# 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.

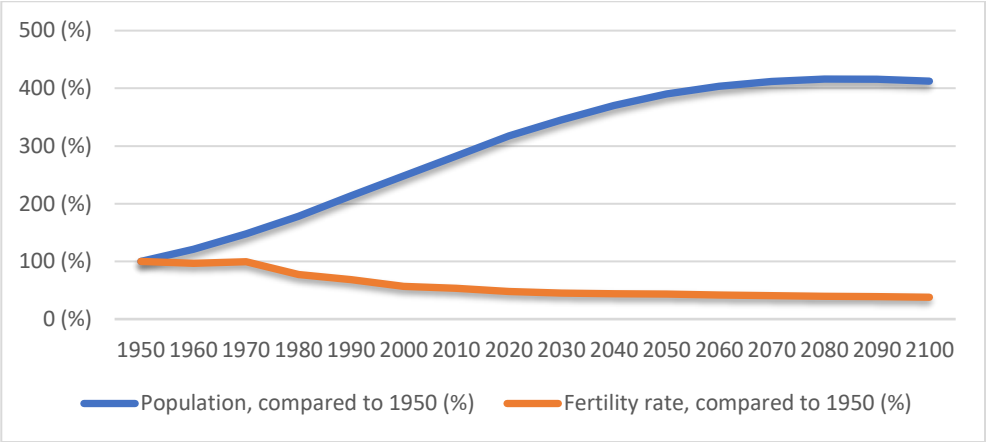


**Figure 1:** Relative changes in population and fertility rate over time
Source: data from United Nations (2024)

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.

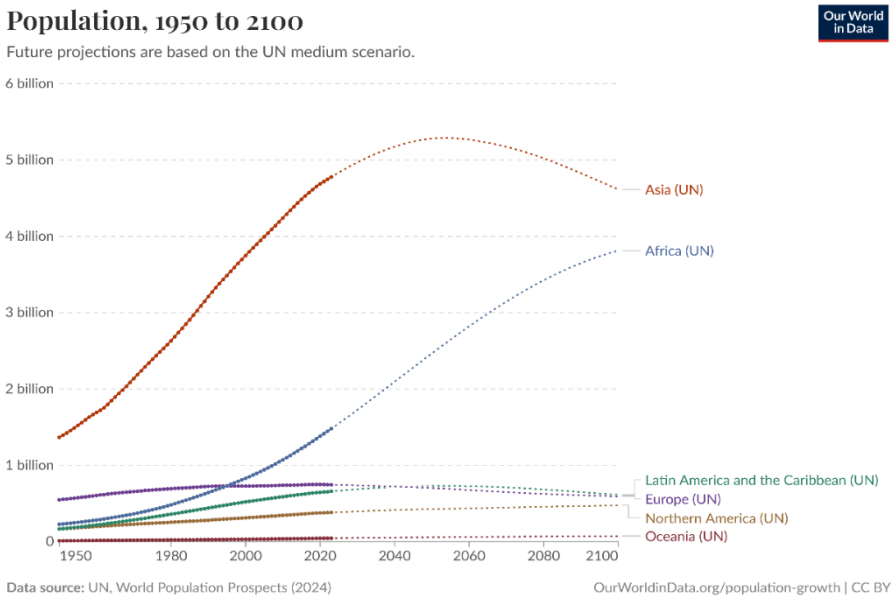


**Figure 2:** Relative changes in population and fertility rate over time
Source: Our World in Data (2024)

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).

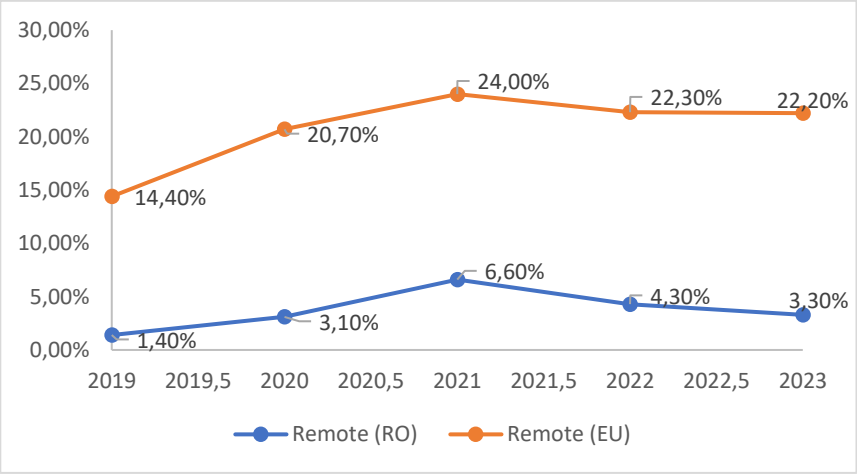


**Figure 4:** Trend in remote work in Romania compared to the EU
Source: data from Eurostat (2024a)

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).

