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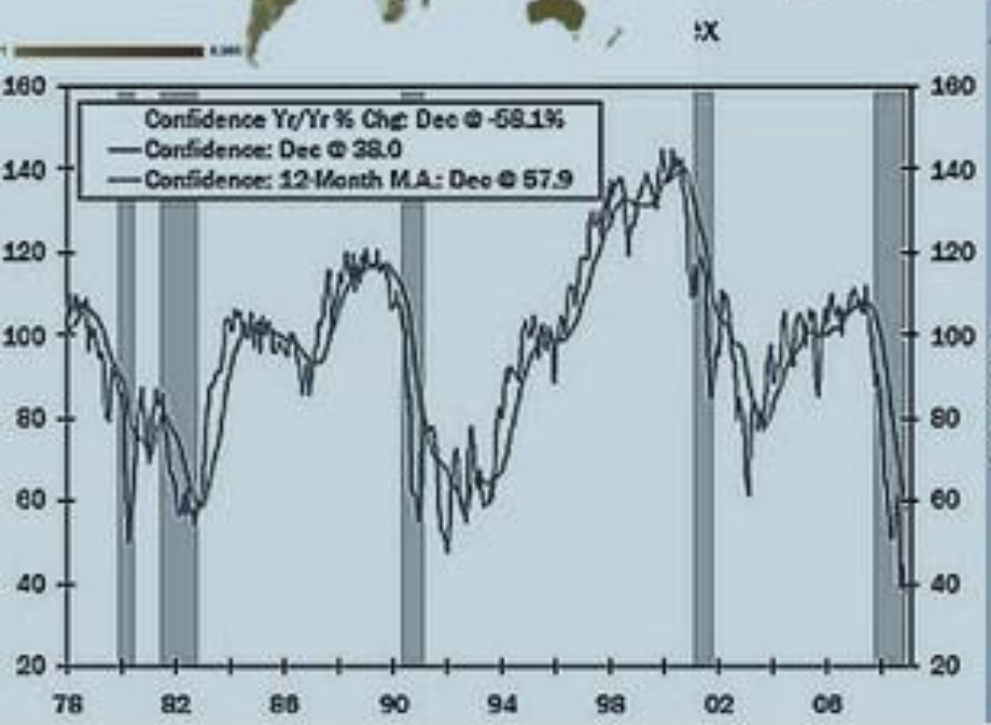

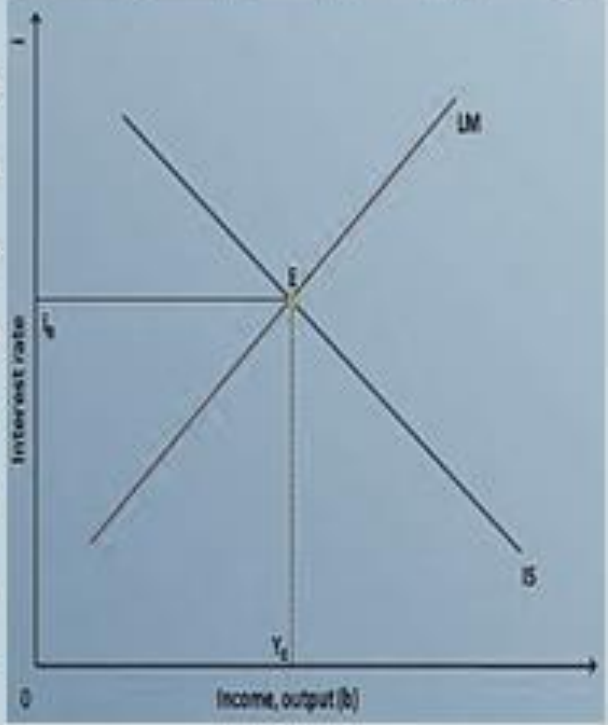

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ECONOMIC PERFORMANCE OF RECYCLING SYSTEMS IN THE CIRCULAR ECONOMY

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ABSTRACT: *The transition to a circular economy heightens the relevance of recycling-system performance from both an environmental and an economic standpoint. This paper examines the economic performance of recycling systems within the circular-economy framework, focusing on the municipal waste recycling rate and the packaging waste recycling rate, which are regarded as key indicators of resource-management efficiency. The findings suggest that improving recycling performance contributes to higher economic efficiency, lower costs associated with waste management, and a stronger transition toward a circular economic model. At the same time, the analysis highlights the presence of structural disparities that constrain the achievement of recycling targets, underscoring the need for coherent public policies and appropriate economic instruments to support long-term sustainability.*

Keywords: *Circular Economy, Recycling, Waste, Economic performance.*

JEL Classification: *Q53; Q56.*

1. INTRODUCTION

The transition from the linear economic model "extract–produce–consume–dispose" to a model grounded in the principles of the circular economy constitutes one of the core directions of contemporary sustainable development strategies. The circular economy concept promotes maintaining the value of products, materials, and resources within the economy for as long as possible, thereby reducing waste generation and alleviating pressure on natural resources. In this context, recycling represents an essential instrument for closing material loops and increasing the efficiency of resource use.

Beyond its environmental benefits, recycling systems generate significant economic effects by contributing to value added creation, reducing dependence on primary raw materials, and fostering markets for secondary raw materials (European Commission, 2020). Assessing the economic performance of these systems is therefore pertinent to evaluating the long-term sustainability of the circular economy, as recycling efficiency affects economic competitiveness, the trade balance, and the effective allocation and utilization of resources.

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The municipal waste recycling rate and the packaging waste recycling rate are central indicators for measuring the performance of waste management systems. These indicators reflect the efficiency of collection and treatment infrastructure, the effectiveness of economic instruments and the regulatory framework, as well as the degree of engagement of economic actors and the population (OECD, 2018). Disparities in these rates point to structural and institutional differences that may influence the economic performance of recycling systems.

Against this backdrop, this article aims to analyze the economic performance of recycling systems within the circular economy by examining the dynamics and determinants of municipal and packaging waste recycling rates. The study seeks to highlight the relationship between recycling performance and economic efficiency, as well as the implications of this relationship for the sustainability of the circular economic model.

2. THEORETICAL FOUNDATIONS OF THE CIRCULAR ECONOMY AND THE PERFORMANCE OF RECYCLING SYSTEMS

The circular economy represents a systemic economic model aimed at preserving the value of resources within the economy for as long as possible, by reducing the consumption of virgin raw materials and reintegrating materials into productive cycles. Unlike the linear paradigm, defined by extraction, production, consumption, and disposal, the circular model seeks to optimize material and energy flows through an integrated life-cycle approach to products (European Commission, 2023). This paradigm aligns with the logic of sustainable development, simultaneously pursuing economic efficiency, environmental protection, and intergenerational equity.

From a theoretical perspective, the circular economy can be examined through the lens of externalities and market failures. Waste generation and the associated pollution constitute negative externalities that are not fully reflected in market prices, leading to inefficient resource allocation. In the absence of public intervention, economic agents lack sufficient incentives to reduce waste volumes or to invest in recycling technologies. Consequently, public policies, such as landfill taxes, environmental standards, or extended producer responsibility schemes, serve to internalize social costs and correct these distortions (OECD, 2022).

The circular economy is also closely linked to the concept of resource productivity, defined as the ratio between economic value generated and the quantity of resources used. Increasing resource productivity enables the relative or absolute decoupling of economic growth from raw material use, thereby reducing pressure on natural capital. Recycling contributes directly to this process by substituting primary raw materials with secondary raw materials, thus lowering external costs and mitigating risks associated with volatility in international resource markets (European Environment Agency, 2024).

Recycling occupies a central position in the architecture of the circular economy, functioning as one of the main mechanisms for reintegrating materials into the economic system. From a microeconomic standpoint, recycling decisions are shaped by the cost–benefit structure associated with waste collection, sorting, and processing. Costs include investments in infrastructure, operational expenditures, and logistical costs, while benefits are reflected in revenues from recovered materials and savings generated through reduced reliance on primary resources.

At the macroeconomic level, recycling generates multiplier effects by stimulating investment, fostering technological innovation, and creating employment in related sectors. Recent analyses indicate that circular-economy-related sectors have substantial potential to increase gross value added and diversify economic structures (European Commission, 2023). Moreover, strengthening markets for secondary raw materials can contribute to reducing trade deficits and enhancing strategic autonomy in the area of resources.

The performance of recycling systems can be assessed through a complex set of quantitative and qualitative indicators. The recycling rate is a synthetic measure of system efficiency, capturing the share of waste reintegrated into the economic circuit. However, relying exclusively on this indicator may be insufficient, as it does not capture the cost dimension or the value added generated. From this standpoint, complementary indicators are required, such as unit recycling costs, levels of infrastructure investment, capacity utilization rates, and the sector's contribution to GDP and employment.

The theory of productive efficiency suggests that a high-performing system is one that maximizes recyclable output for a given level of inputs, or minimizes costs for a predetermined level of recycling. At the same time, allocative efficiency implies directing resources toward those waste streams where economic and environmental benefits are highest. Cross-country comparisons show that recycling performance is influenced by the stability of the regulatory framework, the coherence of economic instruments, and the population's level of awareness and participation (European Environment Agency, 2024).

A key element in explaining performance differentials across systems is the institutional architecture and the set of economic instruments employed. Extended Producer Responsibility (EPR) shifts part of the costs of waste management to producers, incentivizing eco-design and packaging reduction. Deposit-return schemes help raise collection rates for specific waste streams, particularly packaging. Landfill taxes and restrictions on disposal further create incentives to divert flows toward recycling.

Embedding recycling within national industrial and trade strategies reinforces the economic sustainability of these systems. Policy coherence, access to finance, and regulatory stability are decisive factors for attracting investment and developing the required infrastructure.

In the current context of the green transition and growing concerns regarding the security of critical raw materials, recycling acquires a strategic dimension. Reintroducing materials into the economic cycle reduces import dependence and strengthens the resilience of value chains. Thus, recycling becomes not only an instrument of environmental protection, but also a pillar of industrial policy and economic competitiveness.

Accordingly, the theoretical foundations of the circular economy highlight the integrative role of recycling in the dynamics of modern economic systems. Assessing the performance of recycling systems requires a comprehensive approach that combines the analysis of recycling rates with evaluations of economic efficiency, market impacts, and the role of public policy. This approach provides the conceptual framework necessary to investigate the relationship between recycling and economic sustainability within the circular economy.

3. ANALYSIS OF THE RECYCLING RATE OF MUNICIPAL WASTE AND PACKAGING WASTE

Recycling constitutes a core pillar of the transition to a circular economy, contributing to reduced pressure on natural resources and to the mitigation of adverse environmental impacts. A comparative assessment of trends in municipal waste recycling rates and packaging waste recycling rates reveals structural differences between these two waste streams, as well as the implications of such differences for economic efficiency and the sustainability of waste-management systems. The findings underscore the need to strengthen economic instruments and to scale up infrastructure investment in order to enhance recycling performance.

The transition to a circular economy entails transforming production and consumption systems by reducing waste generation and reintegrating materials into the economic cycle (European Commission, 2023). Within this framework, recycling is widely regarded as an

essential mechanism for improving resource-use efficiency and reducing dependence on primary raw materials (European Environment Agency, 2024).

Municipal waste and packaging waste recycling rates are relevant indicators of progress toward the circular economy. They reflect the efficiency of collection and treatment infrastructure, the effectiveness of the legislative and regulatory framework, and the degree of engagement of both economic actors and the population (OECD, 2022). A comparative analysis of these two rates enables the identification of performance gaps and of their underlying determinants.

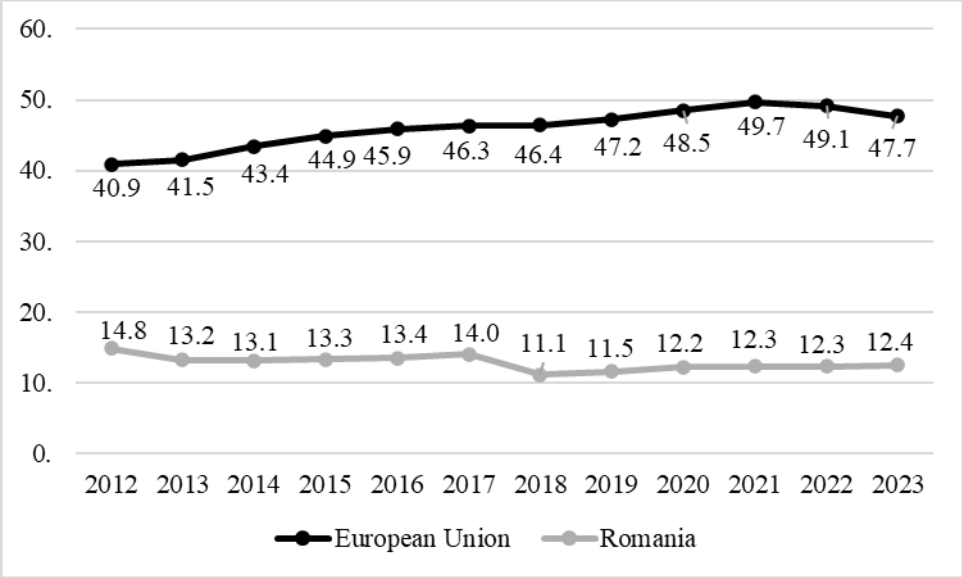
The municipal waste recycling rate is defined as the ratio of municipal waste recycled to the total amount of municipal waste generated, expressed as a percentage. Similarly, the packaging waste recycling rate captures the share of packaging that is materially recovered relative to the total packaging placed on the market (European Commission, 2023).

