

ARTIFICIAL INTELLIGENCE ADOPTION IN ROMANIA AND POLAND: A COMPARATIVE STUDY WITHIN THE EUROPEAN UNION²⁰

Alina Ligia DUMITRESCU²¹

Institute for World Economy, Romanian Academy

ABSTRACT: Artificial Intelligence (AI) has become one of the most influential general-purpose technologies of the twenty-first century, fundamentally transforming production processes, business models, public administration, and labour markets. Recent advances in machine learning, generative AI, natural language processing, and computer vision have significantly expanded the range of economic activities in which AI technologies can be effectively deployed. Consequently, AI is increasingly regarded as a strategic driver of productivity growth, technological innovation, and long-term economic competitiveness. This paper provides a comparative analysis of the level of AI adoption in Romania and Poland, two Central and Eastern European economies with considerable technological potential but differing levels of progress in the implementation of AI-based solutions. The analysis is based on Eurostat data regarding the adoption of AI technologies by enterprises, taking into account enterprise size and sector of economic activity. The findings reveal significant disparities between the two countries, reflecting differences in their digital transformation trajectories and innovation ecosystems. This article argues that narrowing the AI adoption gap requires sustained investment in digital skills, technological infrastructure, and innovation policies, alongside targeted measures aimed at encouraging the adoption of AI technologies among small and medium-sized enterprises (SMEs), particularly in Romania.

Keywords : UE, Artificial Intelligence, Romania, Poland, Digital Transformation

JEL Classification: F02, O32, O33, O38

1. INTRODUCTION

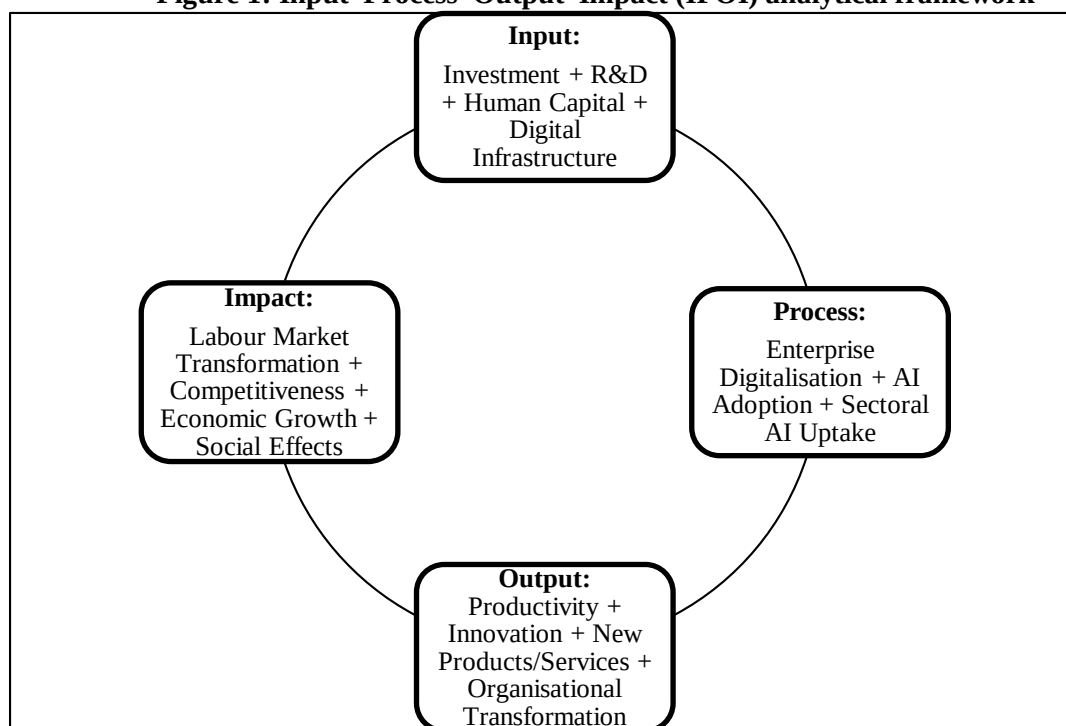
The development of artificial intelligence (AI) represents a multidimensional process in which technological, financial, human, and institutional resources interact to shape the capacity of economies and enterprises to adopt and exploit AI technologies. Differences in AI development across countries cannot therefore be explained solely by the level of AI adoption. They also reflect the availability of investment, research and development (R&D), human capital, digital infrastructure, and institutional support, as well as the capacity of firms to transform these resources into technological and organisational capabilities. To capture these interdependencies, this article adopts an *Input–Process–Output–Impact (IPOI) analytical*

²⁰This article draws on research conducted the study “*Reconfiguring the Labour Market in the European Union in the Context of Artificial Intelligence (AI) and the Circular Economy: Perspectives and Challenges*,” coordinated by Dr. Alina Ligia Dumitrescu, part of the I.E.M. Subprogram 2023–2027 (PS-IEM 4: Sectoral Policies and the Transition to the Circular Economy) within the Research Plan of the Romanian Academy/INCE.

²¹ PhD, Senior Researcher (CSII), alinaligia@gmail.com

framework for assessing AI development in the European Union (EU), Romania, and Poland. The IPOI framework consequently provides a **systemic perspective** on AI development, linking resources to adoption and adoption to economic and social outcomes (Figure1).

