," "impact," "innovation," "knowledge," "leadership," "management," "sports," "strategy," "trust,";

cluster number 2, the green one with 6 items: “antecedents,” “behavior,” “gender,” “perceptions,” “performance,” “personality”; cluster number 3, the blue one with 6 items: “experience,” “football,” “model,” “sport,” “team performance,” “transformational leadership”; and cluster number 4, the yellow one with 4 items: “diversity”, “organizations”, “teams” and “work”.

Based on the keyword analysis, the four groups were assigned representative labels as the most important research topic: "*Competencies for Impact and Performance"*, “*Predictors of behavior and performance*”, *“Leadership in team sports”*, *“Diversity in teams and organizations*”.
As shown in Figure 9, when the keyword "coaching" is analyzed separately, it is directly linked not only to keywords in Cluster 1 (red) but also to several keywords in other clusters. Among these, connections are evident with “performance,” “teams,” “organization,” “work,” and “model,” terms specific to the business environment, as well as with “football” and “sport,” terms specific to the sports environment, and with “behavior” and “personality,” terms specific to psychology. We can see that the keyword “team coaching,” as an integrated concept, does not appear in the map, suggesting it has not been a key concept of major relevance to the research conducted so far. Instead, a connection can be observed among the words “coaching,” “teams,” and “team performance” as separate terms.

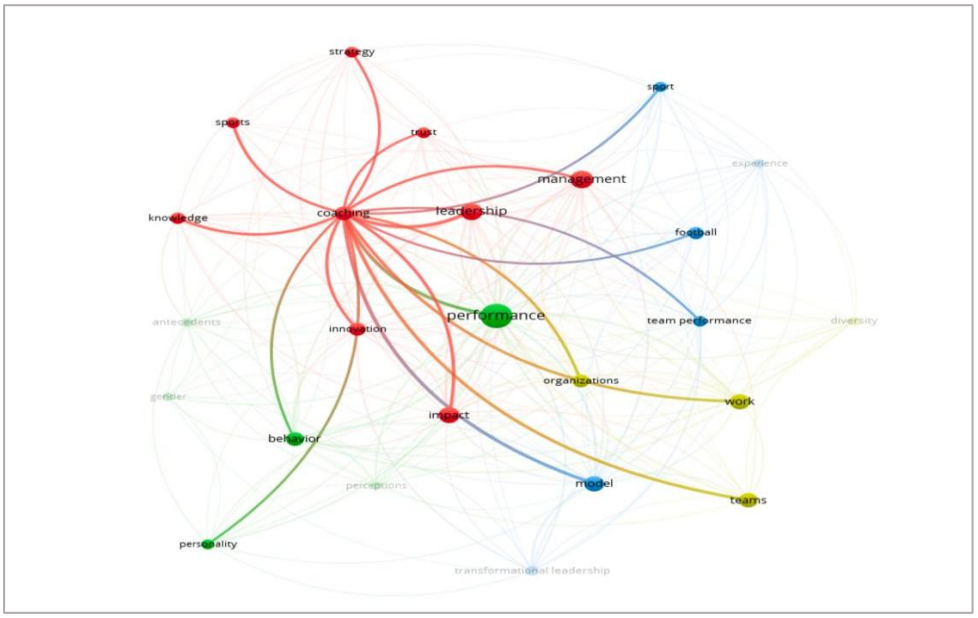


Figure 9: *Keyword “coaching” in the co-occurrence map of keywords in the field of team coaching in the business world*
Source: Authors, own research results/contribution

6.Conclusions and limitations

This article makes several contributions to the field of team coaching in the business environment through a database and bibliometric analysis of specialized literature on the concept, intended for both researchers and practitioners.

An analysis of the database reveals a growing interest in team coaching over the past 10 years, particularly in the United States and Europe. We also conclude that there is some confusion in the literature regarding its use. For example, in the field of sports, the term “team coach” is used to describe sports training rather than organizational interventions of a “team coaching” type. Therefore, a study is recommended to clarify the concept of "team coaching" as an organizational intervention within sports organizations' teams and as a training method in sports.

Based on a bibliometric analysis, the most important and influential articles in the field of team coaching in the business environment are first identified, helping researchers determine which articles are essential to study and assisting practitioners in identifying the connection between theory and practice. On the other hand, the study identifies authors who have had a significant impact on the academic literature. This paper provides a way for future collaborative research projects involving multiple researchers, universities, and professionals.

Based on an analysis of citations and co-citations, the paper by Edmondson, Roberto and Watkins (2003), inspired by Edmondson (1999), remains the most cited and influential work in the literature, alongside Carson, Tesluk and Marrone (2007), Hackman (2005), and Podsakoff *et al.* (2003).

In addition, the most important topics studied to date have been identified through keyword analysis and their relationships, providing valuable insights into areas of interest. Words such as performance, coaching, team performance, leadership, sport, teams, behavior, organizations, and management remain the most frequently used, and grouping them has yielded four research topic areas based on future areas of interest: "*Competencies for Impact and Performance"*, “*Predictors of behavior and performance*”, *“Leadership in team sports”*, *“Diversity in teams and organizations*”.

Finally, the bibliometric research method using VOSviewer visualizers is novel in this research field. The software provides a graphical representation that is easy to analyze and interpret, displaying the most influential authors and journals through citation and co-citation analysis.

The study, of course, has some limitations. The first concerns how the database analyzed was created. The study used only the Web of Science database, which, although the most prestigious, does not include the entire literature. Future studies should consider other databases to expand the population studied in this work. Also, regarding the database, the study was limited to articles, research papers, and early-access articles, thereby excluding part of the population. In the future, it is recommended to examine other works that could be valuable to the field.

After conducting a co-occurrence analysis, it is evident that the keywords “coaching” and “business” have not been among the most important topics studied in the literature to date. This suggests that using these keywords only narrowed the database. It is recommended that, in the future, the database be narrowed to the research area within the business field and to other keywords related to team coaching.

It is also recommended that the integrated concept of “team coaching” be further researched, rather than treating “coaching” and “team” separately. Such conceptual clarification can be particularly useful for researchers to avoid confusion in the literature over term use and for practitioners and professional associations in the field to provide a starting point for their professional work.

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DEMOGRAPHIC DECLINE, DIGITAL ACCELERATION, AND GENDERED EXCLUSION: EVIDENCE FROM ROMANIA

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Abstract: *Against the backdrop of demographic ageing and accelerating artificial intelligence (AI), the nature of work is being redefined, yet not all groups benefit equally. The article examines how digital transformation intersects caregiving constraints on women's labour market participation. This paper proposes a conceptual five-dimensional exclusion mechanism: the digital skills deficit, the remote work desert, the childcare void, the time inequality trap, and the AI acceleration asymmetry. The study analyses Romania's outlier position using descriptive statistics and literature review. Romania ranks last in the EU on digital skills (28%), AI adoption (5.2%), and childcare coverage (6.5%), with a gender employment gap of 17.4 pp (EU-27: 9.4 pp). The analysis reveals three paradoxes: a relatively high share of women among ICT specialists coexisting with the EU's lowest level of women's basic digital skills; generous parental leave associated with measurable depreciation of digital human capital; and a generation of digital natives that remains digitally under-skilled by European standards. Romania faces one of the most severe labour force contractions in the EU and the continued digital exclusion of highly educated women with caregiving responsibilities constitutes not merely a gender equality deficit but a direct threat to economic sustainability.*

Keywords: *Digital Economy; Gender Gap; Industry 4.0; Remote Work; Digital Skills; Childcare; Romania.*

JEL Classification: *J16; J21; O33; J13*

1. Introduction

Population ageing and declining fertility are placing increasing pressure on labour supply and public finance systems across developed economies (Fallick & Pingle, 2007; Káčerová & Mládek, 2012; Prammer, 2019; Queiroz & Ferreira, 2021; Rentería et al., 2024). At the same time, rapid technological progress is reshaping employment patterns and skill requirements (Novakova, 2020; Yu et al., 2021; Roser, 2023). In this context, the digital economy has emerged as a new economic system, in which technological innovation drives transformation while demographic realities shape who can participate and on what terms (World Economic Forum, 2025).

The new work arrangements are seen, in principle, as valuable for women with caregiving duties, as for persons with disabilities navigating physical barriers to employment, workers in rural or peripheral areas with limited access to employers, and older workers seeking partial retirement pathways. This study focuses on women with caregiving responsibilities for three empirically grounded reasons.

First, women constitute the largest underutilised high-skill workforce in the EU. In Europe, 45% of women in the cohort born 1980–1984 attained tertiary education, compared to 35% of men (Rentería et al., 2024). Yet their employment rate remains consistently lower (54.3% vs. 71.7% in Romania; 65.7% vs. 75.1% in the EU), and the gap is driven primarily by caregiving-related withdrawal from the labour market (EURES, 2024). Failing to include this group in the digital economy represents an economic imperative for the survival and competitiveness of companies in a demographically declining continent.

Second, the mechanism of exclusion displays a measurable gendered structure. The European Institute for Gender Equality (2025) demonstrates that women are twice as likely as men to provide over 35 hours per week of childcare, and that 82% of women perform housework at least four days per week compared to 65% of men. This time asymmetry directly constrains the capacity for digital upskilling, professional development, and labour market participation.

Third, the interaction of care burden with digital transformation creates a unique risk of compounding exclusion. Other groups face barriers to digital access (rural populations lack infrastructure; older workers lack training), but women with young children face a barrier of time which is the most non-fungible resource in the digital economy.

This study employs descriptive statistics to compare Romania with EU peers across key indicators and a structured review of policy reports, institutional datasets, and the specialized literature, combined with an in-depth critical case study of Romania selected on the basis of its extreme values across multiple indicators. This strategy is consistent with Yin's (2018) rationale for critical case selection.

The remainder of the article is structured as follows. Section 2 examines demographic changes as a macro-level driver for redefining the nature of work, with particular attention to Romania's population decline and the economic imperative of increasing women's participation in the workforce. Section 3 presents empirical data on remote work, share of women among ICT specialists, and digital skills disparities with an interpretative discussion on Romania. Section 4 identifies a five-dimensional exclusion mechanism affecting women with caregiving responsibilities in Romania, and examines how emerging forms of digital work, including platform labour and Web 3.0 architectures, compound these barriers. Section 5 concludes with the findings, including three paradoxes specific to Romania's digital transition.

2. Demographic Changes as a Driver of the Changing Nature of Work

The global population is facing a phenomenon of demographic ageing and declining birth rates, which is progressively reducing the size of the active workforce. The total fertility rate has declined from 4.9 children per woman in 1950 to 2.3 in 2020, with projections indicating a further decrease to 1.8 by the year 2100. South Korea currently records the lowest fertility rate in the world, at only 0.72 children per woman (United Nations, 2024). Making full use of the available workforce, particularly women whose participation remains constrained by caregiving responsibilities, is no longer a matter of equity alone but of economic necessity.