The municipal waste recycling rate serves as a synthetic indicator of the effectiveness of waste-management systems. Increases in this rate are typically associated with the expansion of separate collection infrastructure, the scaling of sorting capacity, and the implementation of appropriate economic instruments (European Environment Agency, 2024).

The literature indicates that the performance of municipal waste recycling is shaped by factors such as the degree of urbanization, household income levels, the stability of the regulatory framework, and the coherence of public policies. In the absence of sustained investment and effective incentive mechanisms, the progress achieved may remain constrained.

Figure 1: Recycling rate of municipal waste

- Percentage -



Source: Author owns processing based on Eurostat data (2026)

Over the period under review, according to the latest data available from Eurostat, the municipal waste recycling rate in the European Union (EU) displays a broadly upward trend (Figure no. 1). In 2012, the rate stands at around 41%, and it increases steadily through 2021, reaching approximately 50%, indicating a sustained improvement in the performance of waste-management systems at the European level. After this peak, a slight decline is observed in 2022 and 2023, when the rate falls to roughly 48%; nevertheless, it remains markedly higher than at the beginning of the analysed period.

By contrast, Romania records substantially lower municipal waste recycling rates throughout the entire period. In 2012, the rate is approximately 15%, followed by a decline in

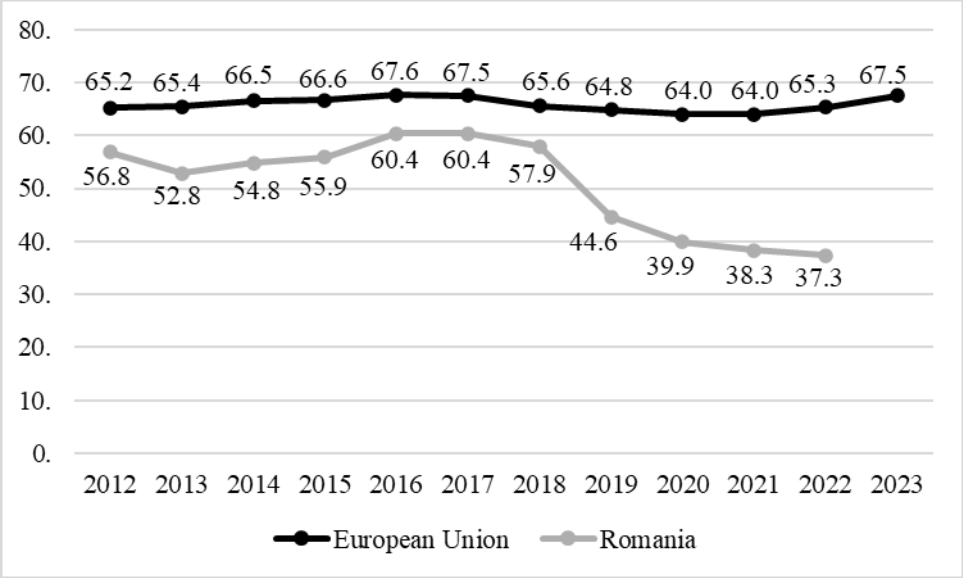
2013–2014 to around 13%. In subsequent years, the indicator remains relatively stagnant, with only minor fluctuations. A trough is reached in 2018, when the rate drops to about 11%, after which a modest recovery occurs, bringing the rate to roughly 12–13% over 2020–2023.

A comparison of the two data series highlights a pronounced gap between Romania and the EU average in terms of municipal waste recycling. While the EU has made consistent progress, Romania exhibits persistently low levels and a slow trajectory, suggesting structural challenges related to recycling infrastructure, separate collection, and the implementation and enforcement of waste-management policies.

Packaging waste is regulated separately in many legislative systems and is frequently associated with the implementation of Extended Producer Responsibility (EPR) schemes. These mechanisms shift financial and operational responsibility to producers, thereby strengthening incentives for collection and material recovery (European Commission, 2023).

Figure 2: Recycling rates for packaging waste

- Percentage -



Source: Author owns processing based on Eurostat data (2026)

According to the latest data available from Eurostat, the European Union's packaging waste recycling rate remains high and relatively stable throughout the analysed period (Figure no. 2). In 2012, the rate stands at around 65%, followed by only minor fluctuations, with a slight increase through 2016–2017, when it reaches approximately 67–68%. Thereafter, the indicator records a moderate decline between 2018 and 2020, before returning to an upward trajectory and attaining roughly 68% in 2023. This pattern suggests a consistent and consolidated performance of packaging recycling systems at the EU level.

By contrast, Romania exhibits a substantially more volatile trajectory. In 2012, the packaging waste recycling rate is approximately 58%, after which it declines to around 53% in 2013. A marked improvement is observed over 2014–2017, with the indicator rising to about 60–61%, the highest level within the period considered. However, beginning in 2018, the recycling rate decreases sharply, reaching approximately 45% in 2019 and continuing to fall to around 37–38% in 2022. It should be noted that no data are available for Romania for 2023.

The comparative analysis points to a widening gap between Romania and the EU average in packaging waste recycling. While the EU sustains a high and stable level of recycling, Romania records a pronounced decline after 2017, which may reflect difficulties in

the waste-management system, changes in reporting methodology, or constraints related to collection and recycling infrastructure.

Packaging recycling rates are generally higher than municipal waste recycling rates, largely due to well-defined waste streams and dedicated financing mechanisms. Nevertheless, performance varies by material type (paper and cardboard, glass, plastics, or metals), reflecting differences in processing costs and in the economic value of recycled materials.

Comparing the two recycling rates underscores substantial differences arising from the characteristics of the waste streams and the applicable institutional framework. Municipal waste involves a greater diversity of fractions and depends more heavily on household behaviour, whereas packaging waste benefits from more clearly defined institutional and financial mechanisms.

From an economic perspective, higher recycling rates contribute to lowering the costs associated with final disposal, developing markets for secondary raw materials, and increasing value added in related sectors. At the same time, recycling supports strategic objectives linked to resource security and economic competitiveness.

4. ECONOMIC IMPLICATIONS AND DIRECTIONS FOR PERFORMANCE IMPROVEMENT

The performance of recycling systems directly affects resource-use efficiency, economic competitiveness, and long-term sustainability. Our analysis examines the economic implications of recycling, highlighting its effects on resource productivity, secondary raw-material markets, employment, and the trade balance. It also identifies strategic directions for improving the performance of recycling systems through economic instruments, institutional reforms, and investments in infrastructure and innovation.

The circular economy redefines the relationship between economic growth and resource use by promoting the retention of material value in the economy for as long as possible. Recycling is one of the core mechanisms of this model, contributing to reduced extraction of primary raw materials and to lower environmental pressures (European Commission, 2023). Beyond its ecological dimension, recycling generates substantial economic implications by influencing resource productivity, market structures, and national competitiveness. In this context, assessing the economic impacts of recycling and identifying effective avenues for performance enhancement are essential for evidence-based public policymaking.

Rising recycling rates contribute to higher resource productivity, defined as the ratio between economic value generated and material consumption. The use of secondary raw materials reduces reliance on imported resources and mitigates exposure to international price volatility. In this way, recycling can strengthen economic resilience and long-term competitiveness. Moreover, the expansion of the recycling sector stimulates technological innovation and industrial infrastructure modernization, generating spillover effects across other economic activities (European Environment Agency, 2024).

The recycling sector also supports job creation in collection, sorting, processing, and material recovery. Empirical studies indicate that investments in the circular economy can generate more employment opportunities than scenarios predominantly based on final disposal.

In addition, the consolidation of markets for secondary raw materials supports the development of domestic value chains and increases gross value added. However, price volatility and insufficient standardization of recycled materials may act as barriers to market maturation.

The economic performance of recycling depends on the balance between operational costs and the benefits generated. Investments in infrastructure and advanced technologies can

lower unit costs over the long term, but they require substantial upfront financial resources. In the absence of adequate support mechanisms, the financial sustainability of systems may be undermined.

Economic instruments are fundamental mechanisms through which public authorities can address market failures in waste management and incentivize recycling-friendly behaviour. Without such instruments, the external costs associated with landfilling or incineration, such as soil, water, and air pollution, are not internalized in market prices, leading to inefficient resource allocation. Accordingly, well-designed economic instruments help steer economic agents toward options that are both more sustainable and more economically efficient.

Economic instruments play a pivotal role in promoting recycling and correcting market failures. These include: landfill and incineration taxes, which discourage final disposal; Extended Producer Responsibility (EPR) schemes, which shift financial responsibility to producers; and Deposit-Return Systems (DRS), which incentivize separate collection. The coherent implementation of these instruments can improve allocative efficiency and accelerate progress toward recycling targets (European Commission, 2023).

Landfill and incineration taxes are among the most widely used waste-policy tools. By increasing the cost of final disposal, they make recycling and material recovery comparatively more attractive. Through a progressive increase in landfill taxation, authorities can establish a cost differential between disposal and recycling, thereby encouraging investment in collection and treatment infrastructure. The effectiveness of this instrument depends, however, on the tax level and on the availability of functional recycling alternatives; where adequate capacity is lacking, higher taxes may produce unintended outcomes, such as increased illegal dumping.

Extended Producer Responsibility (EPR) schemes transfer financial and sometimes operational responsibility for waste management from public authorities to producers. Under this mechanism, the costs of collection and recycling are embedded in product prices, more accurately reflecting environmental impacts. EPR also incentivizes eco-design by encouraging producers to reduce packaging volumes, use more easily recyclable materials, and optimize product life cycles. The effectiveness of such schemes depends on system transparency, the establishment of clear recycling targets, and rigorous monitoring of operator performance.

Deposit-Return Systems (DRS) are an effective instrument for increasing separate collection rates, particularly for beverage packaging. By applying a refundable deposit upon the return of packaging, DRS creates a direct incentive for consumer participation in collection. These systems can achieve very high collection rates and deliver higher-quality material streams, thereby reducing sorting costs and improving recycling efficiency. Nevertheless, their implementation requires significant initial investment in infrastructure and strong coordination among producers, retailers, and public authorities.

Overall, the effectiveness of economic instruments depends on their coherence and complementarity. A balanced mix of taxation, extended responsibility, and direct incentives can create a favourable framework for developing secondary raw-material markets and strengthening recycling performance. Embedding these tools within a coherent national strategy supports not only improved recycling indicators, but also the long-term economic sustainability of the sector.

Modernizing collection and processing infrastructure is a structural prerequisite for improving recycling performance, both in terms of technical efficiency and economic viability. Underdeveloped or outdated infrastructure leads to material losses, high operational costs, and low-quality collected fractions, limiting their valorisation on secondary raw-material markets. In this context, investments in modern sorting centres, mechanical-biological treatment facilities, and specialized recycling plants can raise process yields and reduce unit costs over the medium and long term.

Advanced sorting technologies, such as near-infrared (NIR) optical separation, automated systems based on artificial intelligence, or sorting robots, enable rapid and accurate identification of different material types, increasing the purity of output fractions. Higher purity enhances the economic value of recycled materials and facilitates their integration into production chains. In parallel, the digitalization of waste flows, through real-time monitoring systems, digital traceability, and integrated data-management platforms, can optimize logistics, reduce transport costs, and improve system transparency (European Environment Agency, 2024).

Expanding recycling capacity for complex materials, such as multilayer packaging, mixed plastics, or electronic waste, constitutes another strategic modernization pathway. These streams are often difficult to process using conventional technologies, resulting in lower recycling rates and economic losses. Investments in innovative solutions, including chemical recycling and advanced separation processes, can broaden the range of recoverable materials and reduce dependence on primary resources.