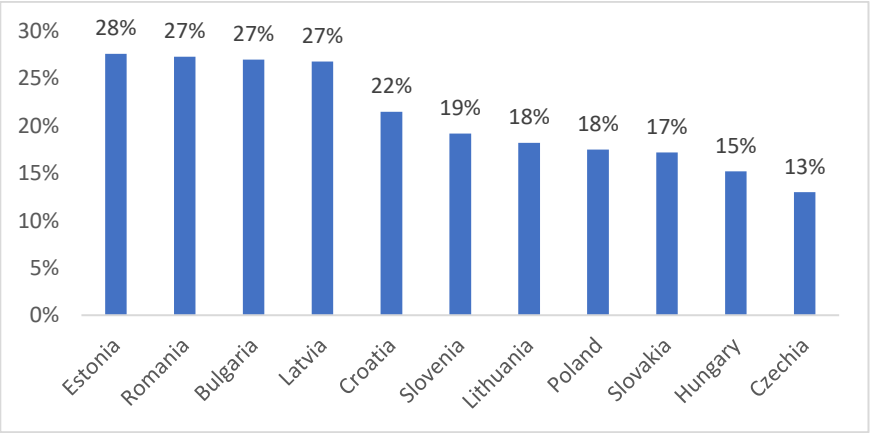


**Figure 5:** Share of women among ICT specialists in Central and Eastern Europe, 2024
Source: data from European Commission (2025)

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).

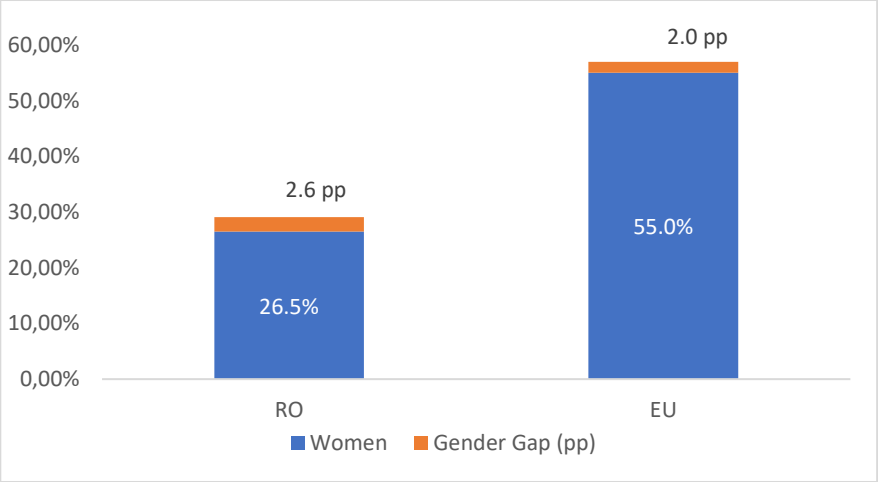


**Figure 6:** Gender Disparity in Digital Competencies: Romania vs. European Union
Source: data from European Commission (2025)

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).

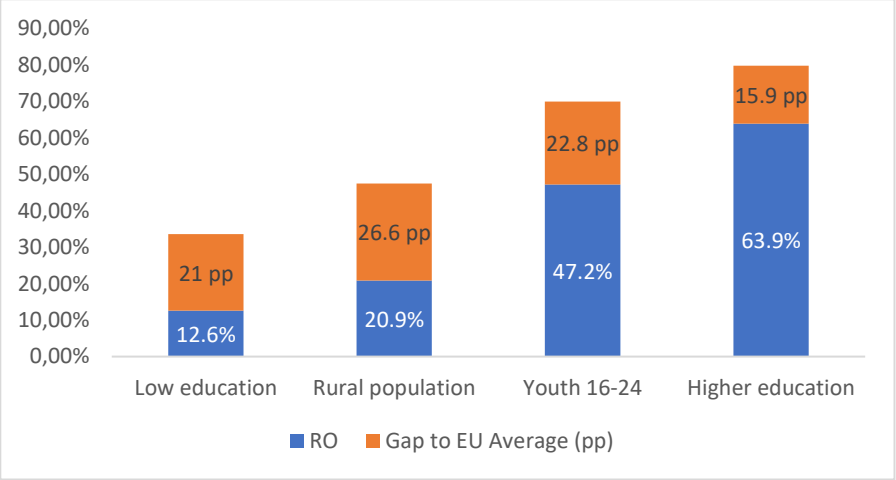


**Figure 6:** Digital Skills in Romania by Subgroups, compared to EU averages
Source: data from European Commission (2025)

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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