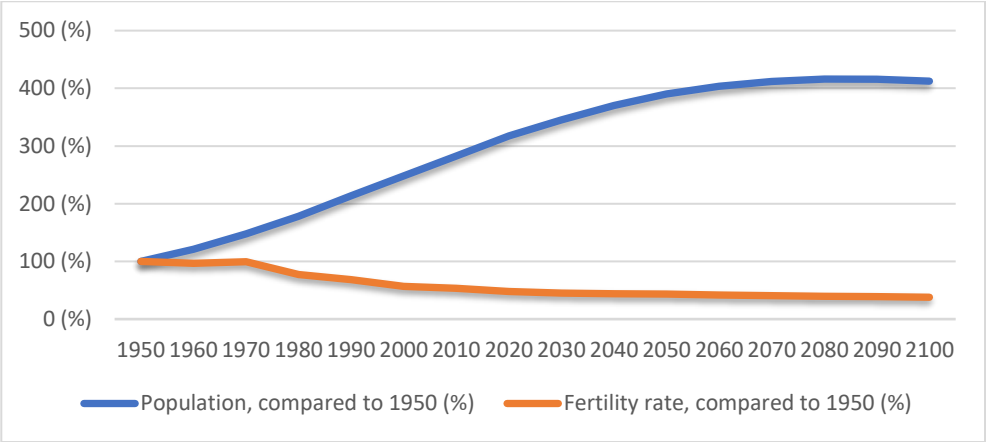


Figure 1: Relative changes in population and fertility rate over time
Source: data from United Nations (2024)

Even though global fertility rates are declining, the world's population is projected to continue growing until approximately 2086, when it is expected to peak at around 10.3 billion before beginning a gradual decline (United Nations, 2024). This continued growth occurs because life expectancy keeps rising, reaching over 79 years for children born after 2020. People live longer even as fewer children are born. The net effect is not population growth in the traditional sense, but a fundamental shift in the age structure: a global ageing of the population. The scale of this shift varies significantly by region. In Japan, nearly 29% of the population is now over the age of 65 (Statistics Bureau of Japan, 2024) whereas the European Union average stands at 21.1% (Eurostat, 2024c). By contrast, Africa's population is projected to more than double by 2100, accounting for most of the global population growth (United Nations, 2024). Figure 2 illustrates these divergent long-term trajectories, showing the distribution of the world's population by region and the projections up to 2100.

For the European labour market, the implication is pronounced: the working-age population (15-64) in the EU is projected to shrink by 57.4 million between 2022 and 2100, from 285.5 million to 228.1 million. This decline will not be distributed evenly: Romania, Bulgaria, Croatia, Greece, and Poland face projected population losses of 20-30% (Eurostat, 2024c). In this context, every segment of the population that remains outside the labour market, whether due to inadequate digital skills, absence of childcare infrastructure, or structural barriers to flexible work, represents an economic loss that demographically declining societies can no longer afford.

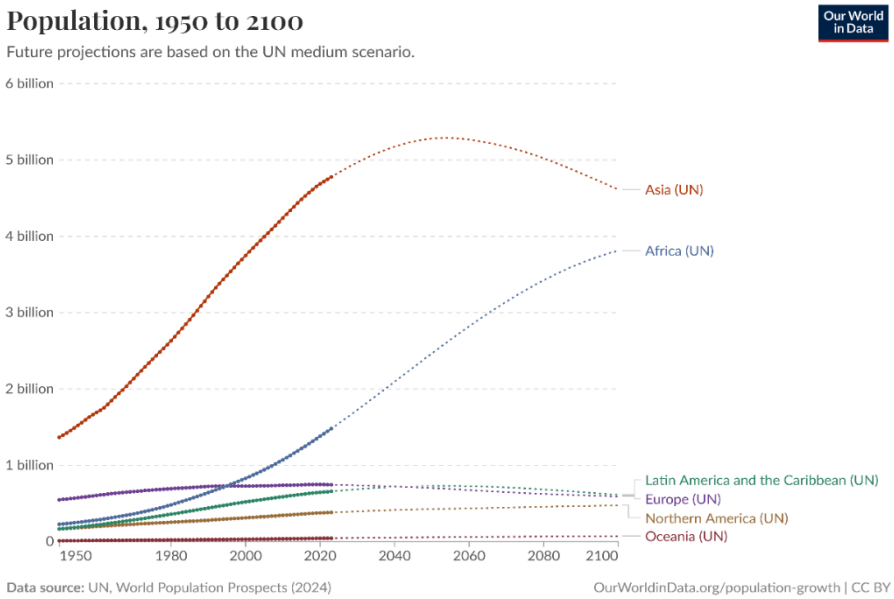


Figure 2: Relative changes in population and fertility rate over time
Source: Our World in Data (2024)

In Romania, the situation is particularly acute. Since 1990, the combined effects of declining birth rates, population ageing, and massive emigration have led to a severe contraction of the labour supply. The country lost approximately 18% of its population between 1990 and 2023, falling from 23.2 million to around 19 million inhabitants (Table 1). This deficit is amplified by a significant exodus of young, working-age citizens toward other states (the brain drain phenomenon). According to the EU Labour Force Survey, Romanian mobile workers numbered 2.1 million in 2022, constituting the single largest group of EU movers at 25% of the total (European Commission, 2023). Unofficial estimates, including those cited by the Ministry of Foreign Affairs, suggest that the actual number of Romanians living abroad may exceed 5 million. Over the past 15 years, this demographic decline has translated into the loss of nearly 20% of the national workforce (Chivu et al., 2020). Looking ahead, projections indicate that the number of employed persons in Romania will register a such significant decline that would fundamentally reshape the country's economic model.
An additional concern is that 72% of Romania's population lacks basic digital skills – the highest deficit in the EU (European Commission, 2024a). Romania is thus confronted with a double vulnerability: a shrinking workforce and a workforce that is, in its majority, unprepared for the digital economy. This combination places extraordinary pressure on the country's economic sustainability and competitiveness.

Table 1: Long Term Evolution of the Romanian Population (1960–2020)

Year	Total	Male	Female	Relative dynamics compared to 1960 (%)		
				Total	Male	Female
1960	18 403 414	8 981 804	9 421 610	100	100	100
1970	20 252 541	9 945 027	10 307 514	110	110.7	109.4
1980	22 201 387	10 953 637	11 247 750	120.6	122	119.4
1990	23 206 720	11 449 147	11 757 573	126.1	127.5	124.8
2000	22 435 205	10 968 854	11 466 351	121.9	122.1	121.7
2010	20 246 798	9 856 669	10 390 129	110	109.7	110.3
2020	19 261 714	9 428 271	9 833 443	104.7	105	104.4

Source: National Institute of Statistics (INS, 2022: 52)

One way of maintaining the same level of economic output is to make the remaining workers more efficient. The transition toward knowledge-based work, accelerated by Industry 4.0, shifts the focus away from physical strength (where gender could previously act as a barrier) toward cognitive skills, creativity, and critical thinking. This shift positions women as ideal candidates for the highly skilled roles that are now among the most competitive positions sought by employers.

The employment data confirms this structural challenge. In 2023, the women's employment rate in Romania stood at 54.3%, compared to 71.7% for men. This translates into a gender employment gap of 17.4 pp, nearly double the EU-27 average of 9.4 pp (EURES, 2024). Notably, Romania's gender employment gap has widened slightly since 2009, making it an outlier in the EU where most countries have narrowed this gap (Robayo-Abril & Rude, 2023). According to the National Institute for Scientific Research in the Field of Work and Social Protection, by 2030 Romania will need over 600,000 people to occupy highly qualified jobs such as IT, legal, or health specialists (EURES, 2024). This represents a demand that cannot be met without significantly increasing women's participation in these sectors.

Table 2: Employment rates by sex – Romania vs EU-27 (2023)

Indicator	Romania	EU-27	Gap (pp)
Employment rate – Men	71.7%	75.1%	−3.4
Employment rate – Women	54.3%	65.7%	−11.4
Gender employment gap	17.4 pp	9.4 pp	+8.0
Youth employment rate	18.7%	35.2%	−16.5

Source: EURES (2024)

In a context where the working-age population is shrinking and the number of effective producers is steadily declining, the importance of integrating women into the labour market, especially in high-skill sectors, is becoming a necessity.

3. Technological transition as a driver for redefining the nature of work

Throughout history, each of the four industrial revolutions has contributed to redefining the nature of work, gradually shifting the emphasis from physical labour to cognitive skills, a process that has facilitated the reduction of gender gaps in the labour market.
Figure 3 provides a schematic representation of the transition across the four industrial revolutions.



Figure 3: Visual Representation of the Four Industrial Revolutions
Source: Own adaptation assisted by Microsoft Copilot's image generator (Microsoft, 2026)

The first and second industrial revolutions (Industry 1.0 and Industry 2.0) radically transformed technology, but not the human experience of work. Mechanization and mass production reshaped industries, yet labour remained largely physical. The Third Industrial Revolution (Industry 3.0), driven by computerization and automation, triggered the expansion of the service sector and office-based work. As automation took over heavy physical tasks, demand shifted toward intellectual and cognitive skills, gradually reducing wage disparities.
Within the Fourth Industrial Revolution (Industry 4.0), an unprecedented fusion is taking place through the convergence of digital, physical, and biological technologies, seen in innovations such as smartwatches, drones that deliver packages, mRNA vaccines, and the 3D printing of tissues or organs using living cells. The employment patterns are reshaped, affecting jobs held by both low skilled workers and highly qualified professionals. This technological development is offering, at least in theory, equal access to professional opportunities regardless of gender, since tasks now depend on technical skills and knowledge rather than biological capacity.
However, this theoretical neutrality masks the fact that access to these opportunities is not evenly distributed. The digital economy rewards those who can continuously update their skills, adapt to rapid technological change, and invest time in learning. When women face disproportionate caregiving responsibilities, limited time for reskilling, or structural barriers to digital education, the promise of equal opportunity becomes difficult to realize.

Data across three dimensions highlights the availability of remote work, which determines women's ability to remain employed during caregiving; the share of women in ICT, which indicates whether high-skill digital jobs are accessible beyond a narrow elite; and the distribution of basic digital skills, which shows how well the population is equipped to participate in the digital economy. The following subsections examine each dimension in turn, positioning Romania within the EU-27 landscape.

3.1. Remote work in Romania: the flexibility deficit

In 2023, only 3.3% of employed persons in Romania worked from home (either usually or sometimes), compared to an EU-27 average of 22.2% – a gap of nearly 19 pp (Eurostat, 2024a).