Figure 1: Input–Process–Output–Impact (IPOI) analytical framework



Source: Author's own representation based on specialized literature.

Within this framework, **Inputs** represent the financial, technological, human, and institutional resources that create the conditions for AI development. The analysis considers **AI investment, R&D expenditure, AI-related human capital, and digital infrastructure** as the principal input dimensions. These factors determine the availability of resources required to develop, implement, and scale AI technologies. At the macroeconomic level, R&D intensity reflects a country's capacity to generate new knowledge and technological innovation, while investment in digital infrastructure provides the technological foundations for data-intensive and computationally demanding AI applications. Human capital, particularly advanced Information and Communication Technology (ICT) and AI-related skills, constitutes a complementary input because *the effective development and use of AI depend on the availability of qualified professionals*.

The **Process** dimension captures the transformation of these resources into technological and organisational capabilities. In this stage, the analysis focuses on **enterprise digitalisation, AI adoption, the use of AI technologies across economic sectors, and the development of organisational capabilities**. AI adoption is not an automatic consequence of investment or infrastructure availability. *Enterprises must integrate AI into production and business processes, adapt organisational structures, develop appropriate governance mechanisms, and acquire the skills necessary to use AI effectively*. Consequently, differences in enterprise-level adoption may reflect not only differences in technological availability but also *variations in managerial capabilities, organisational readiness, access to finance, and the ability to integrate AI into existing business models*.

The **Output** dimension refers to the observable results generated by the process of AI adoption. These include increased use of AI technologies by enterprises, changes in the

composition of business activities, the emergence of new AI-intensive sectors and occupations, productivity improvements, and *the development of new products and services*. At this level, enterprise AI adoption provides an important measurable indicator of the extent to which countries are translating their technological and human resources into actual economic activity. The sectoral distribution of AI adoption is particularly relevant because the economic effects of AI are likely to differ substantially across information and communication technologies, professional and scientific services, manufacturing, finance, and other sectors.

Finally, the ***Impact dimension*** captures the broader economic, *labour-market, and societal consequences associated with AI diffusion*. These may include **productivity growth, changes in employment and occupational structures, shifts in skill demand, wage effects, innovation performance, competitiveness, and organisational transformation**. The impact of AI should therefore be understood as a dynamic and potentially uneven process. AI may complement human labour and increase productivity in some activities while reducing demand for certain routine tasks in others. At the same time, *the emergence of new occupations and tasks may generate additional demand for advanced digital, analytical, and interpersonal skills*. The overall impact will depend on the interaction between technological change, labour-market institutions, education and training systems, and firms' capacity to reorganise work.

Applying this framework to the EU, Romania, and Poland makes it possible to move beyond a simple comparison of AI adoption rates and identify the structural factors underlying differences in AI performance. The EU provides the broader benchmark, while Romania and Poland represent two Central and Eastern European economies with different levels of R&D intensity, digital investment, human-capital development, and enterprise AI adoption. The comparison therefore seeks to determine whether differences in AI adoption are associated with differences in the underlying resource base and institutional environment and to identify the main strengths and constraints affecting AI-driven transformation in the two countries.

This analysis is based primarily on recent evidence from **Eurostat, the European Commission, and the OECD**, complemented where appropriate by international AI reports and datasets. By integrating quantitative indicators across the four dimensions of the IPOI framework, the analysis provides a structured basis for evaluating the current position of Romania and Poland within the European AI landscape and for identifying policy priorities aimed at strengthening AI investment, innovation capacity, workforce skills, enterprise adoption, and the broader economic and labour-market benefits of AI.

2. LITERATURE REVIEW

The relationship between technological progress and employment has long been a central concern in economic research. Traditional economic literature has primarily viewed technological change through the lens of labour substitution, arguing that technological innovation replaces tasks previously performed by human workers, thereby reducing labour demand in certain occupations.

Subsequent research has demonstrated that such an interpretation is incomplete. In their seminal study, Autor, Levy, and Murnane (2003) introduced a task-based approach to technological change, arguing that *technology substitutes routine tasks while complementing activities requiring analytical thinking, problem-solving, and complex decision-making*. Since occupations typically consist of multiple tasks rather than a single activity, technological change *affects only specific components of jobs rather than entire occupations*.

A further theoretical contribution was provided by Acemoglu and Restrepo (2019), who distinguish between the automation of existing tasks and the creation of new tasks performed by workers. According to their framework, while automation may reduce labour demand in certain activities, technological progress simultaneously *generates new responsibilities*,

occupations, and economic opportunities. Consequently, the overall employment effect depends on the balance between labour-displacing and labour-creating mechanisms.

Unlike previous waves of automation, AI is capable of performing not only routine physical tasks but also cognitive, administrative, and information-processing activities. As a result, assessing AI's impact on employment has become substantially more complex. Rather than focusing solely on occupations, recent research increasingly examines the specific tasks performed within occupations and evaluates the extent to which these tasks can either be automated or augmented by AI technologies.

In this context, exposure to Artificial Intelligence should not be interpreted as synonymous with job displacement. As emphasised by the OECD (2026), a clear distinction must be made between AI's technological capabilities and its actual labour market effects. The impact of AI depends not only on technological progress but also on firms' adoption decisions, organisational practices, workforce skills, and the institutional and regulatory environment in which AI technologies are implemented.