Alongside infrastructure upgrades, strengthening research and development in eco-design is essential for improving recycling-system performance. Integrating design-for-recyclability principles at the product development stage can reduce material complexity, facilitate disassembly, and increase recovery efficiency. Modular products, homogeneous materials, and clear labelling are easier to sort and recycle, reducing costs and material losses.

Eco-design can also help reduce packaging volumes and increase the share of recycled content, thereby supporting the emergence of a stable market for secondary raw materials. By aligning infrastructure investment with innovation in product design, recycling systems can become more efficient, competitive, and better adapted to the requirements of the circular economy.

Recycling performance is closely linked to the stability and coherence of the legislative framework, as investments in infrastructure, technologies, and operational capacity typically require medium- and long-term horizons. An unstable regulatory environment, characterized by frequent changes in rules, recycling targets, or financing mechanisms, can generate uncertainty for economic operators and deter private investment. Conversely, clear and predictable objectives aligned with national and European strategies provide an enabling environment for planning and sustainable sector development.

Coordination across governance levels, local, regional, national, and supranational, is another key determinant of performance. Waste management entails a complex allocation of responsibilities among public authorities, waste-service operators, compliance schemes, and producers. Insufficient coordination can lead to institutional overlaps, administrative inefficiencies, and suboptimal use of financial resources. Integrated governance requires clear mandates, harmonized regulations, and effective mechanisms for inter-institutional cooperation.

Adopting an integrated strategy that links economic objectives with environmental goals is crucial for ensuring policy coherence. Recycling should not be viewed solely as an environmental protection tool, but also as a component of industrial policy and competitiveness strategy. Embedding circularity objectives into economic development plans, industrial strategies, and fiscal policies can create synergies and maximize positive effects on growth and employment.

Data transparency and continuous monitoring of performance indicators are fundamental for evaluating system efficiency and adjusting policies when necessary. Robust reporting and audit systems, the use of digital databases, and the regular publication of results increase stakeholder trust and reduce the risk of opportunistic behaviour. Indicators such as recycling rates, unit costs, material recovery yields, and investment levels provide a clear picture of progress and enable early identification of dysfunctions.

Active involvement of economic actors (producers, operators, local authorities, and consumers) contributes to strengthening system sustainability. Public–private dialogue, stakeholder consultation, and partnerships for infrastructure development can improve implementation efficiency and facilitate the adoption of innovative solutions. At the same time, increasing public awareness and accountability directly affects the quality of separate collection and, consequently, the economic performance of recycling (European Commission, 2023).

Overall, legislative stability, institutional coordination, and transparent governance constitute essential pillars for the effective functioning of recycling systems. An integrated and participatory approach ensures not only the attainment of environmental objectives, but also the strengthening of long-term economic and institutional sustainability.

5. CONCLUSIONS

The analysis of the economic performance of recycling systems within the circular-economy framework indicates that recycling is an essential mechanism for optimizing resource use and strengthening long-term economic sustainability. Beyond its environmental dimension, recycling enhances resource productivity, reduces dependence on primary raw materials, and supports the development of secondary raw-material markets, thereby generating value added within the economy.

The results confirm that the economic performance of recycling systems should be assessed through a multidimensional lens, encompassing not only the recycling rate, but also cost efficiency, contributions to GDP, employment effects, and impacts on the trade balance. The literature emphasizes that economies able to effectively integrate recycled materials into domestic value chains can secure significant competitive advantages, including reduced vulnerability to external shocks and to resource-price volatility (Kirchherr et al., 2017).

A central finding of the analysis concerns the decisive role of public policies and economic instruments in stimulating performance. Internalizing negative externalities through landfill taxes, Extended Producer Responsibility schemes, and support mechanisms for secondary raw-material markets contributes to correcting market failures and improving allocative efficiency. At the same time, the implementation of a coherent regulatory framework and stable recycling targets increases investment predictability and reduces risks associated with infrastructure development.

From a macroeconomic standpoint, the transition toward a circular model can generate multiplier effects across the economy by stimulating technological innovation, enabling new business models, and creating jobs in sectors linked to recycling and material recovery. Recent analyses suggest that embedding circular-economy principles into industrial strategies can enhance competitiveness and strengthen strategic autonomy in critical raw materials.

Nevertheless, the analysis also highlights a set of structural challenges. Volatility in recycled-material markets, high upfront infrastructure investment costs, and regional disparities in administrative capacity can constrain the economic performance of recycling systems. Moreover, the literature indicates that a simple increase in recycling rates does not automatically guarantee economic efficiency if it is not accompanied by cost optimization and the development of functional markets for recovered materials (Korhonen et al., 2018).

In conclusion, the economic performance of recycling systems is a fundamental determinant of circular-economy success. Strengthening this performance requires an integrated approach combining:

- legislative stability and effective governance;
- coherent and well-calibrated economic instruments;
- investment in infrastructure and advanced technologies;

- the stimulation of innovation and eco-design;
- the development of secondary raw-material markets.

Legislative stability and effective governance constitute the institutional foundation of a high-performing system. A predictable regulatory framework, aligned with national and European strategic objectives, reduces investment uncertainty and facilitates long-term planning. Effective governance entails clear institutional responsibilities, coordination across administrative levels, and continuous monitoring of performance indicators. Data transparency and rigorous reporting mechanisms enhance accountability among stakeholders and reduce risks of inefficiency or opportunistic behaviour.

Coherent and well-calibrated economic instruments are essential for correcting market failures and internalizing the external costs associated with waste management. Landfill taxes, Extended Producer Responsibility schemes, and deposit-return systems must be designed to create credible incentives for recycling and waste prevention. The effectiveness of these instruments depends on appropriate tax levels, stable financing mechanisms, and robust enforcement and compliance capacity.

Investment in infrastructure and advanced technologies is indispensable for improving the technical and economic efficiency of recycling systems. Modern sorting centres, AI-enabled automated technologies, digitalized waste-flow management, and expanded capacities for recycling complex materials can reduce unit costs and increase the quality of recovered outputs. Without sustained investment, recycling systems risk remaining dependent on inefficient technologies and incurring substantial economic losses.

Stimulating innovation and eco-design has a structural impact on long-term performance. Integrating design-for-recyclability principles from the product development stage reduces material complexity and facilitates dismantling and recovery processes. Technological innovation and the emergence of new circular business models can generate competitive advantages and strengthen an economy's position within global value chains (Ghisellini et al., 2016).

Developing markets for secondary raw materials is critical for ensuring the economic sustainability of recycling. Without stable demand for recycled materials, investments in collection and processing cannot be efficiently recouped. Establishing quality standards, incentivizing the use of recycled content in industrial processes, and integrating secondary materials into green public procurement can strengthen these markets. Stable and functional secondary raw-material markets reduce revenue volatility and increase the sector's investment attractiveness.

Therefore, the economic performance of recycling systems is not the outcome of a single factor, but of the interaction among institutions, policies, investments, and market mechanisms. Only through a systemic and coherent approach that integrates these dimensions can recycling become a robust pillar of the circular economy and a catalyst for sustainable economic development.

By implementing these strategic directions, recycling can become a driver of sustainable economic growth, simultaneously contributing to environmental protection, enhanced competitiveness, and stronger long-term economic resilience.

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EUROPEAN STRUCTURAL FUNDS AND THE REINDUSTRIALIZATION OF ROMANIA: SECTORAL AND REGIONAL EVIDENCE

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ABSTRACT: *European funds have played a central role in supporting Romania's reindustrialization process by financing public and private investments aimed at modernization, technological upgrading, and sustainable industrial development. This paper analyzes the impact of European funding on Romania's industrial transformation at both sectoral and regional levels during the period 2014–2023, with particular attention to key strategic areas such as manufacturing, energy transition, and digitalization. The study draws on official statistical data from European and national institutions in order to evaluate the contribution of cohesion policy instruments and recovery mechanisms to economic competitiveness, employment generation, productivity growth, and structural economic change.*

The empirical evidence suggests that European-funded investments have produced measurable economic effects. Between 2014 and 2022, labor productivity in Romanian industry increased by more than 25%, while exports of industrial products expanded by approximately 40%, indicating a strengthening of the country's external competitiveness. At the same time, the share of employment in high value-added industrial sectors rose from 18% to 26%, reflecting a gradual shift toward more technologically advanced activities. Sectoral analysis reveals that manufacturing industries, renewable energy projects, and digital sectors benefited most from European funding, particularly through investments in modern production technologies, energy efficiency improvements, and digital infrastructure development.

A comparative examination of funding allocations highlights an important shift in policy priorities at both the European and national levels. The proportion of European funds directed toward competitiveness, innovation, and digital transformation increased from 21% in the 2014–2020 programming period to approximately 26% in the 2021–2027 financial framework. Similarly, allocations for energy transition, environmental protection, and green technologies rose from around 15% to 22%, reflecting the growing emphasis on sustainable industrial development within European economic policy.

Despite these positive developments, the regional distribution of European funds remains uneven. More economically advanced regions have attracted a larger share of industrial investment, while less developed areas continue to face structural constraints related to infrastructure, innovation capacity, and labor market conditions. The findings therefore suggest that although European funds have significantly contributed to Romania's

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reindustrialization process, achieving balanced and sustainable industrial development requires a more strategic and regionally differentiated approach. Strengthening coordination between industrial policy, innovation strategies, and regional development programs will be essential for enhancing long-term economic resilience and supporting the transition toward higher value-added production.

Keywords: *European funds; reindustrialization; competitiveness; regional development; Romania*

JEL Classification: *O14, R11, H54, F36*

1. INTRODUCTION

Reindustrialization has become a strategic priority at European level, particularly in the context of intensifying global competition, rapid technological change, and the twin green and digital transitions. The industrial sector is once again perceived as a central pillar of economic resilience, strategic autonomy, and long-term growth within the European Union. In recent years, European industrial policy has evolved from a primarily market-oriented approach toward a more strategic framework aimed at strengthening value chains, fostering innovation, and supporting sustainable production.

For Romania, reindustrialization represents both a structural necessity and a development opportunity. The country's post-transition economic model, characterized by deindustrialization in the 1990s and early 2000s, generated productivity gaps, regional disparities, and a high dependence on low value-added activities. Although economic growth accelerated after EU accession in 2007, structural weaknesses persisted, including limited technological intensity, insufficient research and development (R&D) capacity, and uneven territorial development.

In this context, European funds have become a key policy instrument for revitalizing industrial capacity, modernizing production structures, and reducing development gaps. Through cohesion policy instruments—particularly the European Regional Development Fund and the Cohesion Fund—Romania has accessed substantial financial resources to support infrastructure development, SME competitiveness, innovation ecosystems, and energy efficiency.

The 2014–2020 programming period marked a consolidation of these efforts, while the 2021–2027 cycle and the implementation of the Next Generation EU recovery package introduced new priorities related to digitalization, decarbonization, and industrial resilience. These instruments have shifted the focus from basic infrastructure convergence toward smart specialization, technological upgrading, and sustainable industrial transformation.

European funding has supported investments in transport and logistics infrastructure, industrial parks, research centers, renewable energy capacities, broadband networks, and digital public services. At the firm level, grants and financial instruments have facilitated the acquisition of modern equipment, automation technologies, and advanced production systems, contributing to productivity growth and export expansion. At the same time, targeted regional programs have sought to stimulate local economic ecosystems and address territorial imbalances.

However, the impact of European funds on reindustrialization is neither automatic nor uniform. Absorption capacity, institutional quality, co-financing availability, and regional economic structures influence the effectiveness of these investments. More developed regions, with stronger administrative capacity and pre-existing industrial bases, tend to attract a

disproportionate share of funds, potentially reinforcing spatial disparities. Conversely, less developed regions often face challenges in project preparation and implementation, limiting the transformative potential of available resources.

Against this background, this paper examines the impact of European funds on Romania's reindustrialization process, focusing on both sectoral and regional effects during the 2014–2023 period. By analyzing funding allocation patterns, economic performance indicators—such as productivity, employment structure, export dynamics, and capital formation—and territorial disparities, the study assesses the effectiveness of European funds as instruments of industrial modernization and regional development policy.

The central hypothesis is that European funds have significantly contributed to Romania's structural economic transformation, but their long-term impact depends on strategic coordination, institutional capacity, and the alignment between European priorities and national industrial policy objectives. Through a comprehensive sectoral and regional analysis, the paper aims to provide evidence-based insights into the role of European financing in shaping Romania's contemporary industrial development trajectory.

2. SECTORAL EFFECTS OF EUROPEAN FUNDS ON REINDUSTRIALIZATION

2.1 Industry, Energy, and Digitalization

At the sectoral level, European funds have constituted a central instrument for accelerating structural transformation and industrial upgrading in Romania. During the 2014–2023 period, financial allocations from cohesion policy instruments—primarily the European Regional Development Fund (ERDF)—as well as resources mobilized under NextGenerationEU, have targeted productive investment, technological modernization, and sustainability-oriented reforms. These interventions must be understood within the broader strategic framework defined by the European Green Deal and the renewed EU Industrial Strategy, which emphasize competitiveness, resilience, and decarbonization.