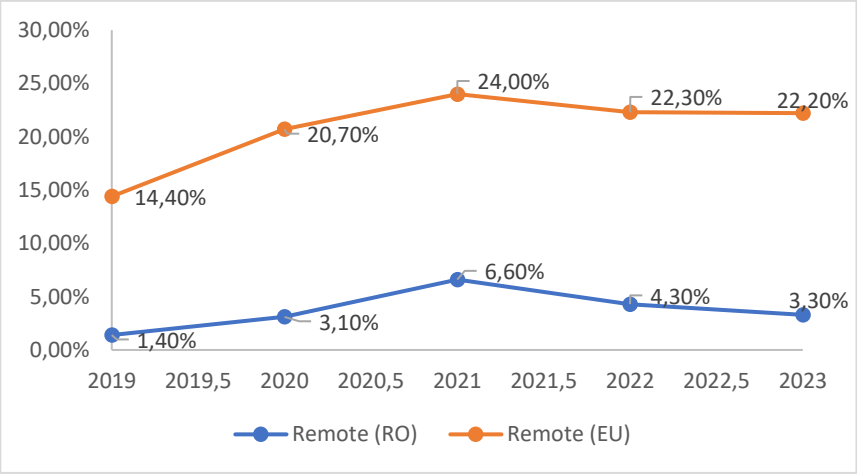


Figure 4: Trend in remote work in Romania compared to the EU
Source: data from Eurostat (2024a)

Access to remote work is essential for maintaining women's employment continuity during caregiving. In the period before and after Covid-19 pandemic, the temporal pattern is revealing. While the pandemic temporarily pushed Romania's remote work rate to 6.6% in 2021, this effect was almost entirely reversed by 2023. The pandemic demonstrated that digital transition alone is insufficient for achieving equality of any kind, and particularly gender equality. Globally, lockdowns acted as an external shock that temporarily reconfigured household life: both parents at home, children in online schooling, and domestic and professional roles merged into a single space. Although digital infrastructure enabled this shift, underlying norms and gendered expectations did not change. The findings show that instead of men durably increasing their share of domestic work, women typically used "flexible" arrangements to compress professional tasks around existing household responsibilities and childcare (Dunatchik et al., 2021; Chung et al., 2021). This finding is further corroborated by Hübener et al. (2024), who documented that egalitarian gender role attitudes in Germany declined significantly during the 2021

lockdown but recovered to pre-pandemic levels by early 2022 once access to daycare and schools was restored.
The EU average stabilised at a significantly higher post-pandemic level (22.2% vs. 14.4% pre-pandemic). The Netherlands (51.9%), demonstrates that where remote work is structurally normalised, the gender employment gap remains modest (8.5 pp – less than half of Romania's 17.4 pp). In contrast, Romania and Bulgaria (~3.2%) share the lowest remote work rates in the EU, effectively eliminating the primary mechanism through which women in Western European economies reconcile caregiving with professional continuity (Eurostat, 2024a).

3.2. Women in ICT: the Romanian paradox

Romania presents a paradox in the ICT gender landscape. With 27.3% of ICT specialists being women, Romania ranks second in the EU, just below Estonia (27.6%) and ahead of Bulgaria (27.0%) and well above the EU-27 average of 19.4% (Eurostat, 2024b).

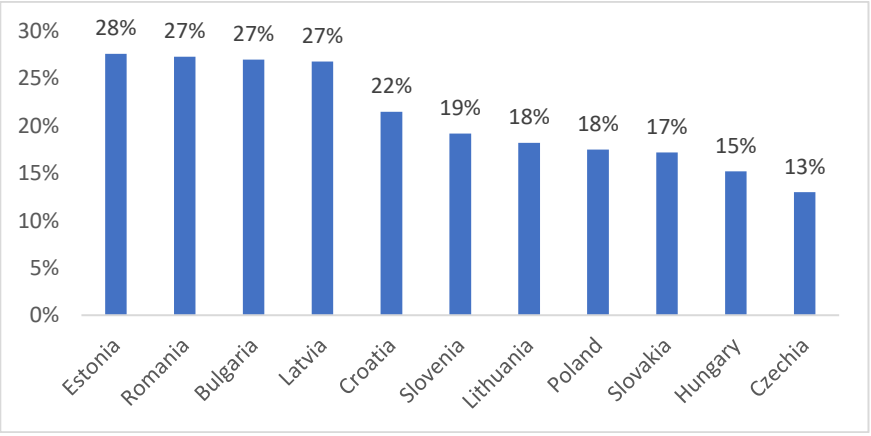


Figure 5: Share of women among ICT specialists in Central and Eastern Europe, 2024
Source: data from European Commission (2025)

However, this positive figure conceals a structural weakness. Romania's ICT sector is among the smallest in the EU as a percentage of total employment (2.6% vs. 4.8% EU average), meaning the 27% of women are concentrated in an exceptionally narrow segment of the economy.
The women who reach ICT careers in Romania represent a highly selected group: typically urban, university-educated, without young children or with access to informal care through extended family. Their statistical presence does not reflect the reality of the average Romanian woman, for whom digital skills remain the lowest in the EU.

3.3. Digital skills: Romania's compounding disadvantage

The most consequential dimension of Romania's position lies not in ICT employment but in the basic digital competencies of the general women’s

population. According to DESI 2024 data, only 26.5% of Romanian women aged 16-74 possess at least basic digital skills, compared to 55% for the EU women's average – a gap of 28.5 pp (CRPE, 2025; European Commission, 2024a).

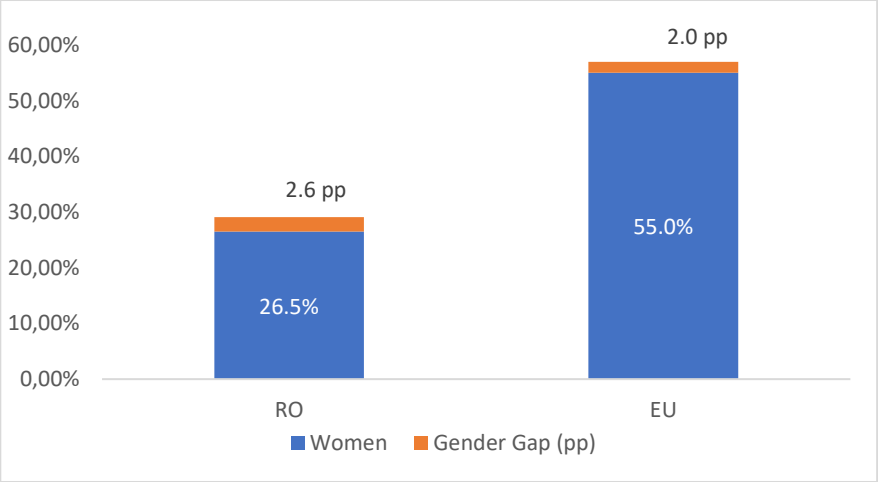


Figure 6: Gender Disparity in Digital Competencies: Romania vs. European Union
Source: data from European Commission (2025)

The internal gender gap within Romania (2.6 pp) is modest, but this revels an important aspect about the general population digital skills: the deficit is structural, not gendered at the national level. Both sexes are so far below EU norms that the gap between Romanian women and European women (28.5 pp) dwarfs the gap between Romanian women and Romanian men (2.6 pp). It is gendered also at the household level, where caregiving responsibilities consume the time that might otherwise be allocated to digital upskilling.

As Silion (2024) demonstrates that the digitalisation of household tasks often reproduces, rather than dissolves, existing hierarchies. While men may take on "digital domestic tasks" (such as the procurement, installation, configuration, and maintenance of smart home equipment) these are discretionary, technical, and framed as personal interest or expertise rather than as labour (Kennedy et al., 2015; Aagaard, 2023). Meanwhile, women continue to perform the routine operational work such as cleaning, laundry or dishwashing. This pattern suggests that technology does not inherently redistribute domestic labour. Instead, it re-codes traditional roles into "expert" versus "maintenance" categories, reinforcing existing power dynamics (Silion, 2024; Strengers & Nicholls, 2018).

Romania ranks last in the EU in terms of basic digital skills in 2023. The aggregate figure of 28% conceals substantial disparities when disaggregated (Figure 7).

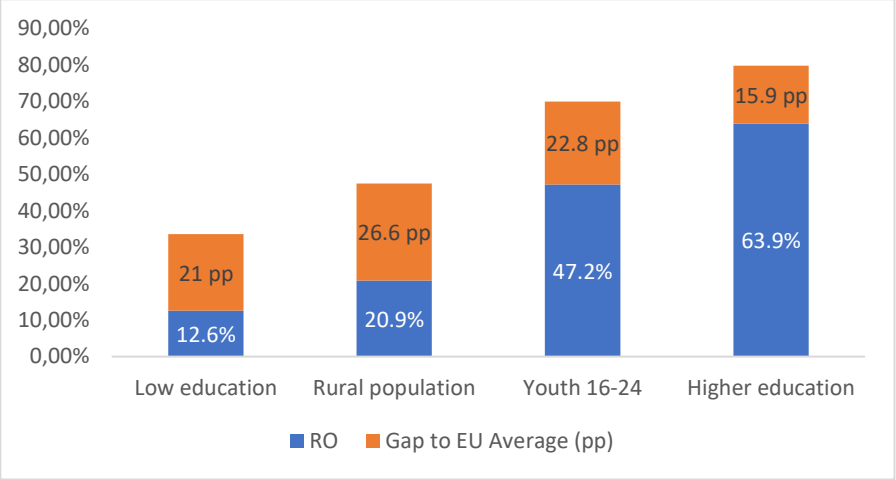


Figure 6: Digital Skills in Romania by Subgroups, compared to EU averages
Source: data from European Commission (2025)

Only 12.6% of Romanians with low formal education possess basic digital skills, compared to 63.9% of those with higher education – an internal gap of 51.3 pp. In Finland, the equivalent gap is merely 14 pp, and in Estonia 12 pp (Eurostat, 2023). In Romania, education functions as a digital segregation mechanism far more powerfully than in Nordic countries.
The rural deficit is significant: only 20.9% digital skills proficiency in rural areas and nearly half of Romania's population living rurally. Furthermore, rural residence, low education, and caregiving create a zone of near-total digital exclusion. Even among digital natives (16-24), Romania's rate (47.2%) falls 23 pp below the EU average of 70%. This proves that the problem will not self-resolve through generational replacement alone. Romania shows improvements to approximately 32% (a four-pp gain in two years) but still occupying last place in the EU (European Commission, 2025). Meanwhile, four countries (Netherlands 84%, Ireland 83%, Denmark and Finland both 81%) have already reached the EU's 2030 target of 80%. Romania would need an annual growth rate of +9.6 pp/year to achieve this target, approximately 10 times its current pace.

4. Implications for Romania: the five-dimensional exclusion mechanism
Romania's position within the digital economy ecosystem is shaped by a unique combination of structural deficits that, taken together, create what this study terms a five-dimensional mechanism of structural exclusion affecting women with caregiving responsibilities.
The first dimension is the digital skills deficit. As demonstrated in Section 3, Romania occupies last place in the EU at 28% basic digital skills (2023), rising to 32% in 2025 but still at the bottom. Compared to the EU average of 55.6%, Romania has a gap of 27.9 pp. Romania's annual change was −0.1 pp (a slight decline from 27.8% in 2022 to 27.7% in 2023), while the EU average grew at +1.6 pp per year (European Commission, 2024a).
The second dimension is the remote work desert. Romania constitutes what may be characterised as a remote work desert where the preconditions for participation

in the remote labour market are structurally absent. Romania's remote work rate is 3.3% (vs. 22% EU average), ranked last in the EU at basic digital skills, and 45% of the population lives in rural areas where just 21% are digitally literate. Furthermore, fibre-optic coverage, coworking infrastructure, and digital public services remain minimal across vast areas of the country. These conditions create a triple lock of skill poverty, structural infeasibility of remote work, and geographic exclusion that the pandemic did not significantly diminish, and which post-pandemic dynamics continue to deepen.

The third dimension is the childcare void. Formal childcare for children 0-3 years covers only 6.5% of children (for 30+ hours/week) which is among the lowest in the EU and far below the revised Barcelona 2030 target of 45% (Eurostat, 2024d). The World Bank study on Romania by Robayo-Abril and Rude (2025) demonstrated that even a modest childcare reform (compulsory half-day classes for six-year-olds) increased maternal employment by 2.6-4.1 pp, with stronger effects in rural areas. This finding confirms that supply-side intervention on childcare directly alleviates the constraints that keep women out of the labour market.