The ***Stanford AI Index 2026*** provides a comprehensive global assessment of artificial intelligence development and diffusion, covering research and development, investment, technical performance, infrastructure, human capital, enterprise adoption, education, and governance. Its key findings highlight the rapid acceleration of AI development, rising investment and organizational adoption, and intensifying competition between the United States and China. Overall, the report highlights the growing importance of ***AI innovation, investment, human capital, and technology diffusion for economic competitiveness and labour-market transformation*** (Stanford HAI, 2026).

Alongside the substantial contributions of international organizations or such as the OECD or **Stanford** Institute for Human-Centred Artificial Intelligence, an important body of evidence is provided by reports published by leading *consulting and technology firms*, which offer empirical insights based on large-scale surveys involving thousands of organizations worldwide.

Studies conducted by McKinsey (2025a, 2025b) indicate that AI has moved well beyond the stage of isolated experimentation and has become a strategic priority for organizations. Nevertheless, a significant gap remains between AI adoption and the realization of tangible economic value. While most organizations have implemented AI applications in one form or another, only a relatively small proportion have succeeded in deploying AI at scale and *translating these investments into measurable improvements in financial performance*.

McKinsey argues that successful AI implementation depends less on technological capabilities than on organizational transformation, workforce capability development, and strong executive leadership. Organizations that employ AI primarily to automate repetitive tasks generally achieve only modest efficiency gains. By contrast, firms that redesign workflows and integrate AI *into decision-making processes experience substantially greater improvements in productivity, innovation, and overall business performance*. A key conclusion is that AI does not automatically generate competitive advantage; rather, such advantages emerge only when technological adoption is accompanied by profound organizational change.

The analyses published by PwC (2026) demonstrate that AI is *driving structural changes in labour markets by reshaping both skills demand and occupational structures*. Recent findings show that organizations with higher levels of AI exposure tend to experience faster productivity growth and, in many cases, higher wages and employment levels than organizations with more limited AI adoption. According to PwC, AI contributes to skills polarization by increasing the importance of advanced cognitive abilities, leadership, creativity, and complex problem-solving skills, while reducing demand for routine and repetitive tasks. This trend reinforces the need for *continuous investments in upskilling and reskilling initiatives*. The findings suggest that AI is not merely replacing specific tasks but is also creating new occupations and fundamentally transforming the nature of work.

IBM (2025) examines AI adoption from the perspective of organizational maturity. According to the *IBM Global AI Adoption Index*, the pace of AI implementation is shaped by several factors, including data availability, digital infrastructure, workforce expertise, and the existence of internal AI governance policies. IBM emphasizes that the primary obstacles to AI adoption are organizational rather than technological. These include skills shortages, difficulties integrating AI into existing business processes, limited trust in AI-generated outputs, and concerns related to cybersecurity, privacy, and data protection. From this perspective, successful AI implementation requires the development of an *organizational culture that promotes innovation, adaptability, and continuous learning*.

The Microsoft Work Trend Index (Microsoft, 2026a) *highlights the transformative impact of generative AI on the organization of work*. AI is increasingly employed to automate administrative tasks, support decision-making, generate content, and augment cognitive activities, enabling employees to devote more time to higher value-added work. Within these organizations, *AI is no longer viewed merely as an automation tool but as a collaborative partner in intellectual work, while employees increasingly assume roles centred on coordination, supervision, critical evaluation, and strategic decision-making*. Furthermore, Microsoft (2026b) emphasizes that the effective deployment of AI must be accompanied by investments in digital skills development and by the evolution of leadership practices capable of unlocking the technology's full potential.

A comparative analysis of these reports reveals a broad consensus that artificial intelligence should not be assessed solely in terms of task automation but rather through its *capacity to transform organizations and generate sustainable competitive advantages*. While McKinsey (2025a, 2025b) focuses on organizational transformation and value creation, PwC (2026) emphasizes productivity growth and workforce skills, IBM (2025) examines the organizational factors determining AI maturity, and Microsoft (2026a, 2026b) concentrates on the transformation of work organization and human–AI collaboration (Table 1).

Table 1. Comparative Analysis of the Major Reports on the Impact of Artificial Intelligence on the Economy and Labour Market

Author / Institution	Research Objective	Methodology	Sample / Coverage	Key Indicators	Key Findings	Labour Market Implications	Limitations
OECD: Employment Outlook 2023; AI Policy Observatory	To assess the impact of AI on employment, productivity, and skills.	Statistical analysis, international databases, and cross-country comparative studies.	OECD member countries	Productivity, skills, employment, occupational exposure to AI.	AI is more likely to complement than replace human labour, although its effects vary considerably across occupations and sectors.	Highlights the <i>need for reskilling and upskilling</i> policies to facilitate workforce adaptation.	Uneven data availability and differences in statistical methodologies across countries.
ILO (2023, 2024)	To examine the effects of AI on job quality and employment.	Occupational modelling and sectoral analysis.	Global	Occupational exposure to AI, job quality, automation potential.	Most occupations are expected to be transformed rather than eliminated through AI adoption.	Supports <i>active labour market policies</i> , social protection, and a just transition for workers.	Long-term impacts remain uncertain due to the rapid pace of technological change.