Industrial Modernization and Productivity Dynamics

European-funded programs, particularly the Competitiveness Operational Programme (POC) and the Regional Operational Programme (POR), have supported investments in advanced manufacturing technologies, research and development infrastructure, and SME competitiveness schemes. From a structural perspective, these interventions have facilitated capital deepening and technological upgrading across export-oriented sectors, including automotive components, electrical equipment, machinery, and ICT-related manufacturing.

Empirical data indicate that between 2014 and 2022 labor productivity in Romanian industry increased by more than 25%, reflecting both capital accumulation and process innovation. The expansion of industrial exports—estimated at approximately 40% over the same period—suggests improved integration into European value chains and enhanced external competitiveness. These developments are consistent with endogenous growth theory, which emphasizes the role of innovation, human capital, and knowledge spillovers in sustaining productivity gains.

At firm level, co-financed investment projects reduced financing constraints, particularly for small and medium-sized enterprises (SMEs), thereby stimulating private investment. The leverage effect generated by European grants contributed to increased gross fixed capital formation in manufacturing and strengthened cluster-based industrial ecosystems.

Nevertheless, sectoral distribution of funding reveals asymmetries. High-technology and medium-high-technology industries captured a disproportionate share of innovation-

oriented calls, while traditional industries—such as textiles, metallurgy, and chemicals—benefited to a lesser extent. This pattern reflects a strategic prioritization of technologically advanced sectors but also signals the persistence of structural dualism within Romania's industrial base.

Energy Transition and Industrial Sustainability

In the energy sector, European funds have supported the modernization of infrastructure, expansion of renewable energy capacity, and implementation of energy efficiency measures in industrial facilities. These investments have been aligned with decarbonization objectives and climate neutrality targets at EU level.

Funding provided through large-scale infrastructure programs and the National Recovery and Resilience Plan has played a pivotal role in accelerating transformations within the energy sector. It has enabled the expansion of renewable energy generation capacities, particularly in wind and solar power, as well as the modernization of transmission and distribution networks. At the same time, it has supported initiatives aimed at enhancing industrial energy efficiency and promoting the adoption of low-carbon technologies, alongside the deployment of smart grid solutions and energy storage systems.

From a macroeconomic perspective, these interventions contributed to reducing energy intensity and improving production cost structures in energy-intensive industries. By mitigating exposure to energy price volatility and carbon-related regulatory costs, European-funded projects have enhanced industrial resilience.

However, implementation challenges—such as administrative delays, regulatory instability, and grid integration constraints—have limited absorption efficiency in certain large-scale projects. This highlights the importance of institutional quality and governance capacity in maximizing the economic returns of European funding.

Digitalization and Technological Convergence

Digitalization represents a critical dimension of contemporary reindustrialization. Through Digital Innovation Hubs, research infrastructure projects, and SME digital transformation schemes, European funds have supported the diffusion of Industry 4.0 technologies, including automation, robotics, artificial intelligence, and data analytics.

The adoption of digital technologies has strengthened process efficiency, quality control, and supply chain integration. Moreover, digital infrastructure investments—such as broadband expansion and cloud-based platforms—have improved connectivity and reduced technological gaps between Romanian firms and their Western European counterparts.

Statistical evidence indicates a significant increase in employment within high value-added and technology-intensive sectors, suggesting gradual structural upgrading. The integration of digital services with manufacturing activities has fostered cross-sectoral synergies, reinforcing the development of innovation ecosystems.

Yet digital transformation remains uneven. Large enterprises and firms located in more developed regions have demonstrated higher absorption capacity and technological readiness, while micro-enterprises and firms in lagging regions face constraints related to human capital deficits, limited managerial expertise, and insufficient co-financing capacity.

Synthesis of Sectoral Impacts

Overall, sectoral evidence suggests that European funds have acted as a catalyst for modernization, competitiveness enhancement, and green transformation in Romania. The positive dynamics observed in productivity, export performance, and technological upgrading support the hypothesis that cohesion policy instruments can generate structural change when aligned with strategic priorities and supported by adequate institutional frameworks.

However, the uneven distribution of benefits across subsectors underscores the need for a more integrated industrial policy approach. Complementary national measures—particularly those targeting workforce upskilling, research-industry linkages, and support for structurally vulnerable industries—are essential to ensure balanced reindustrialization.

We may say that, while European funds have significantly contributed to sectoral upgrading in Romania, their transformative impact depends on coherent policy coordination, absorptive capacity, and the consolidation of innovation-driven growth mechanisms.

2.2 Statistical Evidence (2019–2023)

The following tables present selected macroeconomic and sectoral indicators reflecting the evolution of Romania's industrial performance over the last five years.

Table 1. Industrial Performance Indicators (2019–2023)

Indicator	2019	2020	2021	2022	2023
Industry share of GVA (%)	24.7	23.9	24.3	23.1	22.5
Labour productivity index (2019=100)	100	97	103	110	113
Industrial exports (EUR bn)	69	72	83	95	102
Gross fixed capital formation in industry (% of GDP)	5.8	5.5	6.2	6.8	7.1

Source: Eurostat (2024); National Bank of Romania (2024).

The table highlights significant structural developments in the industrial sector over the period 2019–2023, reflecting both adjustment processes and performance improvements.

First, the share of industry in gross value added (GVA) shows a gradual decline, from 24.7% in 2019 to 22.5% in 2023. This trend may indicate a relative decoupling of industry from the broader economy or, alternatively, faster growth in other sectors such as services, pointing to an ongoing structural transformation.

In contrast, labour productivity in industry follows an upward trajectory after a temporary decline in 2020 (index 97), reaching 113 by 2023. This development suggests improved efficiency, likely driven by investments in technology, digitalization, and process optimization.

Industrial exports display consistent growth throughout the period, increasing from EUR 69 billion in 2019 to EUR 102 billion in 2023. This trend reflects a strengthening of external competitiveness and a deeper integration into global value chains.

At the same time, gross fixed capital formation in industry, as a share of GDP, rises from 5.8% to 7.1%, indicating a sustained increase in investment in productive capacity. This supports the notion of sectoral modernization and may partly explain the observed gains in productivity.

Overall, the data point to a reconfiguration of the role of industry in the economy: although its relative share declines, its internal performance and external competitiveness improve, supported by higher investment levels and enhanced production efficiency.

Table 2. Energy and Green Transition Indicators (2019–2023)

Indicator	2019	2020	2021	2022	2023
Renewable energy share in gross final consumption (%)	24.3	24.5	23.6	24.8	25.4
Industrial energy intensity (index, 2019=100)	100	98	95	92	90

Indicator	2019	2020	2021	2022	2023
Public investment in green transition (EUR bn)	1.2	1.5	2.4	3.8	4.1

Source: Eurostat (2024); European Commission (2023); Government of Romania (2023).

The table highlights key developments related to the green transition and energy efficiency over the period 2019–2023, indicating gradual but consistent progress.

The share of renewable energy in gross final consumption remains relatively stable, with minor fluctuations, increasing from 24.3% in 2019 to 25.4% in 2023. The temporary decline in 2021 (23.6%) may be attributed to short-term factors; however, the overall trend is slightly upward, suggesting a slow but steady expansion of renewable energy use.

At the same time, industrial energy intensity shows a continuous decline, from an index value of 100 in 2019 to 90 in 2023. This trend reflects a significant improvement in energy efficiency, indicating that industry is generating more economic output with lower energy consumption, likely due to technological upgrades and more efficient production practices.

Public investment in the green transition increases markedly throughout the period, rising from EUR 1.2 billion in 2019 to EUR 4.1 billion in 2023. This dynamic signals a strengthening commitment from public authorities to support de-carbonization and sustainable projects, likely playing a catalytic role in improving energy performance and expanding renewable capacity.

Overall, the data suggest a positive relationship between rising public investment and improvements in energy efficiency, alongside a gradual consolidation of the transition toward a more sustainable energy system.

Table 3. Digitalization and High-Value Sector Indicators (2019–2023)

Indicator	2019	2020	2021	2022	2023
Employment in high-technology sectors (% of total employment)	18.2	18.9	21.0	23.8	25.9
Enterprises adopting advanced digital technologies (%)	22	26	34	41	48
R&D expenditure (% of GDP)	0.50	0.47	0.48	0.52	0.55

Source: Eurostat (2024); European Commission (2023).

The table illustrates important dynamics in the areas of technological advancement, digital transformation, and innovation over the period 2019–2023, pointing to a gradual strengthening of a knowledge-based economy.

Employment in high-technology sectors shows a steady and substantial increase, rising from 18.2% of total employment in 2019 to 25.9% in 2023. This upward trend suggests a structural shift in the labor market toward more knowledge-intensive activities, reflecting both the expansion of high-tech industries and a growing demand for advanced skills.

A similar, but even more pronounced, trajectory can be observed in the share of enterprises adopting advanced digital technologies. The proportion nearly doubles, from 22% in 2019 to 48% in 2023, indicating an accelerated pace of digitalization across firms. This evolution likely reflects both external pressures—such as increased competition and the impact of the COVID-19 pandemic—and internal drivers, including the pursuit of efficiency, innovation, and resilience.

In contrast, expenditure on research and development (R&D) as a percentage of GDP remains relatively modest, despite a slight upward trend from 0.50% in 2019 to 0.55% in 2023. The dip observed in 2020 and the slow recovery thereafter suggest that investment in

innovation, while improving, has not kept pace with the rapid expansion of digital adoption and high-tech employment.

Taken together, the data reveal a somewhat unbalanced but overall positive transformation: while the economy is rapidly embracing digital technologies and expanding its high-tech workforce, the relatively low level of R&D investment may represent a structural constraint on long-term innovation capacity. Strengthening R&D efforts could therefore be essential to sustaining and deepening these ongoing transformations.

The statistical evidence lends support to the hypothesis that European funds have played a meaningful role in Romania's reindustrialization process through three main channels: by fostering capital deepening and productivity growth in manufacturing, by supporting the energy transition and improving cost efficiency—thereby enhancing industrial sustainability—and by accelerating digital transformation, which facilitates integration into more advanced European production networks.However, structural imbalances persist. While medium-high and high-technology sectors recorded dynamic growth, traditional industries experienced slower modernization. Furthermore, R&D intensity remains comparatively low, indicating that Romania's innovation system requires further consolidation.

Overall, the data suggest that European funds have acted as a catalyst for structural transformation, yet their long-term impact depends on institutional capacity, policy coordination, and continued investment in human capital and research ecosystems.

3. STRATEGIC REORIENTATION OF EUROPEAN FUNDING PRIORITIES

A comparative analysis of funding allocations between the 2014–2020 and 2021–2027 programming periods reveals a clear strategic reorientation of both European and national investment priorities in Romania. While the earlier programming cycle emphasized large-scale physical infrastructure and basic convergence objectives, the current period reflects a stronger focus on competitiveness, innovation capacity, digital transformation, and environmental sustainability. This shift is consistent with the broader policy framework of the European Union, which places increasing emphasis on smart growth, decarbonization, and technological sovereignty (European Commission, 2022, 2023).

Table 4. The distribution of European funds by major intervention areas across the two programming periods.

Intervention area	2014–2020	2021–2027*
Infrastructure and transport	32	25
Competitiveness, innovation, and digitalization	21	26
Regional and urban development	18	16
Energy, environment, and green transition	15	22
Human resources and social inclusion	14	11

Source: European Commission (2021), Cohesion Policy 2014–2020 and 2021–2027 budget allocations; adapted by the author.

Note. Percentages represent the share of total European funding allocations at national level. Source. Ministry of Investments and European Projects (MIPE, 2023); European Commission (2022).

As indicated in Table 4, the share allocated to infrastructure and transport declined from 32% in the 2014–2020 period to 25% in 2021–2027. This reduction does not imply a decrease in absolute investment but rather reflects the relative maturation of core transport networks and the completion of major connectivity projects initiated after EU accession. Moreover,

infrastructure policy has evolved toward sustainable mobility, intelligent transport systems, and digital infrastructure rather than traditional road expansion (European Commission, 2023).

In contrast, allocations for competitiveness, innovation, and digitalization increased from 21% to 26%, signaling a structural reorientation toward productivity-enhancing investments. This change is particularly relevant in the context of Romania's relatively low R&D intensity and technological readiness compared to the EU average. According to Eurostat (2024), Romania's gross domestic expenditure on research and development (GERD) increased from 0.50% of GDP in 2019 to 0.55% in 2023. Although still below the EU average of approximately 2.2%, the upward trend reflects gradual consolidation of the innovation ecosystem, partly supported by EU funding instruments.