The fourth dimension is the time inequality trap. Romania's Gender Equality Index score, 57.5, last in the EU (EIGE, 2024a) reflects persistent inequality in the distribution of care and housework. Over 99% of parental leave beneficiaries in Romania are women (Răvaș, 2025). The European Institute for Gender Equality CARE Survey 2024, (EIGE, 2025) reports that across the EU, women are twice as likely as men to provide over 35 hours per week of childcare, and that 82% of women perform housework at least four days per week compared to 65% of men. With Romania's standard parental leave lasting up to 24 months at 85% of net salary, each caregiving episode risks producing a substantial erosion of digital human capital. Research on the depreciation of technology-adjacent skills (Deming & Noray, 2020) demonstrates that competences in rapidly evolving fields lose relevance at a significant pace — and that even a relatively brief withdrawal from the labour market, such as the two-year standard parental leave in Romania, can render a considerable portion of a woman's prior digital expertise functionally obsolete. The longer the absence from professional environments where skills are practiced, updated, and socially reinforced, the deeper the gap between the returning worker's competence profile and the demands of a labour market that has continued to evolve in her absence. In this sense, parental leave — while essential as a social protection mechanism — operates paradoxically as a structural driver of professional deskilling when it is not accompanied by opportunities for continued learning and gradual reintegration.

Romania is caught in a “demographic trap” that compounds its digital vulnerability: with a fertility rate of 1.7 in 2022 (FRED, 2024) each new generation enters the labour market roughly 19% smaller than the one before, while an estimated five million working-age Romanians already live abroad (Całus, 2025; FRED, 2024). At the same time, the accelerating pace of AI innovation, with major technology cycles now compressing to approximately two years and digital skill half-lives shrinking accordingly (World Economic Forum, 2025; Walter & Lee, 2022), means that the competences Romania fails to build today will be obsolete before the next generation is large enough to acquire them.

The time inequality trap is further compounded by the structural characteristics of emerging forms of digital work. While the platform economy and gig work offer, in principle, flexibility and autonomy, workers in these arrangements typically lack

access to paid leave, medical insurance, and other social protections that are associated exclusively with formal, long-term employment. For women with caregiving responsibilities, this means that the forms of work most compatible with their time constraints are also those that offer the least institutional support, creating a flexibility paradox in which apparent autonomy masks deeper precarity.
The fifth dimension is the AI acceleration asymmetry. AI adoption by Romanian enterprises stands at 5.2%, which is the lowest in the EU, compared to 42% in Denmark and 20% for the EU average (Eurostat, 2025). Yet, the World Economic Forum, Future of Jobs Report (2025) projects that 86% of employers expect AI to transform their business by 2030, and that 22% of current jobs will be fundamentally restructured. The asymmetry between Romania's slow digital adoption and the global acceleration of AI creates an expanding “scissors effect” that disproportionately affects those whose care-related career interruptions have left them furthest from the digital frontier.
This asymmetry extends beyond AI narrowly defined. The transition to Web 3.0 and decentralised finance (DeFi) introduces economic models that, while promising transparency and autonomy, require advanced technical literacy, including familiarity with digital wallets, blockchain protocols, and cryptocurrency systems. If these emerging architectures are not designed with inclusive access in mind, they risk repackaging established forms of exclusion into digital formats, adding a new layer of technical barriers that disproportionately affect those already furthest from the digital frontier (women with low digital skills and intensive caregiving loads). The broader implication is that each successive wave of technological innovation does not reset the playing field but rather raises the entry threshold, making the cost of prior exclusion cumulative rather than static.
These five dimensions are not independent. They form a cascade: the digital skills deficit means women cannot access remote work even where it exists; the remote work desert forces full labour market withdrawal during caregiving; the childcare void prolongs this withdrawal; the time inequality trap concentrates all care burden on women, deepening human capital depreciation; and the AI acceleration asymmetry ensures that the skills lost during absence become obsolete rather than merely dormant.
The most vulnerable profile is a woman in rural Romania with low formal education, a child under three, without access to formal childcare, and lacking basic digital skills. Her position stands in stark contrast to that of women in more supportive welfare and labour market environments, where childcare is widely available, digital competence is the norm, and access to flexible or remote work is routine, such as a comparable woman in the Netherlands, where childcare coverage exceeds 60% and the gender employment gap is less than half of Romania's (Section 3). The distance between these two profiles is not a gap; it is a structural social distance that is difficult to bridge.
The implication is direct: Romania does not face a single, isolated policy problem. It seems to face a self-sustaining system of exclusion in which each dimension reinforces the others, and in which piecemeal interventions addressing only one barrier, digital training without childcare, or childcare without digital skills, are unlikely to break the cycle.
To capture the multidimensional nature of these barriers, this study proposes extending the analysis to a composite indicator integrating these five dimensions that enables or constrains women's digital economy participation.

This study is subject to several limitations, each of which opens a corresponding avenue for future investigation. First, the analysis is descriptive and comparative rather than causal. The study identifies associations between structural indicators (digital skills, remote work access, childcare coverage, time use, AI adoption) and women's labour market exclusion but does not establish causal relationships through econometric modelling. The five-dimensional framework is proposed as a diagnostic architecture, not as a tested causal model.
Second, the analysis draws exclusively on institutional data and published literature. It does not include qualitative data such as interviews, focus groups, or time-use diaries that would capture how women with caregiving responsibilities experience, navigate, and potentially resist the barriers identified here. Future research should therefore extend the empirical base by incorporating qualitative and mixed methods approaches.

5. Conclusions

Two macro-level drivers, demographic decline and technological acceleration, are simultaneously redefining the nature of work. This article has traced the transmission mechanism from these structural drivers to their most acute micro-level consequence: the progressive exclusion of women with caregiving responsibilities from the digital economy. Romania serves as a critical case precisely because it occupies extreme positions on every relevant dimension: last in the EU on basic digital skills (28%), last on AI adoption by enterprises (5.2%), last on the Gender Equality Index (57.5), and near-last on formal childcare coverage for children 0-3 (6.5%) and remote work access (3.3%).
The analysis has identified a five-dimensional exclusion mechanism, the digital skills deficit, the remote work desert, the childcare void, the time inequality trap, and the AI acceleration asymmetry, in which each barrier reinforces the others, producing a self-sustaining system of structural marginalisation. Three paradoxes specific to Romania's digital transition sharpen this diagnosis: high women's ICT representation coexists with the EU's lowest women's digital skills; generous parental leave generates measurable depreciation of digital human capital; and a generation of digital natives remains, by European standards, digitally under-skilled.
The principal contribution of this study is the five-dimensional diagnostic framework itself, which captures the mutual reinforcement of individual barriers to women's digital participation.
In a country projected to lose nearly 40% of its employed workforce by 2070, the continued exclusion of highly educated women from the digital economy is not a gender issue alone, it is a question of economic survival.

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THE INFLUENCE OF AI-GENERATED FAKE NEWS ON MILITARY COMMUNICATION: A CASE STUDY OF THE *TITU FIREFIGHTERS' DETACHMENT*

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Abstract: *The rapid proliferation of artificial intelligence (AI) technologies has significantly transformed the information ecosystem, enabling the large-scale production and dissemination of highly convincing synthetic content. Within the context of emergency response institutions, this phenomenon raises critical concerns regarding the integrity of communication, operational efficiency, and public trust. This study examines the influence of AI-generated fake news on military-style communication structures, focusing on a case study of the firefighters' detachment in Titu, Romania. The research is based on a structured questionnaire administered to operational and administrative personnel within the unit, aiming to assess their perceptions, experiences, and level of preparedness in relation to digital disinformation. The study explores key dimensions such as awareness of fake news, perceived risks associated with AI-generated misinformation, the ability to distinguish between authentic and fabricated information, and the perceived effectiveness of institutional communication mechanisms in countering false narratives. Preliminary findings indicate a high level of concern among respondents regarding the growing difficulty of differentiating between real and AI-generated information, as well as the potential of fake news to undermine public confidence and complicate crisis management. The results also highlight a perceived need for enhanced training programmes, improved communication strategies, and more rapid and transparent institutional responses to misinformation. Furthermore, social media platforms are identified as primary vectors for the dissemination of false information, amplifying the challenges faced by emergency services during critical interventions. The study contributes to the broader academic discourse on information security and crisis communication by providing empirical insights from a frontline emergency response unit. It underscores the necessity of integrating digital literacy and disinformation resilience into professional training frameworks, as well as strengthening inter-institutional coordination in combating AI-driven fake news. Ultimately, the research emphasises that maintaining credible, timely, and authoritative communication is essential for preserving operational effectiveness and public trust in emergency response systems.*

Keywords: *AI-generated Fake News; Emergency Communication; Disinformation; Firefighters; Crisis Management*

JEL Classification: *D80; D83; H56; L86*

1. Introduction

The accelerated development of artificial intelligence (AI) technologies has profoundly reshaped the contemporary information environment, facilitating not only the rapid dissemination of data but also the large-scale generation of synthetic and potentially misleading content. Among the most concerning manifestations of this transformation is the emergence of AI-generated fake news, which possesses an unprecedented capacity to imitate credible sources, distort reality, and influence public perception. Within critical sectors such as emergency response and public safety, the implications of such phenomena extend beyond informational integrity, directly affecting operational effectiveness and institutional trust.

Emergency intervention structures, including firefighter units, operate within a highly dynamic and time-sensitive communication framework, where the accuracy, clarity, and timeliness of information are essential. In this context, the infiltration of false or manipulated information, particularly when amplified through digital platforms can generate confusion among the population, hinder coordinated responses, and compromise decision-making processes. Furthermore, the increasing sophistication of AI-generated content complicates the ability of both professionals and the public to distinguish between authentic and fabricated information, thereby intensifying the risks associated with misinformation.

This study focuses on analysing the influence of AI-generated fake news on military-style communication within emergency services, using the firefighters' detachment in Titu as a case study. The research is grounded in empirical data collected through a structured questionnaire administered to personnel within the unit, aiming to capture their perceptions, experiences, and level of preparedness in addressing digital disinformation. Particular attention is given to issues such as awareness of fake news, perceived vulnerabilities in communication processes, the effectiveness of institutional responses, and the necessity for specialised training in identifying and countering misleading information.

The selection of this research topic is closely linked to both the contemporary informational context and the author's direct professional experience within the field of emergency response. As commander of the firefighters' detachment in Titu, I am actively involved in coordinating operational activities and managing communication processes in high-pressure, time-sensitive situations. This position provides not only practical insight into the dynamics of intervention but also a clear perspective on the emerging challenges posed by the digital information environment. The motivation behind this study therefore stems from a dual perspective: on the one hand, the need to better understand the impact of AI-generated disinformation on institutional communication, and on the other, the desire to contribute to improving the resilience of emergency services against such threats.

Furthermore, the topic is particularly relevant in the current socio-technological context, where the boundaries between authentic and fabricated information are becoming increasingly blurred. For emergency response institutions, maintaining credibility, transparency, and efficiency in communication is essential for ensuring public trust and effective crisis management. Consequently, this research is motivated by both professional responsibility and academic interest, aiming to bridge the gap between theoretical analysis and practical application in the field of emergency communication.

Moreover, the relevance of this research lies in its contribution to understanding how emerging technological risks intersect with organisational communication in high-stakes environments. By examining the perceptions of frontline responders, the study seeks to identify gaps in current practices and propose directions for enhancing resilience against AI-driven disinformation. Ultimately, ensuring reliable communication in emergency situations is not only a matter of operational efficiency but also a fundamental condition for maintaining public confidence in institutions responsible for safety and crisis management.