Author / Institution	Research Objective	Methodology	Sample / Coverage	Key Indicators	Key Findings	Labour Market Implications	Limitations
Stanford AI Index	To monitor global AI development and diffusion.	Bibliometric, statistical, and trend analysis.	Global	AI investment, patents, scientific publications, AI adoption	The United States and China remain global leaders in AI investment and innovation, while Europe demonstrates strong research performance but uneven commercial adoption.	Underlines the importance of strengthening innovation ecosystems and technology transfer.	Limited emphasis on labour market and broader social impacts.
McKinsey Global Institute	To evaluate the organisational and economic impact of AI.	Global executive surveys and case studies.	Thousands of firms across multiple countries.	AI adoption, productivity, profitability, organisational transformation.	The highest productivity gains are achieved when AI implementation is accompanied by organisational redesign and workforce capability development	Emphasises organisational transformation, digital leadership, and continuous workforce development.	Evidence is primarily derived from large and innovation-oriented firms.
PwC Global AI	To estimate AI's contribution to economic growth and labour market transformation.	Macroeconomic modelling and global surveys.	Global	GDP growth, productivity, wages, skills demand.	AI has the potential to substantially increase economic growth while reshaping labour demand and skill requirements	<i>Reinforces the importance of education reform and lifelong learning systems.</i>	Results depend on assumptions regarding the speed and scale of AI adoption.
IBM Global AI Adoption Index	To assess the maturity of enterprise AI adoption.	Surveys of business executives.	Organisations across multiple industries.	AI adoption, governance, implementation barriers, digital skills.	The principal obstacles to AI adoption include skills shortages, system integration challenges, and data governance issues.	Highlights the need to strengthen digital competencies, organisational readiness, and change management.	Findings rely on managers' perceptions and may therefore reflect subjective assessment

Author / Institution	Research Objective	Methodology	Sample / Coverage	Key Indicators	Key Findings	Labour Market Implications	Limitations
Microsoft Work Trend Index	To analyse the impact of generative AI on work organisation and employee productivity.	Global workforce surveys and analysis of digital tool usage.	Employees and organisations worldwide.	Generative AI use, collaboration, productivity, digital skills.	Generative AI is reshaping work organisation by enabling new forms of human–AI collaboration and increasing knowledge-worker productivity.	Demonstrates the growing importance of digital literacy, AI competencies, and organisational change management.	Strong emphasis on digital work environments and Microsoft technology users.

Source: Author's synthesis based on specialized literature

Despite these different analytical perspectives, the findings converge toward the same conclusion: the successful implementation of AI depends on the existence of *a robust organizational ecosystem supported by digital competencies, effective leadership, investments in human capital, and the ability to redesign business processes*. Consequently, the economic benefits of AI are determined not only by technological performance but also by the quality of organizational governance and strategic investments in human resources.

Overall, the comparison of these reports demonstrates a broad consensus that artificial intelligence has become a key driver of economic and labour market transformation. Nevertheless, each institution approaches the phenomenon from a distinct analytical perspective, as summarized in Table 1.

3. METHODOLOGY

The research methodology focuses on the quantitative analysis of the key indicators specific to AI adoption, as well as on the qualitative analysis of documents and policies related to AI, and on the consultation of specialized literature, studies, and articles published by renowned authors. The research is both applied and relevant for public policy and explanatory, aimed at identifying causal relationships and mechanisms of AI impact.

The Input–Process–Output–Impact (IPOI) analytical framework gives your empirical analysis a stronger theoretical and methodological foundation and, importantly, allows to distinguish between the capacity to develop AI (Inputs), the ability to implement it (Process), the immediate results of adoption (Outputs), and its broader economic and labour-market consequences (Impacts).

4. ARTIFICIAL INTELLIGENCE USE IN FIRMS AND ECONOMIC SECTORS IN THE EUROPEAN UNION MEMBER STATES

Recognising AI as a strategic driver of innovation and competitiveness, the European Union has actively promoted its development and deployment through coordinated policy initiatives, dedicated funding programmes, and a comprehensive regulatory framework, most notably the *Artificial Intelligence Act (AI Act)*.

Despite these efforts, the diffusion of AI technologies remains highly uneven across EU Member States. Significant disparities persist, particularly between the more digitally advanced economies of Northern and Western Europe and the emerging economies of Central and Eastern

Europe. Within this context, Romania and Poland represent relevant case studies for comparative analysis. Although both countries share a common post-socialist transition and have experienced rapid integration into the European digital economy, they differ considerably in terms of digital maturity, innovation performance, and the adoption of AI technologies by enterprises.