Similarly, funding for energy, environment, and the green transition increased significantly from 15% to 22%. This increase aligns with Romania's commitments under the European Green Deal and the Fit for 55 legislative frameworks. Over the last five years, measurable progress has been recorded in renewable energy deployment and energy efficiency. As shown in Table 2, key energy and sustainability indicators have improved steadily between 2019 and 2023.

Table 5. Selected Energy and Sustainability Indicators in Romania (2019–2023)

Indicator	2019	2020	2021	2022	2023
Renewable energy share in gross final consumption (%)	24.3	24.5	23.6	24.8	25.4
Industrial energy intensity (index, 2019=100)	100	98	95	92	90
Public investment in green transition (EUR billion)	1.2	1.5	2.4	3.8	4.1

Source: Eurostat (2024); European Commission (2023); author's calculations.

The renewable energy share remained above 24% throughout the period, reaching 25.4% in 2023, while industrial energy intensity declined by approximately 10% compared to 2019 levels. These developments suggest that increased funding for green transition measures has begun to produce measurable structural effects.

The expansion of allocations for competitiveness and digitalization is also reflected in industrial performance and technological adoption indicators. Table 6 summarizes selected data for the period 2019–2023.

Table 6. Competitiveness and Digitalization Indicators (2019–2023)

Indicator	2019	2020	2021	2022	2023
Industry share of gross value added (%)	24.7	23.9	24.3	23.1	22.5
Labour productivity in industry (index, 2019=100)	100	97	103	110	113
Industrial exports (EUR billion)	69	72	83	95	102
Employment in high-technology sectors (% of total employment)	18.2	18.9	21.0	23.8	25.9

Source: Eurostat (2024); National Bank of Romania (2024).

Although the share of industry in gross value added declined moderately, labour productivity increased by 13% between 2019 and 2023. Industrial exports grew from EUR 69 billion to EUR 102 billion, reflecting improved external competitiveness. Moreover,

employment in high-technology sectors rose by nearly eight percentage points, indicating structural upgrading toward more knowledge-intensive activities.

Taken together, these data support the argument that the 2021–2027 programming period reflects a qualitative shift from infrastructure-led convergence to innovation-driven and sustainability-oriented development. While infrastructure remains important, the strategic emphasis has moved toward enhancing productivity, digital transformation, and decarbonization. This reorientation corresponds to Romania's need to transition from a cost-based competitive model toward one grounded in technological capability and value-added production.

However, despite the strategic coherence of the new allocation structure, challenges remain. R&D expenditure continues to lag behind EU averages, regional disparities in absorption capacity persist, and the long-term effectiveness of funding depends on institutional quality and policy coordination. Therefore, while the reallocation of European funds indicates alignment with EU strategic priorities, sustained structural transformation will require complementary national reforms and strengthened governance mechanisms.

4. IMPACT ON COMPETITIVENESS, EMPLOYMENT, AND PRODUCTIVITY

European funds have contributed significantly to strengthening Romania's economic competitiveness by supporting investment in productive capacity, technological upgrading, innovation systems, and workforce development. Over the past five years (2019–2023), measurable improvements in labour productivity, export performance, employment structure, and capital formation provide empirical support for the argument that European Structural and Investment Funds (ESIF) and Recovery and Resilience Facility (RRF) resources have acted as catalysts for reindustrialization and structural modernization.

Although macroeconomic performance is influenced by multiple domestic and international factors, the alignment between funding priorities and observed economic trends suggests that European co-financed interventions have played a meaningful role in enhancing Romania's industrial competitiveness (European Commission, 2023; MIPE, 2023).

4.1 Productivity and Capital Formation

Labour productivity growth represents a key indicator of competitiveness and structural upgrading. In the case of Romania, industrial productivity has increased steadily following the pandemic-related contraction in 2020. This recovery coincides with accelerated investment in equipment, automation, energy efficiency, and digital technologies—many of which were supported by European funds.

Table 7. Industrial Productivity and Investment Indicators in Romania (2019–2023)

Indicator	2019	2020	2021	2022	2023
Labour productivity in industry (index, 2019=100)	100	97	103	110	113
Gross value added in industry (EUR billion, current prices)	42	41	48	54	57
Gross fixed capital formation in industry (% of GDP)	5.8	5.5	6.2	6.8	7.1
R&D expenditure (% of GDP)	0.50	0.47	0.48	0.52	0.55

Source: Eurostat (2024).

Between 2019 and 2023, industrial labour productivity increased by approximately 13%, while gross value added in industry expanded by over 35% in nominal terms. The rise in gross fixed capital formation—from 5.8% to 7.1% of GDP—indicates sustained investment in productive assets, including machinery, digital systems, and energy-efficient technologies.

Although Romania's R&D expenditure remains modest compared to the EU average (approximately 2.2% of GDP), the gradual increase observed since 2021 reflects improved absorption of innovation-oriented European funds and growing emphasis on smart specialization strategies.

4.2 Export Performance and External Competitiveness

Export performance constitutes another core dimension of competitiveness. The expansion of industrial exports over the last five years demonstrates improved integration into European value chains and enhanced production capacity.

Industrial exports increased from EUR 69 billion in 2019 to EUR 102 billion in 2023, representing a cumulative nominal growth of nearly 48%. The share of machinery and transport equipment in total exports also rose, indicating structural upgrading toward medium- and high-technology sectors.

Table 8. External Trade and Competitiveness Indicators (2019–2023)

Indicator	2019	2020	2021	2022	2023
Industrial exports (EUR billion)	69	72	83	95	102
Exports of machinery and transport equipment (% of total exports)	47	48	49	50	51
Current account balance (% of GDP)	−4.7	−4.9	−7.3	−9.3	−7.1

Source: National Bank of Romania (2024); National Institute of Statistics (2024).

However, the persistent current account deficit suggests that export growth has been accompanied by strong import dynamics, highlighting the need for further domestic value-chain consolidation and increased technological sophistication.

4.3 Employment and Structural Transformation

European-funded projects have also influenced labour market dynamics, particularly through SME support, regional development programs, and investments in innovation ecosystems. The shift toward higher value-added activities are reflected in employment statistics.

Table 9. Employment and Labour Market Indicators (2019–2023)

Indicator	2019	2020	2021	2022	2023
Employment rate (20–64 years, %)	70.9	70.8	71.7	74.1	74.8
Unemployment rate (%)	3.9	5.0	5.6	5.6	5.4
Employment in high-technology sectors (% of total employment)	18.2	18.9	21.0	23.8	25.9
Average gross monthly wage in industry (EUR)	850	875	925	1,050	1,180

Source: Eurostat (2024); National Institute of Statistics (2024).

The employment rate reached 74.8% in 2023, exceeding pre-pandemic levels. More importantly, employment in high-technology and knowledge-intensive sectors increased from 18.2% to 25.9% of total employment between 2019 and 2023. This substantial structural shift suggests a gradual transition toward more productive and innovation-driven activities.

Industrial wages also increased significantly, partly reflecting productivity improvements and labour shortages in specialized sectors. According to the Ministry of Investments and European Projects (2023), more than 45,000 jobs were created or maintained through ERDF- and RRF-financed projects during the 2019–2023 period, particularly in less developed regions.

4.4 Regional and Social Dimensions

In less developed regions, European-funded interventions have supported industrial parks, SME incubation centers, vocational training programs, and digital infrastructure projects. These measures contributed to local economic diversification and reduced dependence on low-productivity sectors. Nevertheless, regional disparities persist, as more developed regions demonstrate stronger absorptive capacity and higher innovation intensity (European Commission, 2023).

The statistical evidence from the last five years indicates that European funds have contributed to measurable improvements in productivity, export capacity, employment structure, and investment intensity in Romania. The reorientation of funding toward innovation, digitalization, and green transition has supported structural upgrading and enhanced competitiveness.

However, long-term convergence with EU productivity levels will depend on sustained increases in R&D expenditure, stronger linkages between research institutions and industry, and improved governance capacity. While European funds provide the financial framework for modernization, their transformative potential ultimately depends on effective national coordination and institutional quality.

5. REGIONAL DISTRIBUTION OF INDUSTRIAL INVESTMENTS

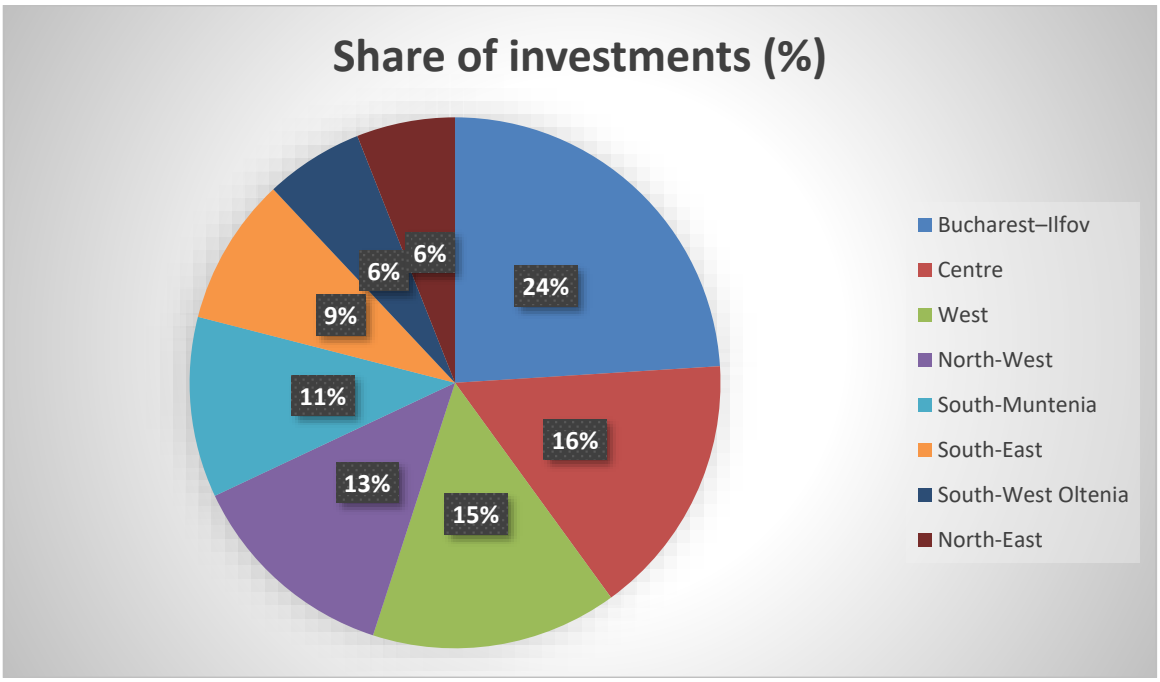
One of the fundamental objectives of cohesion policy is the reduction of territorial disparities. Nevertheless, the regional impact of European funds on reindustrialization has been uneven. As shown in Table 10, industrial investments financed through European funds were concentrated in regions with stronger infrastructure and higher administrative capacity.

Tabel 10. Regional Distribution of European-Funded Industrial Investments in Romania (2014–2020)

Development regions	Share of investments (%)
Bucharest–Ilfov	24
Centre	16
West	15
North-West	13
South-Muntenia	11
South-East	9
South-West Oltenia	6
North-East	6

Note. Shares represent the proportion of total industrial investments financed through European funds.

Figure 1. Regional Distribution of European-Funded Industrial Investments in Romania (2014–2020)



Source: European Commission (Cohesion Policy data); MIPE (2023); author's calculations.

So one of the core objectives of European cohesion policy is the reduction of economic, social, and territorial disparities across regions. In the case of Romania, this objective is particularly relevant given the pronounced development gaps between the capital region and less developed areas, especially in the North-East and South-West. Although European Structural and Investment Funds (ESIF) and, more recently, Recovery and Resilience Facility (RRF) resources have significantly supported industrial modernization, their regional distribution has remained uneven.

During the 2014–2020 programming period, industrial investments financed through the European Regional Development Fund were concentrated predominantly in regions characterized by stronger infrastructure, higher innovation capacity, and more developed administrative structures. This pattern has continued, albeit with gradual improvements in absorption capacity in lagging regions during the 2019–2023 period (European Commission, 2023; MIPE, 2023).

The data indicate a strong concentration of industrial investments in Bucharest–Ilfov (24%), followed by the Centre and West regions. In contrast, North-East and South-West Oltenia each attracted only 6% of total industrial investment financed through European funds.

