

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-Illfov 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 (Trippel & 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 Trippel (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 through 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 Trippel, 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 (Trippel, Grillitsch, & Isaksen, 2017). Here as well we can see a parallel with current day regional realities in Romania. In regions such as the Bucharest-Ifov 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 South-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 Trippel (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 experimental; 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 attractiveness 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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