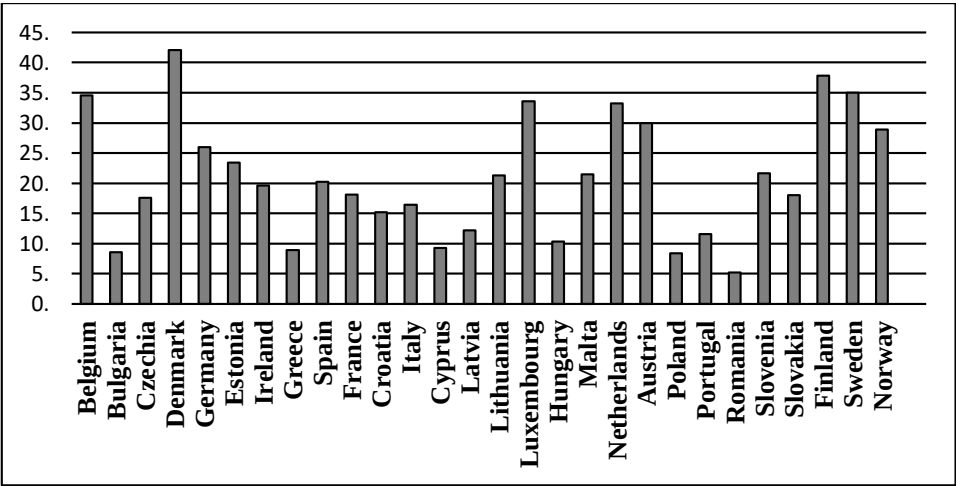
At the EU level, AI adoption has followed a sustained upward trajectory in recent years. According to Eurostat data, in 2025 approximately 19.95% of firms employing at least ten persons, including self-employed businesses, reported using at least one AI technology (Eurostat, 2025a). The analysis by enterprise size reveals pronounced differences in adoption rates: 17.00% of small enterprises, 30.36% of medium-sized enterprises, and 55.03% of large enterprises had implemented AI solutions. These disparities can largely be attributed to differences in financial capacity, technological readiness, economies of scale, and the substantial upfront investments required for AI implementation, which are generally more affordable for larger firms.

Cross-country comparisons further highlight the heterogeneous diffusion of AI across the European Union. In 2025, the share of enterprises adopting at least one AI technology ranged from 5.21% to 42.03%. Denmark recorded the highest adoption rate (42.03%), followed by Finland (37.82%) and Sweden (35.04%). At the opposite end of the distribution, the lowest levels were reported in Romania (5.21%), Poland (8.36%), and Bulgaria (8.55%) (Figure 1). Nevertheless, AI adoption continued to expand throughout the Union, with 26 Member States reporting higher adoption rates than in the previous year. The most substantial increases were observed in Denmark (+14.45 percentage points), Finland (+13.45 percentage points), and Lithuania (+12.54 percentage points), reflecting the accelerating pace of digital transformation across the European economy.

Although the European Union actively promotes AI adoption through common policies, funding mechanisms, and regulatory frameworks such as the AI Act, empirical evidence suggests that these instruments have not generated uniform outcomes across Member States.

From a sectoral perspective, in 2025, the information and communication sector recorded the highest share of enterprises using artificial intelligence (62.52%), followed by professional, scientific and technical activities (40.43%). In all other sectors of the economy, AI adoption remained below 25%, ranging from 24.82% in real estate activities to 10.79% in the construction sector.

Figure 1. Share of firms using Artificial Intelligence technologies in the European Union Member States, 2025 (% of Total Enterprises 10 persons or more)



Source: Author’s processing based on Eurostat data (2025)

EU enterprises implemented a wide range of artificial intelligence technologies. The most widely adopted were written language analysis technologies, including automated text extraction, used by 11.75% of enterprises in 2025. These were followed by visual and audio content generation technologies (9.55%) and technologies for generating written or spoken language and programming code (8.76%). Other AI applications including speech recognition, machine learning algorithms for data analysis, workflow automation systems, decision-support systems, and image recognition technologies were used by between 7.22% and 3.78% of enterprises. At the opposite end of the spectrum, technologies enabling the autonomous physical mobility of intelligent systems, such as autonomous vehicles, were adopted by only 1.39% of enterprises.

With regard to the purposes of AI adoption, the data indicate that, in 2025, 34.70% of firms using AI applied these technologies to marketing and sales activities, while 31.05% employed them for business administration and management processes. AI adoption was least common in logistics, where only 6.08% of AI-using enterprises reported deploying such technologies.

An analysis by enterprise size reveals substantial disparities in the purposes for which AI is employed. The largest gap between small and large enterprises was observed in the area of information and communication technology (ICT) security, where 47.51% of large enterprises used AI-based solutions compared with only 14.51% of small enterprises. Significant differences were also identified in the use of AI for business administration and management (43.38% among large enterprises versus 28.49% among small enterprises) and production processes (33.46% versus 19.02%).

Romania and Poland represent two relevant economies in Central and Eastern Europe.

According to Eurostat data for 2025, Romania recorded the lowest proportion of enterprises using at least one AI technology in the European Union, at 5.21%, while Poland, although performing slightly better, remained below the EU average, with 8.36% of enterprises adopting AI technologies. These figures highlight a considerable gap compared with Northern and Western European Member States, where AI adoption is substantially more widespread.

The differences between the two countries can be attributed to several structural and institutional factors. Poland benefits from a larger domestic market, higher investment in research and development, and a more coherent implementation of its national artificial intelligence strategy. Furthermore, *Poland's innovation ecosystem is supported by a greater number of technology clusters and stronger collaboration among academia, the private sector, and public authorities.*

In Romania, although the information technology sector is internationally competitive and largely export-oriented, AI adoption among enterprises remains limited, particularly among small and medium-sized enterprises (SMEs). This situation can be associated with relatively low levels of investment in digitalisation, shortages of advanced AI-related skills, and comparatively weak absorption of European funds dedicated to technological innovation.