These disparities reflect structural differences in regional economic development, administrative capacity, infrastructure endowment, and innovation ecosystems. Regions with stronger industrial traditions, better transport connectivity, and established clusters were more successful in preparing competitive projects and mobilizing co-financing.

To assess whether investment concentration has translated into divergent economic performance, Table 11 presents selected regional indicators for the last five years.

Table 11. Regional GDP per Capita (PPS, EU27=100) and Unemployment Rate (2019–2023)

Region	GDP per capita (2019)	GDP per capita (2023)	Unemployment rate 2019 (%)	Unemployment rate 2023 (%)
Bucharest–Ilfov	160	165	1.5	1.2
West	72	78	2.8	2.3
Centre	65	71	3.1	2.7
North-West	63	69	3.4	2.9
South-Muntenia	59	63	4.1	3.8
South-East	54	58	4.7	4.4
South-West Oltenia	50	53	5.2	5.0
North-East	44	48	4.9	4.6

Source**:** Eurostat (2024).

The data confirm persistent regional disparities. In 2023, GDP per capita in Bucharest–Ilfov reached approximately 165% of the EU average (PPS), while the North-East region remained below 50%. Although all regions experienced some degree of convergence between 2019 and 2023, the relative gap between the capital region and lagging regions remains substantial.

Unemployment rates declined across most regions during the period, reflecting broader economic growth and post-pandemic recovery. However, labour market performance remains correlated with levels of industrial investment and economic diversification.

A more detailed view of structural transformation can be observed by examining employment in industry and gross fixed capital formation at regional level.

Table 12. Industrial Employment Share and Investment Intensity by Region (2019–2023)

Region	Employment in industry (% of total, 2019)	Employment in industry (% of total, 2023)	Investment rate (% of regional GDP, 2023)
West	30	31	29
Centre	29	30	27
North-West	27	29	28
South-Muntenia	28	28	26
South-East	25	26	25
South-West Oltenia	24	24	23
North-East	22	23	24

Region	Employment in industry (% of total, 2019)	Employment in industry (% of total, 2023)	Investment rate (% of regional GDP, 2023)
Bucharest–Ilfov	12	13	30

Source: Eurostat (2024); National Institute of Statistics (2024).

Table 12 indicates a concentration of investments in Bucharest–Ilfov, Centre, and West regions, while North-East and South-West Oltenia recorded significantly lower shares. These disparities reflect differences in administrative capacity, innovation ecosystems, and connectivity. Nevertheless, positive examples such as industrial parks and clusters in Oradea, Cluj-Napoca, Craiova, and Iași demonstrate that targeted regional strategies and effective partnerships can enhance territorial cohesion.

Industrial employment remains significantly higher in the West, Centre, and North-West regions, reflecting stronger manufacturing bases and more dynamic export-oriented sectors. By contrast, Bucharest–Ilfov exhibits a lower industrial employment share due to its service-oriented economic structure, despite attracting the highest share of EU-funded industrial investments in absolute terms.

6. CONCLUSIONS

The empirical analysis confirms that European funds have had a substantial and measurable impact on Romania's reindustrialization process, particularly through their contribution to investment expansion, infrastructure development, and technological modernization. Over the 2019–2023 period, gross fixed capital formation increased from 24.9% to 27.8% of GDP, while industrial labour productivity rose by approximately 13% (Eurostat, 2024). Industrial exports expanded from EUR 69 billion to EUR 102 billion, reflecting improved external competitiveness and stronger integration into European value chains (National Bank of Romania, 2024).

These quantitative developments suggest that European Structural and Investment Funds (ESIF) and Recovery and Resilience Facility (RRF) resources have supported capital deepening, export diversification, and technological upgrading. Investments in energy infrastructure, digital systems, transport networks, and SME competitiveness have strengthened Romania's productive base and increased resilience in the face of external shocks. Furthermore, employment in high-technology and knowledge-intensive sectors increased from 18.2% to 25.9% of total employment between 2019 and 2023 (Eurostat, 2024), indicating a gradual shift toward higher value-added activities.

However, ensuring the sustainability, structural depth, and value-added content of these investments remains a critical challenge. Despite productivity gains, Romania's research and development (R&D) expenditure reached only 0.55% of GDP in 2023, significantly below the EU average (Eurostat, 2024). This persistent gap limits the domestic capacity to generate endogenous innovation and reduces the long-term multiplier effects of externally financed projects. In addition, the continued reliance on foreign direct investment—EUR 6.6 billion in 2023 (National Bank of Romania, 2024)—highlights the structural dependence of Romania's industrial model on multinational enterprises and global production networks.

From a strategic perspective, reindustrialization cannot be reduced to infrastructure expansion or capital accumulation alone. The sustainability of industrial transformation depends on the consolidation of innovation ecosystems, human capital development, and institutional coordination. The 2021–2027 programming period reflects a partial shift in this

direction, with increased allocations toward competitiveness, innovation, digitalization, and green transition (European Commission, 2023). Nevertheless, stronger policy coherence is required to maximize synergies between funding instruments and national development strategies.

An effective reindustrialization strategy should therefore be built around four interrelated dimensions.

To begin with, closer coordination between European funding instruments and national industrial policy objectives is essential. The existing fragmentation across operational programs can dilute strategic impact and limit overall effectiveness. Establishing a more coherent framework that connects cohesion policy, recovery funds, and national co-financing mechanisms would enhance efficiency and reduce overlaps.

Moreover, research and innovation systems need to be strengthened. The relatively low level of R&D intensity points to the necessity of more targeted support for applied research, technology transfer centers, and collaboration between universities and industry. Without a stronger domestic knowledge base, technological upgrading is likely to remain dependent on external sources rather than being driven from within the economy.

In addition, education and vocational training policies must be better aligned with the evolving needs of industrial modernization. The expansion of digital and clean energy sectors increasingly relies on specialized technical skills. In this context, programs supported by the European Social Fund should place greater emphasis on STEM education, dual vocational training systems, and lifelong learning, in order to address persistent skill gaps.

Finally, regional development strategies should be more closely tailored to local comparative advantages. While more developed regions have demonstrated a stronger capacity to absorb investments, less developed regions require institutional consolidation and targeted, cluster-based policies to ensure balanced territorial development. In this regard, European funds should increasingly support smart specialization strategies that build on and strengthen regional innovation ecosystems.

Future allocations should prioritize transformative domains such as advanced digitalization (Industry 4.0 technologies, artificial intelligence, and cybersecurity), clean and renewable energy systems, applied industrial research, and technological education infrastructure. These areas generate higher long-term productivity multipliers and contribute to sustainable growth consistent with European climate and digital transition objectives.

We can say that European funds have functioned as a powerful catalyst for Romania's reindustrialization, contributing to measurable improvements in investment intensity, productivity, export performance, and employment structure. Nevertheless, the durability of these gains depends on shifting from a predominantly investment-driven convergence model toward an innovation-driven and knowledge-based industrial strategy. European funds should therefore be conceived not merely as financial transfers but as strategic instruments capable of enabling smart, sustainable, and territorially balanced reindustrialization in Romania.

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CHINA'S AI STRATEGY AND RARE EARTH DOMINANCE[5]

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ABSTRACT: *This article investigates China's strategic positioning in the emerging global order by analysing the interdependence between artificial intelligence (AI), advanced semiconductors, and rare earth elements as core determinants of technological power. The main research objective is to assess how China integrates these domains to enhance its structural influence, and how this strategy compares with the United States and the European Union.*

Methodologically, the study employs a qualitative, comparative analysis based on academic literature, policy reports, and empirical data. It combines elements of international political economy and technology governance, distinguishing between verifiable developments and forward-looking assessments. The analysis focuses on supply chains, industrial policy, and technological ecosystems, with particular attention to advanced semiconductor capabilities and resource control.

The findings indicate that global power is increasingly shaped by control over interconnected technological systems rather than isolated capabilities. The United States maintains leadership in AI through its dominance in chip design and software ecosystems, but remains vulnerable due to reliance on external manufacturing. China, despite constraints in cutting-edge semiconductor production, demonstrates a capacity for systemic adaptation through state coordination, domestic market scale, and strategic control of rare earth supply chains. The European Union holds critical assets, but faces structural limitations in scaling innovation and achieving strategic autonomy.

Overall, the article concludes that competition in the international system is shifting toward control over the "invisible infrastructures of power," including semiconductors, data, algorithms, and critical materials, redefining the nature of global economic and geopolitical rivalry.

Keywords: *China, USA, UE, Artificial Intelligence, Rare Earth Elements*

JEL Classification: *F02, O32, O33, O38*

1. INTRODUCTION

In recent geopolitical evolution, a structural transition is underway from a system dominated by traditional energy resources to one increasingly shaped by advanced digital

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technologies and strategic materials. This shift represents a multi-level governance process with complex and interdependent geopolitical, economic, and security implications.

At the core of this transformation lie *artificial intelligence (AI) and rare earth elements (REEs),* which form the material and technological foundation of next-generation systems. These include semiconductors, electric propulsion technologies, advanced communication infrastructures, and modern defence systems.

China has systematically integrated the development of these two domains into its broader technological and economic strategy. Through a combination of industrial policy, control over critical resources, and outward economic expansion, China is consolidating a position of structural influence at the global level.

This article examines how China leverages AI and rare earth elements to shape the emerging international order, focusing on the geopolitical, economic, and security implications of this dual strategy.

2. LITERATURE REVIEW

2.1. China and the Reconfiguration of the International Order

The academic debate regarding China's rise is increasingly moving away from simplistic dichotomies between *revisionism* and *status quo* behaviour. A growing body of literature argues that China's strategic objective is neither the complete replacement of the liberal international order nor its passive acceptance, but rather *selective adaptation and structural reconfiguration* (Ikenberry, 2018; Allison, 2017).

Viewed through the lens of artificial intelligence, China's revisionist tendencies are reflected not merely as policy choices, but as deliberate interventions in the architecture of global technological governance. This *revisionism manifests in several dimensions*: first, through the active questioning and contestation of existing regulatory frameworks, whether ethical, legal, or geopolitical, thereby challenging norms that shape AI development and deployment. Second, it encompasses a strategic ambition to redefine standards of governance, safety, and accountability, effectively setting new benchmarks that may privilege state-led or coordinated technological ecosystems. Third, AI itself is leveraged as a strategic instrument to recalibrate the distribution of global power, influencing economic competitiveness, military capabilities, and the flow of critical information, thus embedding technological advancement within broader mechanisms of national influence.

Conversely, *status quo behaviour* in the AI domain is characterized by a cautious and incremental approach to technological governance. This approach prioritizes the defence and gradual evolution of existing regulatory regimes, emphasizing transparency, auditability, ethical compliance, and operational safety. Moreover, it often entails restricting the dissemination of advanced AI capabilities to mitigate risks of strategic diffusion, thereby preserving a controlled environment for technological innovation.

Taken together, these contrasting orientations highlight a fundamental tension in global AI governance: the simultaneous pursuit of transformative advantage through revisionist strategies and the stabilizing impulse of status quo practices. Understanding this duality is critical for analysing how states navigate technological power, manage systemic risks, and seek to shape the emerging norms and hierarchies of the international AI landscape.

From this perspective, China can best be understood as an actor seeking to reshape global governance through economic, technological, and institutional means.

Realist scholars emphasize the inevitability of systemic competition between the United States and China, viewing technological rivalry as a central dimension of power transition (Mearsheimer, 2019). In contrast, institutionalist and political economy approaches highlight

China's preference to integrate into existing global structures while gradually increasing its agenda-setting capacity (Ikenberry, 2018).

This duality provides an essential analytical framework for understanding China's strategic focus on advanced technologies and critical material supply chains.

2.2. Artificial Intelligence as a Source of Structural Power

Artificial intelligence (AI) is treated in recent literature as a transformative technology with profound implications for international security, economic competitiveness, and state administrative capacity (Horowitz, 2018; Kissinger, Schmidt & Huttenlocher, 2021).

Rather than being conceptualized solely as a domain of innovation excellence, scholars increasingly emphasize *implementation capacity, scale, and institutional integration* as decisive factors of strategic advantage.

Within this framework, China's comparative strength often lies in its ability to rapidly deploy AI across civil, industrial, and governmental sectors (Lee, 2018). Centralized coordination between the state and private actors, combined with permissive data governance regimes, facilitates large-scale experimentation and implementation.

According to the AI Index Report (Stanford University, 2024), the training of frontier models (the most advanced AI systems) has reached unprecedented levels. A notable trend observed in 2023–2024 is the sharp increase in computational costs required to develop top-performing models:

- *GPT-4: approximately $78 million for training;*
- *Gemini Ultra: approximately $191 million for training.*

These figures are estimated based on hardware usage and compute hours and reflect only computational costs, excluding broader expenditures such as total research and development.