2. Literature Review

The phenomenon of fake news has been extensively analysed in recent years, particularly in the context of rapid technological advancement and the expansion of digital communication platforms. Scholars have emphasised that fake news is not a novel occurrence; however, its scale, speed of dissemination, and level of sophistication have significantly increased due to the development of artificial intelligence technologies. According to Allcott Hunt and Matthew Gentzkow, fake news can be defined as intentionally false information designed to mislead readers, often mimicking the format of legitimate news sources “to exploit cognitive biases and attract attention” (Allcott & Gentzkow, 2017, p. 213).

The integration of AI into content generation has further complicated this landscape. Advanced models are now capable of producing highly realistic text, images, and videos, which significantly reduces the ability of individuals to distinguish between authentic and fabricated information. Chesney Robert and Danielle Citron argue that deepfakes and AI-generated media represent a new category of informational threat, noting that such technologies “undermine trust in information ecosystems and create plausible deniability for malicious actors” (Chesney & Citron, 2019, p. 1763).

Within the field of crisis communication, the impact of misinformation has been identified as particularly significant. Effective communication during emergencies relies on accuracy, timeliness, and credibility. According to Timothy Coombs, misinformation can disrupt these core principles, as “conflicting or false messages during crises can intensify uncertainty and reduce public compliance with official guidance” (Coombs, 2015, p. 142). This perspective is particularly relevant for emergency services, where operational success often depends on the public’s ability to respond appropriately to official information.

Moreover, the role of social media as a primary vector for the dissemination of fake news has been widely documented. Sinan Aral and colleagues demonstrate that false information spreads more rapidly and widely than truthful content, largely due to its novelty and emotional appeal, stating that “falsehood diffuses significantly farther, faster, deeper, and more broadly than the truth” (Vosoughi, Roy & Aral, 2018, p. 1146). This dynamic poses a substantial risk in emergency contexts, where rapid information flows can either support or hinder response efforts.

In the specific context of public institutions and emergency response organisations, trust plays a central role. Niklas Luhmann conceptualises trust as a mechanism for reducing social complexity, arguing that “without trust, coordinated action becomes significantly more difficult” (Luhmann, 1979, p. 25). When fake news targets institutions such as fire services, it can erode this trust, leading to scepticism, reduced cooperation, and challenges in managing crisis situations effectively.

Recent studies have also highlighted the importance of digital literacy and institutional preparedness in countering misinformation. Claire Wardle emphasises that combating fake news requires both individual competencies and organisational strategies, noting that “understanding the mechanisms of information disorder is essential for developing effective responses” (Wardle & Derakhshan, 2017, p. 7). Training personnel to recognise and respond to disinformation is therefore increasingly viewed as a necessary component of modern emergency management.

As we can observe, the existing literature underscores the growing complexity of the informational environment shaped by AI technologies and highlights the significant risks posed by fake news, particularly in high-stakes domains such as emergency response. However, there remains a need for empirical studies focused on specific operational units, such as firefighter detachments, to better understand how these challenges manifest in practice and how they can be effectively addressed.

3. Methodology

This methodology of research employs a quantitative research design, based on the use of a structured questionnaire aimed at assessing the perceptions, experiences, and level of awareness of personnel regarding AI-generated fake news and its impact on emergency communication. The methodological approach was selected in order to obtain empirical data directly from practitioners operating within a real intervention environment, thus ensuring the practical relevance and applicability of the findings.

The research instrument consisted of a questionnaire comprising 24 items, designed to capture multiple dimensions of the analysed phenomenon. The items included both closed-ended questions (using Likert-scale responses and multiple-choice options) and open-ended questions, allowing respondents to elaborate on their experiences and opinions. The questionnaire was structured around several key themes: professional background (function and seniority), level of exposure to training on disinformation, perception of risks associated with AI-generated fake news, ability to identify false information, sources and frequency of encountered misinformation, and evaluation of institutional communication and response mechanisms. Additionally, several items focused on identifying perceived vulnerabilities, risks, and potential measures for improving resilience against disinformation within emergency services. The questionnaire is available at https://forms.gle/vRhG6gXy1cCQR6FXA .

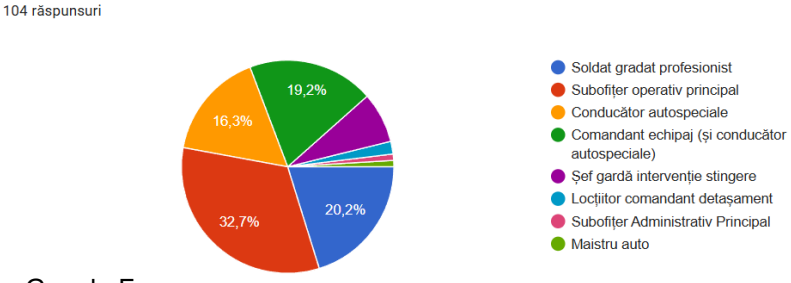
The target population consisted of personnel from the Firefighters’ Detachment in Titu, ensuring a homogeneous sample in terms of organisational context and operational responsibilities. A total of 104 respondents participated in the study, representing both operational and administrative staff. This sample size provides a relevant basis for identifying trends and patterns in perceptions related to fake news and its impact on professional activity. Data collection was conducted through an online survey, using the Google Forms platform. This method was chosen due to its accessibility, efficiency, and ability to facilitate anonymous participation, thereby encouraging honest and unbiased responses. The questionnaire was distributed internally within the unit, and participation was voluntary. The collected data were subsequently analysed using descriptive statistical methods, focusing on frequency distributions, percentages, and comparative interpretations of responses.

Qualitative answers obtained from open-ended questions were analysed through thematic categorisation, allowing for the identification of recurring ideas and relevant insights. Overall, the chosen methodology ensures a balanced approach, combining quantitative measurement with qualitative interpretation, and provides a solid empirical foundation for examining the influence of AI-generated fake news on communication within emergency response structures.

4. Results and Discussion

From the perspective of occupational roles, the respondents represent a diverse range of professional categories, which enhances the robustness of the analysis. The largest group is composed of senior operational non-commissioned officers (32.7%), followed by professional enlisted personnel (soldiers and corporals) (20.2%), crew commanders and vehicle operators (19.2%), and vehicle operators (16.3%). Smaller proportions of the sample include respondents occupying other operational and administrative roles, such as fire intervention shift leaders, deputy detachment commanders, administrative non-commissioned officers, and technical personnel (auto mechanics). This distribution indicates that the collected perspectives are not limited to a single hierarchical level but rather reflect the views of a heterogeneous professional body with varied responsibilities in both intervention and support activities (view *Figure 1).*

Figure 1: Position held within the detachment



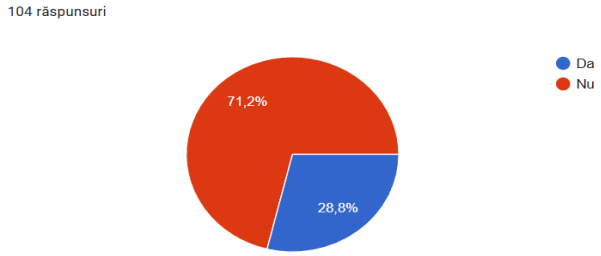
Source: Google Forms

In terms of length of service, the majority of respondents fall within the 10–20 years of experience category (59.6%), suggesting a high degree of professional maturity and prolonged exposure to the operational realities of emergency response. Additionally, 23.1% of respondents have less than 5 years of experience, 10.6% have over 20 years, and 6.7% fall within the 5–10 years interval. This distribution is particularly relevant for the interpretation of results, as it indicates that the perceptions expressed are largely shaped by personnel with substantial field experience.

A particularly significant aspect in relation to the research topic is participation in training or courses on disinformation / fake news. The data reveal that only 28.8% of respondents have participated in such training, while a substantial majority of 71.2% reported no prior involvement in this type of professional development. This finding is noteworthy, as it highlights a gap in institutional training in an area that is becoming increasingly critical for emergency response organisations. At the same time, it provides an explanatory framework for the strong emphasis placed by

respondents, in subsequent sections, on the need for systematic training in identifying and countering digital misinformation (view *Figure 2*).

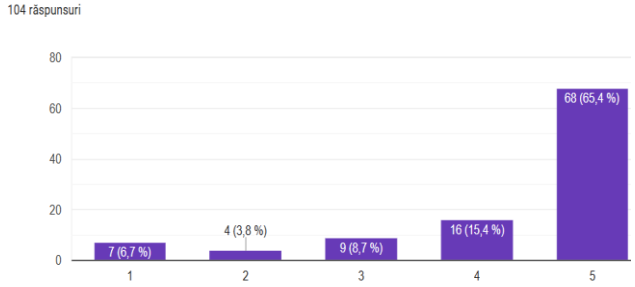
Figure 2: Participation in courses or training on disinformation / fake news



Source: Google Forms

The empirical results broadly confirm the theoretical assumptions identified in the literature review, namely that AI-generated fake news increases informational uncertainty, accelerates the circulation of false narratives, and may weaken institutional credibility in crisis contexts. As Wardle and Derakhshan argue, the contemporary information environment is marked by a complex form of "information disorder" that requires both institutional and individual resilience (Wardle & Derakhshan, 2017, p. 7). In the specific case of the Titu Firefighters' Detachment, the questionnaire data indicate that respondents perceive this phenomenon not as a hypothetical threat, but as a concrete operational and communicational challenge. A first significant result concerns the perception of risk associated with AI-generated fake news. For Item 4, 65.4% of respondents selected the highest agreement category, while a further 15.4% selected the next highest category. Thus, more than four-fifths of the sample regarded AI-generated fake news as a real risk for intervention institutions (view *Figure 3*). This result is fully consistent with the literature on synthetic media and deepfakes, which emphasises that advanced AI systems can generate highly persuasive content capable of undermining trust, distorting events, and creating operational vulnerabilities. Chesney and Citron warn that deepfakes pose serious risks for "privacy, democracy, and national security" (Chesney & Citron, 2019, p. 1763), and the present findings suggest that emergency institutions should also be added to this area of concern.

Figure 3: AI-generated fake news represents a real risk for emergency response institutions



Source: Google Forms

The responses to Item 5 reinforce this interpretation. A combined 66.3% of participants selected the upper two categories when asked whether it is becoming increasingly difficult to distinguish between real information and AI-generated content, while 24% chose the middle category. This indicates not only awareness of the problem, but also recognition of a deteriorating epistemic environment. The result directly reflects the argument advanced by Vosoughi, Roy and Aral that false information spreads more efficiently than truthful information and benefits from novelty, emotional salience, and platform dynamics. Their conclusion that "falsehood diffused significantly farther, faster, deeper, and more broadly than the truth" (Vosoughi, Roy & Aral, 2018, p. 1146) helps explain why operational personnel perceive growing difficulty in verifying digital content under conditions of urgency.

This perception of informational ambiguity is especially important in emergency communication. In intervention settings, decisions must often be taken rapidly, and trust in the accuracy of available information becomes a functional necessity. In Luhmann's terms, trust is "a mechanism for the reduction of social complexity" (Luhmann, 1979, p. 25). When information can no longer be assessed quickly and reliably, complexity increases, and both institutional action and public response may become less coordinated. The answers offered by the respondents indicate precisely this fear: that AI-generated fake news introduces an additional layer of uncertainty into an already highly demanding operational environment.