From the perspective of enterprise size, both Romania and Poland exhibit significantly higher AI adoption rates among large enterprises than among small and medium-sized firms. However, medium-sized enterprises in Poland demonstrate a stronger propensity to adopt AI solutions, suggesting a more advanced integration of digital technologies within the country's economic structure.

Regarding the fields of application, *AI use in both countries is concentrated primarily in the information and communication sector and in professional, scientific and technical services.* Nevertheless, Romania displays a lower degree of diversification in AI applications across sectors such as manufacturing, logistics, and business administration compared with Poland, where these technologies are deployed across a broader range of economic activities.

5. ARTIFICIAL INTELLIGENCE DEVELOPMENT FACTORS

The development and diffusion of artificial intelligence (AI) depend on a combination of complementary factors, including investment, research and development (R&D), human capital, and digital infrastructure. These dimensions jointly determine a country's capacity to generate, adopt, and scale AI technologies across economic sectors (European Commission, 2025a). A comparison between the European Union (EU), Romania, and Poland reveals significant disparities in AI readiness and innovation performance (Table 2).

Table 2: Comparative Indicators for Artificial Intelligence Development in the European Union, Romania, and Poland (2024–2025)

INDICATOR	EUROPEAN UNION	ROMANIA	POLAND
Gross domestic expenditure on R&D (% of GDP)	2.24%	≈0.46%	≈1.41%
National Digital Decade roadmap budget	€288.6 billion (aggregate national roadmaps)	Romania allocates 22% of its Recovery and Resilience Plan (€5.8 billion) to digital transformation, complemented by €2.7 billion (9%) in cohesion policy funding for digitalisation.	Poland's Digital Decade roadmap comprises 55 measures with a total budget of €12.4 billion, equivalent to 1.47% of GDP.
AI human capital (ICT specialists / digital skills)	Shortage of AI specialists remains an EU-wide challenge.	High share of ICT graduates but low basic digital skills.	Improving digital skills, yet shortages of advanced ICT specialists persist.
Digital infrastructure	Continuous investment in HPC, cloud, AI factories and data spaces,	Very strong fixed broadband connectivity; AI and semiconductor initiatives	Strong broadband infrastructure; investment in AI, quantum computing and cybersecurity
Enterprises using at least one AI technology	19.95%	5.21%	8.36%

Source: Author's synthesis based on specialized literature.

The EU benefits from a considerably larger investment base and a more mature research, infrastructure, and innovation ecosystem. Overall, the indicators point to a *multi-dimensional AI development gap* between the EU and the two Central and Eastern European economies examined. Poland appears to have a comparatively stronger AI development environment than Romania, particularly in terms of R&D intensity, digital investment, and enterprise AI adoption. Romania possesses important assets in ICT human capital and digital connectivity, but these advantages are not yet sufficiently translated into AI adoption and innovation outcomes. Romania's policy challenge is not simply to increase digital connectivity, but to *strengthen the mechanisms linking R&D, ICT skills, investment, innovation ecosystems, and enterprise adoption*. Poland's comparatively stronger performance suggests that higher R&D intensity and larger digital transformation investments may contribute to a more favourable environment for AI diffusion, although a causal relationship cannot be established from these descriptive indicators alone.

5.1 AI investment

The European Union has significantly strengthened its strategic commitment to AI through programmes such as *Horizon Europe*, the *Digital Europe Programme*, the AI Factories initiative, and the implementation of the AI Act. These initiatives are designed to reinforce Europe's technological sovereignty, expand high-performance computing (HPC) infrastructure, and accelerate the development and deployment of trustworthy AI applications (European Commission, 2025a).

According to the OECD, total artificial intelligence investment in the European Union was estimated at approximately €257 billion in 2023 (range: €220–294 billion), with private investment accounting for 73% of total AI expenditure (Fonteneau et al., 2025). AI-related investment was concentrated primarily in skills development (41%), followed by data and equipment (37%), research and development (13%), and other intellectual property assets (9%), highlighting the strategic importance of human capital and digital infrastructure in strengthening the EU's AI ecosystem. It is important to distinguish between *three different measures of AI investment*, because they are often confused in the literature (Table 3).

Table 3: The three different measures of AI investment

INDICATOR	FIGURES	SOURCES
Estimated total AI investment in the EU-27 (all public and private investment)	€220–294 billion	Fonteneau et al. (2025)
EU policy target (Coordinated Plan on AI)	€20 billion annually by 2030	European Commission (2021)
EU27 venture capital (VC) investment in AI companies	From a comparative perspective, in 2025, on the first place was the United States which accounted for approximately 75% of global AI venture capital deal value, equivalent to USD 194 billion, far exceeding the shares of the EU27 (6%; USD 15.8 billion), China (5%; USD 13.9 billion), and the United Kingdom (5%; USD 13.8 billion).	OECD (2026)

Source: Author's synthesis based on specialized literature.

Comparatively, Poland has emerged as one of the leading Central and Eastern European economies in attracting AI and digital-related investment. Public funding has been complemented by increasing private-sector investment, particularly in cloud computing, cybersecurity, and AI applications. According to the European Commission (2025b), Poland has incorporated AI as a strategic priority within its Digital Decade roadmap, supporting the development of digital innovation hubs and AI ecosystems.