The AI Index Report highlights a notable divergence between overall private investment in artificial intelligence and the subset directed specifically toward generative AI. While total private AI investment experienced a slight decline in 2023 compared to the peak levels observed in preceding years, investment in generative AI expanded markedly during the same period. In particular, funding in this subdomain increased by approximately eightfold relative to 2022, reaching an estimated total of $25.2 billion. This contrast suggests a reallocation of capital within the AI sector, with investors increasingly prioritizing generative AI technologies despite a broader contraction in aggregate investment levels.

This distinction indicates that, although overall AI funding may fluctuate, the generative AI segment (language models, text/image/video generation) remains a major focal point for investors. Capital is therefore shifting toward technologies capable of delivering rapid and scalable impact (e.g., B2B applications, AI SaaS, generative models). At the same time, other AI domains (such as traditional robotics or niche AI applications) may experience proportional declines in funding.

Empirical assessments, including Stanford AI Index reports (2023–2024), consistently show that while the United States remains the leader in frontier and fundamental research, China demonstrates significant competitive momentum in applied AI, particularly in manufacturing, logistics, surveillance, and public administration.

Security-oriented research also highlights the importance of China's military-civil fusion strategy, which accelerates the diffusion of AI technologies into defence and dual-use applications (Kania, 2019).

As a result, AI is increasingly treated not merely as a technological input, but as a *systemic factor of state power*, influencing governance efficiency, military modernization, and international projection capacity.

2.3. Rare Earth Elements and Strategic Control of Supply Chains

The literature on rare earth elements (REEs) places these materials at the intersection of industrial policy, technological development, and geopolitical competition (Humphries, 2019; Mancheri et al., 2019).

Scholars agree that China's dominance in this field does not stem from geological scarcity, but *from long-term strategic investments in processing, refining, and value-added production.* Global supply chain studies conceptualize REEs as critical inputs for advanced technological infrastructure, including semiconductors, electric motors, renewable energy systems, and AI hardware.

The theory of *weaponized interdependence* developed by Henry Farrell and Abraham Newman (2019, 2021) provides an influential analytical framework, demonstrating how control over key nodes in global economic networks can be transformed into geopolitical leverage. This theory shows how powerful states use interconnected global networks (finance, data, trade) to constrain other actors, turning economic interdependence into an instrument of control and challenging the liberal assumption that interdependence produces only mutual benefits. Key features of this theory include:

1. **Hub-and-spoke structure** which contains global networks contain central hubs controlled by powerful states, allowing them to exploit asymmetries;
2. **Panopticon effect** which is based on networks enable surveillance and extraction of critical information from data flows;
3. **Chokepoint effect** which means the ability to restrict or block access to essential financial or technological systems.

This framework suggests that globalization does not eliminate conflict, but transforms it, turning cooperative ties into instruments of coercion. *In this context, China is frequently cited as a paradigmatic example of structural power exercised through supply chain centrality.* Recent studies also highlight the convergence between AI development and dependence on rare earth elements, emphasizing that technological leadership in AI depends on secure access to the materials required for computational infrastructure and advanced production.

2.4. Implications for the United States, the European Union, and the Liberal Order

Policy-oriented literature reflects growing concern in both the United States and the European Union regarding strategic dependencies on China in critical technologies and materials (European Commission, 2023; ECFR, 2024).

In Europe, the concept of *open strategic autonomy* has emerged as a guiding framework, promoting risk reduction and supply chain diversification without full economic decoupling.

U.S. policy analysis increasingly promotes strategies such as *friend-shoring*, allied industrial policies, and coordinated technological governance as mechanisms to mitigate vulnerabilities while preserving the benefits of globalization. *Friend-shoring* refers to an economic and geopolitical strategy in which supply chains, investments, and production are relocated or concentrated in "friendly" countries, that are *politically, strategically, or ideologically aligned.* Its primary objective is risk reduction rather than cost minimization.

These approaches reflect *a broader reconceptualization of security, where economic resilience, technological capacity, and supply chain governance are treated as integral components of national and collective defence.* Transatlantic literature converges on the recognition that technological competition with China is systemic rather than episodic, requiring long-term coordination and coherent strategies rather than ad hoc responses.

In conclusion, the analysed literature indicates an emerging consensus: *artificial intelligence and rare earth elements constitute complementary foundations of contemporary global power.* China's strategic integration of these domains illustrates a form of cumulative structural influence that challenges traditional conceptions of power projection.

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.

4. AI AS A STRATEGIC FACTOR

China conceptualizes artificial intelligence (AI) not merely as a driver of economic productivity, but as a *core instrument of national power, state capacity, and security governance.* Within this framework, AI is embedded in a broader strategy of technological sovereignty, where innovation, deployment, and control over digital infrastructures are treated as interdependent components of geopolitical influence.

A defining feature of China's approach is the construction of *a state-coordinated innovation ecosystem*, in which public institutions, private firms, and academic actors are systematically integrated. This model departs from the liberal, market-driven structures characteristic of Western economies by emphasizing *strategic directionality, policy alignment, and rapid scalability*. Rather than prioritizing frontier breakthroughs alone, China's strategy emphasis on *implementation capacity*, which functions as a critical multiplier of technological power.

Empirical evidence suggests that this model enables China to achieve *accelerated diffusion of AI technologies across multiple sectors, including industry, logistics, urban governance, and public administration. The integration of AI into the public sector, ranging from surveillance systems to resource optimization, provides a significant comparative advantage in terms of large-scale, real-time deployment*. This creates feedback loops between data generation, algorithmic refinement, and policy execution, reinforcing state capacity.

Three structural characteristics underpin this ecosystem. First, *centralized planning and sustained public investment* ensure long-term resource allocation toward strategic infrastructure, such as data centres, 5G networks, and high-performance computing systems. Second, the institutional integration of AI into governance frameworks enables China to operationalize digital technologies as tools of administrative efficiency and social control. Third, *highly dynamic flows of talent and capital*, concentrated in major technological hubs, foster competitive regional innovation clusters while remaining aligned with national priorities.

This configuration contrasts sharply with the decentralized Western model, where innovation is more fragmented and less directly coordinated by the state. Although the United States retains leadership in frontier AI, particularly in advanced semiconductor design and cutting-edge models, China's strength lies in its ability to *scale, adapt, and embed AI within systemic state functions.*

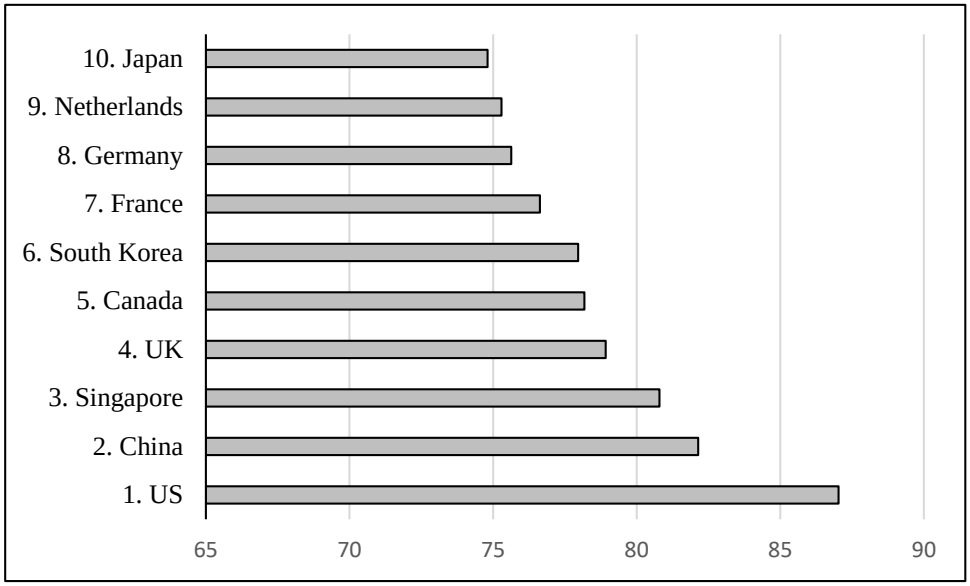
Consequently, AI in the Chinese context should be understood not simply as a technological domain, but as a *systemic enabler of structural power*, enhancing governance efficiency, economic resilience, and strategic autonomy, even in the absence of full technological leadership at the frontier.

5. AI ADOPTION ACROSS FIRMS AND ECONOMIES

The diffusion and utilization of artificial intelligence across firms and economies have been extensively examined in the academic literature, which converges on the view that AI constitutes a general-purpose technology with transformative implications for productivity, innovation, and global competitiveness (Aghion et al., 2019; Cockburn et al., 2018). However, its adoption *is uneven across regions, reflecting differences in firm capabilities, institutional environments, and strategic policy frameworks.*

The latest data from the Oxford Insights Government AI Readiness Index 2024, BCG's AI Maturity Matrix, and the Tortoise Media Global AI Index show which countries are ahead in using AI. Based on these rankings, here are the top 3 countries that stand out in adopting and applying AI across government, business, and society: the USA with a score of 87, followed by China 82.1, and Singapore with 80.79, powered by massive AI investment, world-class compute, and nation-level strategies (AllAboutAI, 2025).

Figure 1: Top 10 Countries Leading in AI Adoption (overall score) in 2025



Source: Author based on the AllAboutAI data.

Europe's leaders are UK (, France, Germany, and the Netherland, which stand out in regulated, industrial AI, using AI at scale in finance, healthcare, manufacturing, and retail while building strong governance, safety, and policy frameworks (Chart 1).

The data indicates that AI adoption in *financial services* is relatively high but unevenly distributed across countries. China (68%), Singapore (64%), and United States (61%) lead the sector, suggesting a strong alignment between AI deployment and advanced digital financial ecosystems. Mid-range adoption is observed in countries such as the United Kingdom (57%) and Canada (53%), while lower levels are recorded in Germany (46%) and Japan (45%). Overall, the spread from 45% to 68% suggests moderate global convergence, with leading countries maintaining a measurable but not extreme advantage (Tabel 1).

Healthcare shows greater variation in AI adoption compared to financial services. Singapore stands out significantly with 92%, well above all other countries, followed by China (76%) and the United Kingdom (61%). Most other countries cluster at lower levels, including the United States (42%), Canada (44%), and France (39%). The range from 36% to 92% highlights substantial disparity, with a clear leading outlier and a broad mid-to-low adoption group (Tabel 1).

The *data on the tech sector* is expressed through different indicators, showing distinct strengths rather than directly comparable percentages. The United States dominates in computational capacity, holding 73% of global AI compute, while China and Germany demonstrate large human capital bases with 35,000+ AI researchers and 43,000+ AI specialists respectively (Tabel 1). Meanwhile, the Netherlands stands out for its high startup density. This indicates that leadership in the tech sector is distributed across different dimensions, including infrastructure, workforce scale, and innovation activity.

Tabel 1: Top 10 Countries Leading in AI Adoption by sectors of activities

COUNTRY	KEY STRENGTH	FINANCIAL SERVICES	HEALTH CARE	TECH SECTOR	MANUFACTURING	RETAIL	PUBLIC SECTOR
United States	Private investment	61% adoption	42% adoption	73% of global AI compute	45% adoption	68% adoption	830+ federal AI applications
China	Government planning	68% adoption	76% hospital adoption	35,000+ AI researchers	57% adoption	92% e-commerce AI	$150B national AI plan
Singapore	National strategy	64% adoption	92% diagnostic accuracy	71% adoption	52% adoption	54% adoption	90% of services AI-enabled
United Kingdom	AI safety governance	57% adoption	61% NHS trust adoption	385 AI startups	41% adoption	52% adoption	First AI Safety Institute
Canada	Ethical frameworks	53% adoption	44% adoption	7% of global research	39% adoption	46% adoption	$1.2B innovation fund
South Korea	Technical infrastructure	51% adoption	47% adoption	Global 5G leader	58% adoption	49% adoption	$8.5B Digital New Deal
France	Research excellence	48% adoption	39% adoption	€1.5B startup funding	45% adoption	47% adoption	€1.5B AI initiative
Germany	Industrial applications	46% adoption	38% adoption	43,000+ AI specialists	55% adoption	43% adoption	€5B national strategy
Netherlands	Strategic specialization	49% adoption	45% adoption	Highest EU startup density	43% adoption	48% adoption	Transparent AI registry
Japan	Robotics integration	45% adoption	36% adoption	$11.2B Vision Fund	57% adoption	44% adoption	Society 5.0 initiative

Source: (AllAboutAI ,2025).