The questionnaire also shows a strong belief that fake news has consequences beyond the internal informational environment of the institution. Item 6 indicates that respondents largely consider fake news capable of influencing public perception of firefighters' activity. Although the transcription of this item contains some formatting irregularities, the dominant tendency is clearly one of high agreement. This result is corroborated by the open-ended responses, where participants repeatedly referred to "image", "credibility", "public perception", and "loss of trust". Such answers are theoretically grounded in the work of Allcott and Gentzkow, who describe fake news as intentionally false content designed to resemble legitimate news forms and exploit audience vulnerabilities (Allcott & Gentzkow, 2017, p. 213). In the case of emergency services, the danger is particularly acute because reputation is not merely symbolic; it conditions compliance, cooperation, and legitimacy in crisis situations.

The operational implications are even more visible in Items 10 and 12. For Item 10, 51% of respondents selected the highest category and a further 19.2% selected the next highest, indicating that over 70% believe false information can create confusion among the population during interventions. Similarly, for Item 12, 49% selected the highest category and 25% the next highest, meaning that nearly three-quarters of respondents consider disinformation capable of making crisis management more difficult. These results are strongly aligned with crisis-communication theory, which stresses that uncertainty and contradictory messages reduce the effectiveness of institutional response and increase public anxiety. In practical terms, the qualitative data show how respondents translate this general risk into concrete operational consequences: panic, unnecessary calls to 112, delayed access to intervention sites, hostile reactions from citizens, false alarms, resource wastage, and distorted judgements regarding response times.

The answers to Item 21 are especially relevant in this respect. Respondents most frequently identified panic among the population, the erosion of trust in firefighters,

reputational damage to the institution, false alarms, unnecessary mobilisation of resources, delayed interventions, and even verbal or physical aggression towards personnel. These concerns reflect a clear understanding that fake news does not remain confined to the symbolic sphere; rather, it can transform into behavioural effects that directly hinder operational efficiency. Several respondents explicitly mentioned recurring online accusations that firefighters arrive late or travel "without water in the tank", demonstrating that misinformation often targets visible aspects of intervention and seeks to simplify complex operational realities into emotionally charged accusations. In this sense, the findings confirm that fake news functions not only as disinformation, but also as reputational sabotage.

Another important set of results concerns the sources from which false information is believed to emerge. The answers to Item 8 show a very clear concentration around social media platforms. A frequency count of the open-ended responses indicates that TikTok was mentioned 85 times and Facebook 67 times, followed by online press (39 mentions), television (34), private groups (11), and WhatsApp (9). This distribution is analytically significant. It shows that respondents perceive the principal vectors of misinformation not in traditional official channels, but in fast-moving, socially amplified digital environments. This is entirely consistent with the literature, which identifies social media as the ecosystem in which fake news gains speed, reach, and visibility. The prominence of TikTok is especially noteworthy, as it suggests that short-form video platforms are viewed as major carriers of simplified or manipulated narratives about emergency interventions.

Table 1: Main Sources of False Information Regarding Emergency Situations

Source of misinformation	Frequency (mentions)	Percentage (%)
TikTok	85	81.7%
Facebook	67	64.4%
Online press	39	37.5%
Television	34	32.7%
Private groups	11	10.6%
WhatsApp	9	8.7%

Source: Google Forms

The answers to Item 9 further strengthen this interpretation. Of the 104 respondents, 50 stated that they had encountered false information about firefighters' interventions online "sometimes", 36 answered "rarely", 15 "frequently", and only 3 "never". In other words, 97.1% of respondents had encountered such content at least occasionally. This is an extremely important empirical result, because it indicates that fake news is not perceived merely through abstract media narratives or academic discourse; it is encountered directly by personnel working in the field. The case study therefore offers evidence of experiential rather than merely theoretical awareness.

With regard to institutional preparedness, the findings reveal both confidence and concern. On the one hand, responses to Item 17 suggest a relatively strong self-assessment of individual ability to identify AI-generated fake content: 54 respondents rated their capacity as "good", 42 as "very good", and only 8 as "average". This indicates that personnel generally trust their own judgement. On the other hand, this individual confidence does not eliminate the perceived need for

structured training. Item 7 shows a strong orientation towards the view that operational staff should be trained to identify false digital information, while the answers to Item 18 repeatedly classify such training as “important” or “very important”. This apparent tension is analytically meaningful: respondents believe they possess a reasonable baseline capacity but also recognise that the sophistication of AI-generated content is increasing and that institutional training is necessary to maintain readiness. This conclusion is fully compatible with Wardle and Derakhshan’s argument that the response to information disorder must combine individual literacy with organisational strategy (Wardle & Derakhshan, 2017, p. 7).

The results concerning official communication are more nuanced. For Item 13, which asked whether the institution’s official communication process is sufficiently rapid to combat false information, responses were distributed more evenly: 32.7% selected the middle category, while 26% and 27.9% selected the upper two categories. This suggests cautious rather than unqualified confidence. A similar pattern appears in Item 14, regarding whether the leadership of the Department for Emergency Situations publicly recognises the risks generated by disinformation: 30.8% chose the middle category, while 24% and 29.8% selected the upper categories. These results imply that respondents do not reject institutional efforts, but neither do they perceive them as fully adequate or consistently proactive.

By contrast, the pattern for Item 15 is much clearer. Here, 87 respondents expressed total agreement that the public positions of intervention-structure leadership contribute to combating false information, while 17 expressed total disagreement. This indicates that leadership communication is seen as important and potentially effective when it occurs. The issue, therefore, is not whether official communication matters, but whether it is sufficiently rapid, systematic, and visible. The open-ended answers support precisely this reading: the most common proposed measures were faster official communication, immediate clarification of false claims, active monitoring of social media, collaboration with the press, public education, and stronger sanctions for those spreading fake news.

The qualitative material provided for Items 19, 22 and 23 is particularly rich and reveals a coherent practical doctrine emerging from within the detachment itself. Respondents most frequently recommended: periodic training for personnel; rapid verification of online information; faster and more transparent official communication; closer collaboration with the media; public education campaigns; monitoring teams dedicated to social media; and legal or administrative sanctions, including fines, account closures, and stronger punishment for deliberate disinformation. Particularly notable is the repeated demand for speed. In many answers, respondents implicitly argue that the best antidote to fake news is not simply denial, but immediate, clear, visible, and authoritative counter-information. This insight is closely aligned with crisis-communication theory, which holds that institutions must respond early and consistently in order to preserve credibility and reduce uncertainty.

Finally, the open-ended answers to Item 24 provide concrete illustrations of how fake news can affect professional activity. Although many respondents stated that they had not personally experienced a severe case, a significant number described recurrent patterns: false claims about major fires, rumours that crews arrived late or without water, edited or fragmentary videos circulated on TikTok, panic generated among relatives and the public, unnecessary calls to 112, and increased hostility at

intervention sites. These examples are valuable because they show that even when AI-generated fake news has not yet produced catastrophic organisational failure, it already imposes communicational burdens, consumes attention, and shapes the emotional climate in which emergency response unfolds.

5. Conclusions

We examined the influence of AI-generated fake news on communication within an emergency response structure, using the Titu Firefighters' Detachment as a case study. The findings provide strong empirical support for the central premise advanced in the literature, namely that the evolution of artificial intelligence technologies has significantly amplified the risks associated with misinformation, particularly in high-stakes operational environments.

First, the results demonstrate a clear and consistent perception among respondents that AI-generated fake news constitutes a real and growing threat to emergency institutions. The overwhelming majority of participants acknowledge not only the existence of this risk, but also its increasing complexity, especially in relation to the difficulty of distinguishing between authentic and manipulated information. This confirms the theoretical perspective that the contemporary information environment is characterised by heightened uncertainty and reduced epistemic clarity.

Secondly, the study highlights the direct operational and communicational consequences of fake news. Respondents identified multiple concrete effects, including public confusion during interventions, unnecessary emergency calls, delays in operational response, reputational damage, and even hostile reactions from citizens. These findings emphasise that fake news is not merely a reputational or informational issue, but a factor that can actively interfere with crisis management and the effectiveness of intervention activities.

Another important conclusion concerns the central role of social media platforms—particularly Facebook and TikTok—as primary vectors for the dissemination of false information. The speed and reach of these platforms amplify the impact of misleading content, making rapid institutional response essential. At the same time, the study reveals that exposure to fake news is widespread among personnel, with nearly all respondents having encountered false information related to firefighting interventions in the online environment.

In terms of institutional capacity, the findings reveal a dual dynamic. On the one hand, respondents express a relatively high level of confidence in their individual ability to identify false information. On the other hand, there is a strong and consistent demand for systematic training programmes, indicating an awareness that individual intuition is insufficient in the face of increasingly sophisticated AI-generated content. This highlights the need for integrating digital literacy and disinformation detection into the professional training of emergency personnel.

Furthermore, the evaluation of institutional communication suggests that, although official responses are generally perceived as useful and necessary, there is a need for greater speed, consistency, and visibility in countering fake news. The most frequently proposed measures, such as rapid official communication, real-time monitoring of online platforms, collaboration with media, public education, and stricter sanctions point towards a comprehensive, multi-layered approach to combating misinformation.

The study demonstrates that AI-generated fake news represents a significant emerging risk for emergency response systems, affecting not only public perception

but also operational effectiveness and institutional trust. Addressing this challenge requires a combination of organisational adaptation, technological awareness, and proactive communication strategies. For institutions such as the firefighters' detachments, maintaining credibility and ensuring the rapid dissemination of accurate information are essential conditions for effective crisis management in the digital age.

Future research could expand this analysis to multiple units or regions, as well as explore the integration of technological tools for detecting AI-generated content. Additionally, developing standardised protocols for countering disinformation in emergency contexts represents an important direction for both academic inquiry and institutional practice.

6. Practical Implications and Recommendations

The findings of this study highlight the urgent need for emergency response institutions to adapt their communication strategies and operational practices to the evolving challenges posed by AI-generated fake news. Given the direct impact of misinformation on public behaviour, institutional credibility, and intervention efficiency, a proactive and structured approach is required. The following practical implications and recommendations are derived from both the empirical results and the theoretical framework.

First, there is a clear necessity to implement systematic training programmes for personnel in the field of digital disinformation. Although many respondents expressed confidence in their ability to identify false information, the majority had not participated in formal training. This indicates a gap between perceived competence and institutional preparedness. Training should include modules on identifying AI-generated content, verifying sources, understanding misinformation dynamics, and responding appropriately in both operational and communicational contexts.

Secondly, emergency institutions should develop rapid and standardised communication protocols for countering fake news. The data suggest that delays in official responses can allow false information to spread and consolidate. Therefore, communication structures within institutions such as the Ministry of Internal Affairs (MAI) and the Department for Emergency Situations (DSU) should prioritise speed, clarity, and consistency. Establishing predefined procedures for issuing rapid clarifications, including templates and designated spokespersons, could significantly improve response effectiveness.

A third key recommendation is the creation of dedicated monitoring units responsible for tracking misinformation in real time. These teams should actively monitor social media platforms, particularly Facebook and TikTok, identified by respondents as primary sources of fake news in order to detect emerging narratives and intervene promptly. Such units could collaborate with communication departments, operational command structures, and external partners, including media organisations and digital platforms.