Romania has likewise adopted a *National Strategy in the Field of Artificial Intelligence 2024-2027*, for digital transformation and AI development (National Research Authority, 2024). Nevertheless, investment in AI remains relatively limited compared with the EU average. Although Romania benefits from excellent broadband connectivity and a highly qualified ICT workforce, *lower levels of venture capital, research funding, and technology commercialisation continue to constrain AI adoption across enterprises* (European Commission, 2025c).

5.2 AI-related research and development expenditure

Investment in research and development (R&D) represents one of the most important determinants of long-term AI competitiveness. According to Eurostat (2025b), total gross domestic expenditure on R&D (GERD) in the European Union exceeded €403 billion in 2024, corresponding to approximately 2.2% of GDP, reflecting sustained investment in scientific research, innovation, and emerging digital technologies.

Romania remains among the lowest-performing EU Member States in terms of R&D intensity, allocating approximately 0.46% of GDP in 2024 to research and development (ranks last in the EU in R&D funding). This relatively low level of investment limits scientific output, knowledge transfer, innovation capacity, and the commercialisation of AI technologies (Eurostat, 2025b).

By comparison, Poland has achieved a substantially higher level of R&D expenditure than Romania, although it still remains below the EU average. Continuous increases in public investment, together with stronger collaboration between universities, research institutes, and industry, have enhanced Poland's research capacity and strengthened its AI innovation ecosystem (European Commission, 2025b; Eurostat, 2025b).

5.2 AI human capital and the labour market impact

Human capital is widely recognised as a key driver of AI adoption and innovation. Across the European Union, policy initiatives increasingly emphasise investments in digital skills, AI education, reskilling, and lifelong learning to address the growing demand for AI specialists and digitally skilled workers (European Commission, 2025a).

Poland has made considerable progress in strengthening AI-related human capital through digital education programmes, reforms in higher education, and investments in cybersecurity and advanced digital skills. Nevertheless, shortages of AI specialists and highly qualified ICT professionals remain an important structural challenge (European Commission, 2025b).

Romania possesses one of the largest shares of ICT graduates in the European Union and benefits from internationally competitive software engineers. However, *persistent weaknesses in basic digital skills, labour migration (brain drain), and limited collaboration between academia and industry continue to constrain the country's AI innovation capacity* (European Commission, 2025c).

The evidence therefore suggests that the quality, availability, and effective utilisation of human capital are at least as important as the number of ICT graduates.

5.4 Digital infrastructure

Digital infrastructure constitutes the technological foundation for AI development and diffusion. Under the Digital Decade Strategy, the European Union continues to invest in broadband connectivity, cloud computing, high-performance computing (HPC), data spaces, and secure digital infrastructure (European Commission, 2025a).

Romania performs relatively well regarding fixed broadband and very high-capacity network coverage, ranking among the leading EU Member States in several connectivity indicators. However, *cloud adoption, digital public services, and enterprise digitalisation remain below the EU average*, limiting the broader diffusion of AI technologies across the economy (European Commission, 2025c).

Poland has also made substantial progress in broadband infrastructure while investing in cybersecurity, cloud services, AI computing capacity, and quantum technologies.

Nevertheless, the adoption of advanced digital technologies among small and medium-sized enterprises (SMEs) continues to lag behind the EU average (European Commission, 2025b).

6. RESULTS

The cases of Romania and Poland clearly illustrate the limitations of the current European model for the diffusion of advanced technologies. *Despite sharing similar historical and geopolitical backgrounds, the two economies display different levels of AI adoption, indicating that domestic institutional factors, administrative capacity, and the coherence of national strategies play a decisive role in translating European policy initiatives into tangible economic outcomes.* While Poland appears to benefit from a more mature and better-coordinated innovation ecosystem, Romania continues to face structural constraints that limit the integration of artificial intelligence into the business sector.

Overall, the European Union maintains a significant advantage over both Romania and Poland in AI investment, research capacity, digital infrastructure, and innovation ecosystems. Poland has positioned itself as a regional leader in Central and Eastern Europe owing to higher levels of investment, stronger R&D performance, and more advanced digital ecosystems. Romania's comparative advantages lie primarily in ICT talent and digital connectivity; however, persistent underinvestment in research, limited AI adoption by enterprises, and shortages of advanced digital skills continue to hinder AI-driven economic transformation (European Commission, 2025b, 2025c).

7. CONCLUSIONS AND RECOMMENDATIONS

Over the past decade, Artificial Intelligence has emerged as a cornerstone of the global digital economy, profoundly transforming economic activity, organisational processes, and technological development. From a critical perspective, the relatively low level of AI adoption among small and medium-sized enterprises points to a systemic challenge that extends beyond technological costs. It also reflects shortages of advanced digital skills, managerial resistance to organisational change, and the absence of effective policy instruments tailored to the specific needs of SMEs. *Without differentiated public policy interventions, artificial intelligence may reinforce existing economic disparities by disproportionately benefiting large enterprises and technologically advanced economies.*

Moreover, the concentration of AI adoption in sectors such as information and communication and professional services indicates that the diffusion of AI technologies across the real economy remains selective and incomplete. This trend raises important questions regarding the capacity of countries with relatively low levels of digitalisation to integrate AI into traditional sectors such as manufacturing, construction, and logistics, where the potential productivity gains are particularly significant.