Furthermore, the study emphasises the importance of public education and awareness campaigns. Since misinformation often exploits gaps in public understanding, educating citizens on how to verify information and rely on official sources can significantly reduce the impact of fake news. Campaigns could include informational materials, social media content, school-based programmes, and

collaborations with journalists and influencers to promote responsible information consumption.
Another important implication concerns the need for strengthening institutional transparency and visibility. Regular updates, clear explanations of intervention procedures, and post-intervention briefings can help build trust and reduce the susceptibility of the public to misleading narratives. In this regard, the use of modern communication formats, such as short videos, infographics, and real-time updates, which can enhance engagement and accessibility.
In addition, respondents frequently highlighted the necessity of legal and regulatory measures. This includes the application of stricter sanctions for individuals who intentionally disseminate false information, as well as collaboration with online platforms to remove or limit the spread of harmful content. While such measures must be balanced with principles of freedom of expression, they are considered essential for protecting public safety in emergency contexts.
Finally, it is recommended that institutions foster inter-institutional cooperation in combating disinformation. Effective responses require coordination between operational units, communication departments, governmental bodies, and external stakeholders. Developing integrated strategies at the national level, supported by shared resources and information exchange, would enhance overall resilience against AI-driven fake news.

7. Limitations and Future Research

While the present study provides valuable empirical insights into the influence of AI-generated fake news on communication within an emergency response structure, several limitations must be acknowledged to contextualise the findings and guide future research directions. Firstly, the study is based on a single-case design, focusing exclusively on the Titu Firefighters' Detachment. Although this approach allows for an in-depth analysis of a specific operational environment, it limits the generalisability of the results. The organisational culture, level of experience, and communication practices within this unit may not fully reflect those of other detachments or emergency institutions at regional or national levels. Future research should therefore extend the analysis to multiple units, enabling comparative studies and the identification of broader patterns.
Secondly, the research relies on self-reported data collected through a questionnaire. While this method is effective for capturing perceptions, attitudes, and experiences, it may be influenced by subjective biases, such as social desirability or overestimation of individual competencies. For instance, respondents' relatively high self-assessment of their ability to identify fake news may not necessarily correspond to their actual performance in real-world scenarios. Future studies could complement survey data with experimental methods or practical assessments designed to objectively measure detection skills.
Another limitation concerns the cross-sectional nature of the study. The data reflect perceptions at a specific point in time, within a rapidly evolving technological and informational context. Given the continuous advancement of AI technologies and the increasing sophistication of synthetic content, perceptions and challenges may change significantly over time. Longitudinal research would be particularly valuable in tracking these developments and assessing the effectiveness of implemented measures. Additionally, although the questionnaire included open-ended items, the

study does not fully capture the depth and complexity of individual experiences related to fake news in operational contexts. Qualitative methods such as in-depth interviews, focus groups, or case-based analyses of specific incidents could provide richer insights into how misinformation affects decision-making, communication, and behaviour during interventions. A further limitation lies in the lack of technical analysis of AI-generated content itself. The study focuses on perceptions and organisational responses, rather than on the technological characteristics of fake news or the specific mechanisms through which it is created and disseminated. Future research could integrate interdisciplinary approaches, combining insights from communication studies, information technology, and security studies to better understand both the production and detection of AI-generated misinformation. Finally, the research does not explore in detail the institutional communication strategies at higher organisational levels (e.g., national MAI or DSU structures), nor does it assess the effectiveness of existing policies or protocols in combating fake news. Expanding the scope of analysis to include strategic and policy-level perspectives would contribute to a more comprehensive understanding of institutional resilience. In terms of future research directions, several avenues can be identified. Comparative studies across different emergency services (e.g., police, medical emergency units, civil protection) could reveal sector-specific vulnerabilities and best practices. Experimental research could test the effectiveness of training programmes in improving the detection of AI-generated content. Furthermore, the development and evaluation of technological tools, such as automated detection systems or real-time monitoring platforms represent promising areas for applied research.

While the present study offers a valuable contribution to understanding the intersection between AI-generated fake news and emergency communication, addressing its limitations through expanded, interdisciplinary, and longitudinal research will be essential for developing effective strategies to counter disinformation in the future.

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ADOPTION OF SMART RETAIL TECHNOLOGIES IN EMERGING MARKETS: INSIGHTS FROM ROMANIA'S FMCG SECTOR

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Abstract: *This paper examines the adoption of smart retail technologies, with a particular focus on smart checkout systems, in the context of an emerging market, Romania's fast-moving consumer goods (FMCG) sector. Addressing the research questions "What are the key technologies underpinning smart checkout systems in contemporary retail environments?" and "What are the main challenges and limitations associated with their implementation?", the study aims to bridge existing gaps in the literature related to the organizational, operational, and contextual dimensions of these technologies. The research adopts an empirical, qualitative approach, combining documentary analysis with semi-structured interviews conducted among the largest FMCG retailer in Romania. This methodological triangulation enables both a strategic and operational perspective on technology adoption. The findings reveal that the implementation of smart checkout systems is strongly influenced by factors such as urban infrastructure, digital payment penetration, and store format, with retailers adopting a phased and data-driven deployment strategy. From a technological standpoint, the study confirms the integration of advanced solutions such as self-checkout kiosks, automation systems, and data-driven decision-making tools. In terms of challenges, the results highlight significant disparities in adoption across demographic groups, particularly regarding age and education, as well as operational constraints related to infrastructure dependency and customer readiness. Moreover, time efficiency emerges as a primary driver of consumer adoption, while system usability and digital literacy act as critical moderating factors. The study contributes to the limited body of empirical research on smart retail technologies in emerging markets and provides valuable insights for both academics and practitioners. For retailers, the findings offer guidance on aligning technological implementation with consumer characteristics and market conditions, while for researchers, they underscore the importance of context-sensitive analyses in understanding digital transformation in retail environments.*

Keywords: *Smart Check-out technologies; Romanian retail; emerging market; innovations in retail; fast-moving consumer goods sector*

JEL Classification: *O31; O32; Q56*

1. Introduction

In recent years, technology has become an integral part of consumers' everyday lives. The changes brought about by the COVID-19 pandemic have been particularly reflected in individuals' consumption behavior. Consequently, a significant increase in e-commerce activity has been observed, and companies that identified this trend and adapted to consumers' expectations and preferences have been able to strengthen their market position (National Institute of Statistics, 2025). At the same time, the return to "normality" has further transformed purchasing behavior, with consumers becoming increasingly independent and accustomed to managing their shopping activities autonomously, without substantial support from others.

The expansion of e-commerce trends was initially more visible in the fashion sector; however, consumer independence has become more pronounced in the fast-moving consumer goods (FMCG) sector. In response, some retailers capitalized on these behavioral shifts and implemented changes to their business models in order to better meet customer needs. These changes have been primarily driven by technological advancements.

Smart checkout systems, encompassing self-checkout kiosks and fully autonomous cashier-less stores, represent a critical component of this transformation. These systems aim to reduce friction in the purchasing process, enhance operational efficiency, and improve the customer experience through automation and data-driven decision-making (Agrawal & Mittal, 2024; Shamsul et al., 2024).

The evolution of checkout technologies reflects a broader shift toward digital integration in physical retail environments. Early systems relied primarily on barcode scanning and manual interaction, whereas contemporary solutions increasingly incorporate computer vision, deep learning, the Internet of Things (IoT), and other advanced technologies to enable seamless and contactless transactions (Falcão et al., 2021; Lee et al., 2022).

Starting from the premise that employees can be regarded as "internal customers" of an organization, the first retailer to implement such technologies in daily operations was the FMCG company with the largest number of employees. The objective was twofold: to simplify employees' tasks and to better address the needs and preferences of consumers.

Building on these considerations, a significant research gap emerges in relation to the limited focus on the organizational and operational implications of smart checkout systems. Specifically, there is a scarcity of research examining how retailers adopt, implement, and evaluate these systems in practice. Furthermore, there is insufficient empirical evidence within specific market contexts, as only a limited number of studies investigate smart checkout adoption at the national or regional level, particularly in emerging markets.

Similarly, there is a lack of information regarding consumer satisfaction with these innovations, particularly in the context of emerging markets such as Romania. At the same time, consumers have limited awareness of the strategic directions that retailers intend to pursue.

In response to these gaps, the present study aims to analyze the specific case of an emerging market, Romania, by focusing on the retailer with the largest number of employees. The novelty of this research lies in its methodological approach,

which combines documentary analysis with qualitative research, as well as in its examination of consumer satisfaction through discussions with company representatives.

Within this context, the research questions formulated are as follows: *"What are the key technologies underpinning smart checkout systems in contemporary retail environments?"* and *"What are the main challenges and limitations associated with the implementation of smart checkout systems?"*

2. Literature review

Digital transformation has significantly reshaped the retail sector, accelerating the adoption of self-service and automation technologies, particularly in the aftermath of the COVID-19 pandemic. A growing body of literature highlights that smart checkout systems, ranging from self-checkout kiosks to fully autonomous cashier-less stores, represent a key innovation within this transformation, aiming to enhance operational efficiency, reduce transaction time, and improve customer experience (Mahariq et al., 2025; Jhanjhi et al., 2025).

These systems are part of a broader shift toward "smart retail," where artificial intelligence (AI), Internet of Things (IoT), and data analytics are increasingly integrated into physical retail environments (Manoj et al., 2025).

From a technological perspective, recent studies emphasize that contemporary smart checkout systems rely on a combination of advanced tools, including computer vision, mobile self-scanning, and deep learning algorithms. These technologies enable frictionless and contactless transactions, reducing reliance on human intervention and supporting real-time inventory and behavioral analytics (Marannan et al., 2025; Lycia et al., 2025).

Furthermore, modular and scalable system architectures have been identified as critical for enabling retailers to adapt these technologies across diverse store formats and markets (Marannan et al., 2025). Such developments align with the increasing demand for seamless omnichannel experiences, where physical and digital retail converge (Asif, 2025).

A substantial stream of research focuses on consumer adoption of self-checkout technologies. The Technology Acceptance Model (TAM) (Davis, 1986) and its extensions are frequently employed to explain user behavior, highlighting perceived usefulness, ease of use, and trust as key determinants (Nagi & Singh, 2025). Empirical findings suggest that convenience, reduced waiting times, and perceived control over the shopping process positively influence adoption and satisfaction (Jhanjhi et al., 2025; Lau & Zulkipli, 2025). However, factors such as perceived risk, lack of technological familiarity, and security concerns can hinder adoption, particularly in emerging markets (Chauhan et al., 2025).

In addition, recent studies underline the importance of service quality and system reliability in shaping customer satisfaction. For instance, Singh et al. (2025) demonstrate that perceived service quality in self-checkout systems significantly influences customer behavior, especially during periods of heightened health concerns, such as pandemics. Similarly, Lau and Zulkipli (2025) identify a strong positive relationship between system efficiency and customer satisfaction, emphasizing the importance of intuitive interfaces and minimal error rates. Nevertheless, some research also points to the "dark side" of self-service technologies, including user frustration, system failures, and reduced human

interaction, which may negatively affect the overall shopping experience (Naeem, 2025).

Another important dimension addressed in the literature concerns the organizational and operational implications of implementing smart checkout systems. While these technologies offer clear benefits in terms of cost reduction and efficiency, their adoption requires significant investment, changes in workforce structure, and new capabilities in data management and cybersecurity (Mahariq et al., 2025; Špička & Dvořáková, 2025). Retailers must also balance automation with the need to maintain customer engagement and trust, particularly among less tech-savvy consumer segments (Špička & Dvořáková, 2026). Moreover, internal stakeholders, including employees, play a crucial role in the successful implementation of these systems, as their acceptance and adaptation influence operational performance.

Despite the growing interest in smart checkout technologies, the literature reveals several limitations. First, most empirical studies are concentrated in developed economies, such as the United States, Japan, or Western Europe, with relatively limited research conducted in emerging markets (Ghazali et al., 2025; Asif, 2025). This creates a gap in understanding how contextual factors, such as digital literacy, infrastructure, and cultural attitudes, affect adoption and satisfaction. Second, there is a lack of in-depth analysis regarding how retailers implement and evaluate these systems in practice, particularly from an organizational perspective. Existing studies tend to focus predominantly on consumer behavior, overlooking strategic and operational considerations (Mahariq et al., 2025).

Furthermore, while several studies examine adoption intention, fewer provide robust empirical evidence on long-term customer satisfaction and loyalty regarding smart checkout systems, especially in specific national contexts. For example, research conducted in emerging markets such as South Africa and Southeast Asia indicates that trust, perceived security, and technological readiness are critical but underexplored variables (Chauhan et al., 2025; Musa et al., 2025). This suggests the need for context-specific investigations that integrate both consumer and organizational perspectives.

In light of these findings, the existing literature supports the relevance of analyzing smart checkout systems within emerging retail markets. However, significant gaps remain regarding their practical implementation, impact on internal stakeholders, and influence on customer satisfaction in specific national contexts such as Romania. Addressing these gaps requires a comprehensive methodological approach that combines qualitative insights with empirical data, contributing to a more nuanced understanding of smart retail transformation.

3. Methodology

This study adopts a mixed qualitative research design, combining documentary analysis with primary qualitative data collection, in order to provide a comprehensive understanding of the implementation and implications of smart checkout systems within the Romanian retail sector.

The research is structured around two complementary components: (1) documentary research and (2) qualitative inquiry. This dual approach enables both contextual understanding and in-depth exploration of stakeholder perspectives, aligning with established methodological frameworks that advocate triangulation to enhance validity and robustness in social science research (Creswell & Creswell, 2017; Flick, 2022).

Also, the methodological approach is explicitly structured to address the two research questions because the alignment between research questions and methods ensures analytical coherence and enhances the explanatory power of the study, consistent with best practices in qualitative research design (Creswell & Creswell, 2017; Salmona et al., 2019).

The first stage of the study consists of documentary research focused on the analysis of secondary data sources. This includes company reports, industry publications, and publicly available information related to the Romanian retail market. Particular attention is given to the leading FMCG retailer in Romania, identified as the organization with the largest number of employees and among the first to implement smart checkout systems at scale.

Documentary analysis is employed to examine the evolution of the retailer's business model, the technological infrastructure underpinning smart checkout adoption, and the strategic motivations driving digital transformation. This method facilitates the contextualization of the case study within broader retail trends and supports the identification of key technological and organizational developments (Bowen, 2009).

The second stage involves qualitative research based on semi-structured interviews conducted with in-store personnel. This approach is selected due to its suitability for capturing detailed insights into experiences, perceptions, and operational challenges associated with smart checkout systems (Brinkmann & Kvale, 2014).

A purposive sampling strategy is employed to select participants from "super" retail stores located in major urban areas in Romania. The sample comprises approximately 100 respondents, ensuring a diverse representation of employees directly interacting with or affected by smart checkout technologies. Special emphasis is placed on individuals belonging to Generation X and Baby Boomer cohorts, as these groups may exhibit distinct attitudes toward technological adoption compared to younger generations (Venkatesh et al., 2012).

The interview protocol is designed to explore key themes such as perceptions of smart checkout systems, perceived benefits and limitations, operational challenges, and observed customer reactions and satisfaction levels.

By integrating documentary research with qualitative insights from internal stakeholders, this study addresses existing gaps in the literature related to the organizational and operational dimensions of smart checkout implementation. Furthermore, the focus on a specific emerging market, Romania, provides context-sensitive evidence, contributing to a more nuanced understanding of retail digitalization.

4. Results and discussions

The findings of this study provide a comprehensive understanding of the implementation and adoption of smart checkout systems within the Romanian retail sector, while simultaneously addressing the two research questions related to underlying technologies and implementation challenges.

The results indicate that the deployment of self-checkout systems followed a targeted and data-driven strategy, primarily concentrated in major urban centers such as Timișoara, Cluj-Napoca, Bucharest, and Iași. These locations are characterized by higher levels of economic development and digital infrastructure, which facilitate the integration of advanced retail technologies.

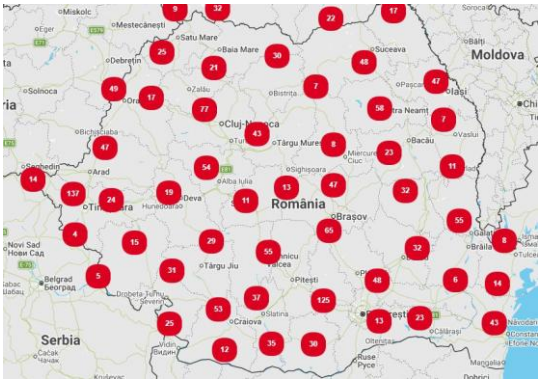


Figure 1: The territorial distribution of the retailer's stores
Source: (Profi, 2026)

A critical determinant in site selection was the prevalence of card-based payments, with a minimum threshold of 50% serving as a prerequisite for implementation. This finding highlights the interdependence between payment digitization and retail automation, supporting previous research which emphasizes that digital payment ecosystems are foundational for enabling frictionless retail technologies (Asif, 2025; Ghazali et al., 2025).

The large-scale rollout, approximately 1,200 self-checkout registers across 500 stores, demonstrates a significant organizational commitment to automation. The focus on medium-and large-sized "super" format stores suggests that retailers prioritize environments with high customer throughput, where efficiency gains are most impactful.

From a technological perspective (RQ1), these results confirm that smart checkout systems are not implemented uniformly but are instead aligned with store characteristics, transaction behaviors, and technological readiness. This reflects a broader trend in retail digitalization, where technological adoption is contingent upon contextual and infrastructural factors.

A key finding of this study is the dominant role of time efficiency in driving consumer adoption. Approximately 65% of respondents reported using self-checkout systems to avoid queues, while 11% indicated abandoning purchases due to long waiting times.

These results underscore the operational significance of checkout processes, positioning them as a critical determinant of customer satisfaction and retention. In line with the Technology Acceptance Model (TAM), perceived usefulness, particularly in terms of time savings, emerges as a primary driver of adoption (Venkatesh et al., 2012). Furthermore, the identification of abandoned purchases highlights the direct financial implications of inefficient checkout systems, reinforcing the strategic value of automation.

However, while self-checkout systems effectively address queue-related inefficiencies, they also introduce new challenges, including system usability issues and varying levels of customer readiness. This duality reflects the complexity of implementing retail technologies that must balance efficiency with accessibility.

The findings reveal significant heterogeneity in adoption patterns, particularly across generational and educational dimensions.

Younger consumers (Generation Z and Millennials) exhibit a higher degree of openness and adaptability, consistent with their greater exposure to digital technologies. In contrast, older cohorts (Generation X and Baby Boomers) demonstrate lower levels of engagement, often requiring additional support or expressing reluctance toward self-service systems.

Similarly, education level plays a crucial role in shaping adoption behavior. Respondents with higher education levels show the highest propensity to use self-checkout technologies, whereas only approximately 20% of individuals with elementary education reported using such systems.

These findings align with prior studies emphasizing the importance of digital literacy, cognitive familiarity, and technology readiness in influencing adoption (Nagi & Singh, 2025; Yeoh et al., 2025). From an implementation perspective (RQ2), these disparities represent a key challenge, as they necessitate inclusive system design, targeted user education, and hybrid service models that accommodate diverse customer segments.

The results highlight several operational challenges associated with the implementation of smart checkout systems due to customer heterogeneity, which requires tailored approaches to support different user groups. Also, the dependence on payment infrastructure is limiting implementation in areas with lower digital payment adoption and could appear a Risk of customer frustration, particularly among less technologically confident users.

At the same time, the findings confirm that when effectively implemented, smart checkout systems reduce congestion, enhance perceived control, and improve overall shopping efficiency.

This reinforces the notion that the success of such systems depends not only on technological sophistication but also on organizational alignment and user-centered design.

In conclusion, by combining insights from both research questions, the study demonstrates that the effectiveness of smart checkout systems is contingent upon the interaction between technology, context, and consumer characteristics. While advanced technologies enable automation, their impact is mediated by factors such as digital literacy, payment behavior, and demographic structure.

Thus, smart checkout systems should be understood not merely as technological innovations, but as socio-technical systems embedded within broader retail ecosystems.

5. Conclusions

This study set out to explore how smart checkout technologies are being adopted and implemented within the Romanian FMCG retail sector, offering insights into both technological developments and real-world operational challenges. The findings show that smart checkout systems are no longer experimental solutions, but rather an increasingly important component of modern retail strategies, particularly in urban areas where digital infrastructure and consumer readiness are more advanced.

A key conclusion of the research is that the successful implementation of these systems depends not only on the technologies themselves, but also on the context in which they are introduced. Factors such as payment behavior, store format, and customer demographics play a crucial role in shaping both adoption and effectiveness. While consumers are generally motivated by the convenience and

time-saving benefits of self-checkout systems, differences in age, education, and digital literacy create uneven adoption patterns. This highlights the importance of designing solutions that are accessible and intuitive for a broad range of users.

At the same time, the study shows that smart checkout systems bring both opportunities and challenges. On the one hand, they improve efficiency, reduce waiting times, and enhance customer autonomy. On the other hand, they may lead to frustration among less technologically confident users and require significant organizational adjustments, including employee training and infrastructure investments.

The implications of this research are relevant for multiple stakeholders. For retailers, the findings emphasize the need for context-aware implementation strategies, combining technological innovation with customer support and education. For researchers, the study contributes to the limited body of knowledge on smart retail technologies in emerging markets and highlights the importance of integrating both organizational and consumer perspectives in future research.

However, several limitations should be acknowledged. The study focuses on a single retailer, which may limit the generalizability of the findings. In addition, the qualitative nature of the research, while providing depth, does not allow for broad statistical generalization. Future research could expand the scope by including multiple retailers, employing quantitative methods, or conducting comparative studies across different emerging markets.

Building on the conclusions of this study and considering the evolving landscape of retail digitalization, several avenues for future research can be identified.

First, further investigation is needed into the potential implementation of fully autonomous (cashier-less) stores within emerging markets such as Romania. While current findings suggest a gradual transition toward automation, future studies could examine the feasibility of such systems over a medium-term horizon (3-5 years), with particular attention to the role of consumer acceptance, trust, and technological readiness in shaping adoption trajectories.

Second, there is a need for in-depth empirical research on the introduction of cashier-less retail environments in Romania, focusing on their impact on consumer behavior, employee roles, and overall shopping experience. Such studies could adopt longitudinal designs to assess changes over time, particularly in relation to customer satisfaction, loyalty, and perceived value.

Finally, interdisciplinary approaches that integrate perspectives from marketing, information systems, and organizational studies could provide a more comprehensive understanding of smart retail ecosystems, supporting the development of sustainable and inclusive innovation strategies in the retail sector.

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