In conclusion, artificial intelligence has become a strategic driver of the European Union's economic competitiveness. However, its impact remains strongly conditioned by national and sectoral contexts. *For Romania and other Central and Eastern European economies, narrowing the gap with the EU average requires not only formal alignment with European AI strategies but also the implementation of coherent public policies aimed at developing human capital, strengthening institutional capacity, and promoting AI adoption among small and medium-sized enterprises. Without such measures, artificial intelligence risks becoming a driver of economic polarisation rather than an instrument of European convergence.*

REFERENCES

1. Acemoglu, D., & Restrepo, P. (2019). Automation and new tasks: How technology displaces and reinstates labour. *Journal of Economic Perspectives*, 33(2), 3–30. <https://doi.org/10.1257/jep.33.2.3>.
2. Acemoglu, D., & Restrepo, P. (2022). Tasks, automation, and the rise in U.S. wage inequality. *Econometrica*, 90(5), 1973–2016. <https://doi.org/10.3982/ECTA19815>.
3. Autor, D.H., Levy, F., & Murnane, R. J. (2003). The skill content of recent technological change: An empirical exploration. *The Quarterly Journal of Economics*, 118(4), 1279–1333. <https://doi.org/10.1162/003355303322552801>.
4. AllAboutAI (2025). *The 2026 Global AI Adoption Report: Is Your Country Leading the Revolution*. <https://www.allaboutai.com/resources/ai-statistics/global-ai-adoption>.
5. European Commission (2021). Annexes to the Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions Fostering a European approach to Artificial Intelligence. COM (2021) 205 final. <https://digital-strategy.ec.europa.eu/en/library/coordinated-plan-artificial-intelligence-2021-review>
6. European Commission (2025a). 2025 State of the Digital Decade Report. Publications Office of the European Union. <https://digital-strategy.ec.europa.eu/en/library/state-digital-decade-2025-report?utm>.
7. European Commission. (2025b). Digital Decade Country Report: Poland. Publications Office of the European Union. <https://digital-strategy.ec.europa.eu/en/library/digital-decade-2025-country-reports>.
8. European Commission. (2025c). Digital Decade Country Report: Romania. Publications Office of the European Union. <https://digital-strategy.ec.europa.eu/en/library/digital-decade-2025-country-reports>.
9. European Parliament & Council of the European Union. (2024). *Regulation (EU) 2024/1689 of 13 June 2024 laying down harmonised rules on artificial intelligence (Artificial Intelligence Act)*. Official Journal of the European Union, L 2024/1689.
10. Eurostat (2025a). *Artificial intelligence by size class of enterprise Enterprises using AI technologies*. ec.europa.eu/
11. Eurostat (2025b). Research and development expenditure. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=R%26D_expenditure.
12. Fonteneau, F., Mollins, J., Marchi, S., Russo, L., Gentaz, A., Daoud, M., & André, (2025). *Advancing the measurement of investments in artificial intelligence*. OECD Artificial Intelligence Papers No. 47. OECD Publishing. <https://doi.org/10.1787/13e0da2f>.
13. IBM (2025). *Global AI Adoption Index 2025*. IBM Institute for Business Value. <https://www.ibm.com/think/news/stanford-hai-2025-ai-index-report>.
14. McKinsey (2025a). *Superagency in the workplace: Empowering people to unlock AI's full potential*. <https://www.mckinsey.com/capabilities/tech-and-ai/our-insights/superagency-in-the-workplace-empowering-people-to-unlock-ais-full-potential-at-work>.
15. McKinsey (2025b). *The State of AI in 2025: Agents, innovation, and transformation*. <https://www.mckinsey.com/capabilities/quantumblack/our-insights/the-state-of-ai>.
16. Microsoft (2026a) *Work Trend Index: Agents, human agency, and the opportunity for every organization*. <https://www.microsoft.com/en-us/worklab/work-trend-index/agents-human-agency-and-the-opportunity-for-every-organization>.

17. Microsoft (2026b). *Global AI Adoption in 2025: A widening digital divide*. <https://www.microsoft.com/en-us/corporate-responsibility//topics/ai-economy-institute/reports/global-ai-adoption-2025>.
18. National Research Authority (2024). National Strategy in the Field of Artificial Intelligence 2024-2027. <https://www.research.gov.ro/programe-nationale/strategia-nationala-in-domeniul-inteligentei-artificiale-2024-2027>.
19. OECD (2026). Venture capital investments in artificial intelligence through 2025. https://www.oecd.org/content/dam/oecd/en/publications/reports/2026/02/venture-capital-investments-in-artificial-intelligence-through-2025_3bcb227f/a13752f5-en.pdf.
20. PwC (2026). *AI Global Jobs Barometer 2026: Two futures for jobs in an AI era*. <https://www.pwc.be/en/fy26/documents/global-ai-jobs-barometer.pdf>.
21. Stanford Institute for Human-Centred Artificial Intelligence (Stanford HAI) (2026). The 2026 AI Index report. Stanford University. <https://hai.stanford.edu/ai-index/2026-ai-index-report>.
22. World Economic Forum. (2025). *The Future of Jobs Report 2025*. Geneva. https://reports.weforum.org/docs/WEF_Future_of_Jobs_Report_2025.pdf.