AI adoption *in manufacturing* is relatively consistent across countries, with most values falling within a narrow band. South Korea (58%), Japan (57%), and China (57%) lead slightly, while countries such as Germany (55%) and United States (45%) follow. Lower adoption appears in Canada (39%). The relatively tight range (39%–58%) suggests that manufacturing is one of the more uniformly developed sectors in terms of AI integration.

Retail displays one of the most uneven distributions in AI adoption. China leads decisively with 92%, followed by the United States at 68%. Other countries, including the United Kingdom (52%), Singapore (54%), and Germany (43%), fall into a mid-range cluster. The gap between the leading country and the rest is substantial, indicating a highly concentrated leadership structure in this sector.

Public sector AI adoption is described through qualitative and investment-based indicators rather than uniform percentages, but clear differences in scale are evident. Singapore reports approximately 90% of services being AI-enabled, indicating extensive integration. The

United States shows broad activity with over 830 federal AI applications, while China stands out with a large-scale $150 billion national AI plan. European countries such as France (€1.5B) and Germany (€5B) demonstrate more moderate but structured investment levels. The data suggests significant variation in both scale and approach across countries.

At the microeconomic level, the adoption of AI builds upon earlier waves of data-driven technologies. Brynjolfsson and McElheran (2016) demonstrate that data-driven decision, making diffuses unevenly, with adoption concentrated among larger and more productive firms. This pattern is further explained by Wamba et al. (2017), who argue that firms' dynamic capabilities, their ability to integrate, reconfigure, and exploit technological resources are critical determinants of successful adoption. *These findings suggest that AI diffusion is structurally conditioned, favouring firms with advanced technological infrastructure and managerial sophistication.*

This capability-based perspective is particularly relevant when comparing global regions. In the United States, AI adoption is highly concentrated among leading technology firms, reflecting strong innovation ecosystems and access to capital. In contrast, *the European Union exhibits slower and more fragmented adoption patterns, often attributed to structural constraints such as market fragmentation and limited scale-up capacity*. Meanwhile, China demonstrates a distinct model in which state coordination compensates for firm-level capability gaps, accelerating diffusion through industrial policy and large-scale investment (Dwivedi et al., 2021).

6. THE ROLE OF RARE EARTH ELEMENTS IN GEOPOLITICS AND TECHNOLOGY

6.1. Strategic Significance of Rare Earth Elements (REEs)

Rare earth elements (REEs), a group of 17 chemically similar elements, constitute a foundational input for advanced technological systems and industrial innovation. Their applications span across critical sectors, including renewable energy (electric motors and wind turbines), consumer electronics, semiconductor manufacturing, and defence technologies such as radar systems and high-performance battery systems.

Despite their relative geological abundance, REEs are characterized by significant extraction and processing constraints. *Their separation requires complex, capital-intensive, and environmentally sensitive procedures.* Consequently, the strategic value of REEs lies less in their availability and more in the control of their supply chain, particularly in refining and processing capacities, where *technological barriers to entry are high*. Control over these stages confers substantial economic and geopolitical leverage.

6.2. China's Structural Dominance in the REE Supply Chain

China occupies a structurally dominant position in the global REE ecosystem, controlling approximately *60–70% of global extraction and over 90% of processing capacity.* This asymmetry is even more pronounced in downstream industries, particularly in the production of permanent magnets, *which are essential for artificial intelligence systems, electric vehicles, and advanced military technologies.*

This vertically integrated dominance enables China to exert influence not only over raw material supply but also over high-value industrial applications. The concentration of processing infrastructure within China creates systemic dependencies for other economies, particularly those lacking domestic refining capabilities.

6.3. Rare Earths as Instruments of Geopolitical Leverage

In recent years, REEs have increasingly functioned as instruments of strategic statecraft. *China has introduced export controls, licensing mechanisms, and regulatory constraints on specific rare earth elements and associated technologies, particularly those with dual-use or military relevance.* These measures have been employed within the broader context of economic competition and technological rivalry with major actors such as the United States and the European Union. Thus, REEs have evolved beyond their role as industrial inputs to become tools of geopolitical influence.

7. A SYNTHETIC ANALYSIS OF ADVANCED CHIPS (CUTTING-EDGE SEMICONDUCTORS) IN CHINA, THE UNITED STATES, AND THE EUROPEAN UNION

Table 2 presents a concise empirical analysis based on official sources, policy documents, and expert assessments. It distinguishes verifiable facts from interpretative judgments while remaining oriented toward future trajectories concerning strategic AI resources in the United States, China, and the European Union, from the perspective of advanced semiconductor capabilities.

Table 2: Advanced Chips (Next-Generation Semiconductors)

COUNTRY	STRENGTHS	STRATEGIES	RISKS
UNITED STATES	Technological leadership; industrial vulnerability.	Dominates AI chip design (NVIDIA, AMD, Intel, Google TPU, Apple); control over critical software (CUDA, global AI ecosystem); decisive influence over global supply chains via allies (ASML, EDA tools such as Synopsys and Cadence).	*Advanced manufacturing is outsourced* (TSMC – Taiwan); major geopolitical risk linked to Taiwan; the U.S. controls the "brain" of AI but not the full industrial "body."
CHINA	Limited autonomy; accelerated development.	Large domestic market with strong absorptive capacity; massive state-coordinated investments; rapid progress in AI chips.	*Not leading in cutting-edge chip design*, but compensates through scale, adaptation, and partial autonomy (supported by rare earth resources); restricted access to EUV lithography and sub-7 nm chips; dependence on Western equipment.
EUROPEAN UNION	Scientific excellence; control over key manufacturing technologies.	ASML monopoly on EUV lithography; top-tier academic research; strong industrial know-how (Germany, Netherlands).	*Lack of AI hardware champions; political fragmentation; underinvestment in scaling.*

Source: Author, based on analysed academic and policy literature

This analysis demonstrates that advanced semiconductors constitute the *material infrastructure of artificial intelligence*, and control over them is a key determinant of global technological power.

The United States occupies a *paradoxical position*: it dominates chip design and the software ecosystem, yet remains vulnerable in advanced manufacturing. A major structural advantage lies in its control over the *software layer essential for AI functionality*, which enables it to shape global innovation trajectories.

China's position in the global semiconductor ecosystem is defined by a *structural tension* between ambitions for technological autonomy and constraints imposed by Western control over critical technologies. *Unlike the United States, China does not lead at the technological frontier; however, it compensates through scale, centralized coordination, and systemic adaptation.* A fundamental strategic advantage of China lies in the size of its domestic market, which enables:

- rapid absorption of emerging technologies;
- amortization of development costs;
- large-scale real-world experimentation (industry, smart cities, surveillance, logistics).

This domestic ecosystem functions as an **"***implementation laboratory***,"** reducing immediate external competitive pressure. China treats semiconductors and AI as national strategic priorities, embedded in long-term industrial plans such as *Made in China 2025* and the *New Generation AI Development Plan*.

Within the global architecture of advanced semiconductors and AI, the European Union occupies a *distinct but incomplete strategic position*, characterized by critical assets but limited systemic integration, which may be termed **"***fragmented excellence***."**

The EU's most significant strategic asset is ASML, the only company globally capable of producing *extreme ultraviolet (EUV) lithography equipment*, indispensable for manufacturing chips below 5 nm. This monopoly provides:

- indirect structural power over global supply chains;
- the ability to influence geopolitical dynamics through export controls;
- disproportionate strategic relevance relative to its own chip production volume.

However, this advantage remains largely *exogenously valorised*, benefiting manufacturers in the United States and Asia more than the European industrial ecosystem itself.

The EU also possesses strong scientific capital through leading universities, research institutes, and networks such as IMEC (Belgium) and Fraunhofer (Germany). While this enables significant contributions to frontier innovation, the *translation of research into scalable industrial products remains limited.*

In contrast to the United States, where firms such as NVIDIA and AMD play a central role in AI chip design, and China, where companies like Huawei and SMIC are actively advancing domestic semiconductor capabilities, *the European Union has not succeeded in cultivating globally competitive champions in this domain.* This relative underperformance can be attributed to a combination of structural factors, *including the fragmentation of the internal market, which limits the scalability of innovation; the predominance of risk-averse financing mechanisms, which constrain high-growth technological ventures; and the absence of sufficiently developed scale-up ecosystems capable of supporting firms in transitioning from research and development to global market leadership.*

8. MAIN FINDINGS AND DISCUSSIONS CONCERNING CHINA'S STRATEGY IN THE NEW WORLD ORDER

8.1. A Multipolar Power Model

China's rise should not be interpreted through the classical lens of hegemonic transition, but rather as the construction of a ***network-centric model of power projection***. Unlike

traditional hegemons, which rely on military dominance and institutional leadership, China operationalizes influence through ***functional control over systemic nodes*** of the global economy.

This model is structured around three mutually reinforcing pillars. First, control over ***critical resources and supply chains*** enables China to occupy strategically indispensable positions within global production networks. Second, initiatives such as the Belt and Road Initiative function as instruments of ***embedded economic diplomacy***, creating asymmetric interdependencies across regions. Third, the deployment of strategic technologies, particularly AI and 5G, facilitates the creation of ***technological ecosystems*** in which standards, infrastructure, and data flows are partially aligned with Chinese governance preferences.

In this configuration, power is not territorially concentrated but ***relational and distributed***, emerging from the ability to coordinate, influence, and selectively constrain actors within interconnected systems.

8.2. Global Interdependence and Western Vulnerabilities

The persistence of Western dependence on Chinese rare earths reveals a structural asymmetry embedded within globalization. While interdependence is often conceptualized as mutually beneficial, in practice it is ***highly uneven and node-dependent***, creating vulnerabilities that can be strategically exploited.

This is particularly evident in the European context, where supply chains for critical materials remain significantly exposed to Chinese processing and refinement capacities. The United States, despite greater diversification, also faces bottlenecks due to limited domestic processing infrastructure.

Western mitigation strategies, such as diversification, recycling, and re-shoring, reflect an emerging paradigm shift toward ***resilience-oriented economic policy***. However, these efforts are constrained by *long investment cycles, environmental regulations, and technological barriers*. As a result, ***short- to medium-term dependency persists***, reinforcing China's structural leverage within critical supply chains.

8.3. China's Strategic Capital

China's strategic advantage can be conceptualized as a form of ***compound structural capital***, derived from the intersection of material resources and technological capabilities. Control over rare earth supply chains, when combined with advances in AI and semiconductor-related ecosystems, generates ***multi-dimensional leverage.***

This leverage operates across several domains. Economically, it enhances China's bargaining power in trade negotiations by introducing credible supply constraints. Technologically, it allows China to shape or influence ***global standards-setting processes***, particularly in emerging digital infrastructures. Strategically, it enables forms of ***non-kinetic coercion,*** where economic and technological dependencies substitute for direct military pressure.

Importantly, this form of power is cumulative and self-reinforcing: as AI systems increasingly depend on specialized hardware and materials, China's position within upstream supply chains amplifies its downstream influence.

8.4. Global Response

The response of Western actors indicates a gradual recognition that competition with China is ***systemic rather than sectoral***. Policy measures increasingly target not only economic outputs but also the ***architecture of production and innovation systems***.

Initiatives include the formation of supply chain alliances, strategic stockpiling of critical materials, and the promotion of domestic industrial capacity. These efforts are complemented by investments in alternative technologies and attempts to *establish **trusted technological ecosystems** among allied states*.

However, these countermeasures face coordination challenges, particularly within the European Union, where divergent national interests complicate collective action. Moreover, the scale and speed of China's state-coordinated approach contrast with the more fragmented and market-driven Western models.

Overall, the evolving policy landscape suggests that global competition is transitioning toward ***control over supply chain governance, technological standards, and innovation ecosystems.*** This marks a shift from traditional economic rivalry to a more complex contest over the structural foundations of global power.

9. CONCLUSIONS

China's strategy in the emerging global economic order is based on a paradigm in which *technological dominance and control over strategic resources are inseparable*. In a world defined by AI, semiconductors, and critical materials, power is increasingly derived from *system-level integration.*

Through its rare earth policies and its state-coordinated AI strategy, Beijing has consolidated a form of influence that no longer relies primarily on military strength, but on the *economic and technological dependencies of other actors. This strategic model should not be underestimated: it equips China with tools to shape trade negotiations, project influence across key regions, and maintain a central role in the global technological architecture of the 21st century.*

The comparative analysis of the United States, China, and the European Union demonstrates that AI, advanced semiconductors, and critical resources must be understood as *interdependent components of a new global power architecture.* Overall, the emerging international order is defined by competition over the **"***invisible infrastructures of power***,"** such as: chips, algorithms, data, critical materials, and supply chains. This competition is not primarily military, but is expressed through: technological standards, export controls, industrial policy, and structural influence over the global economy.

In conclusion, the global race for artificial intelligence and advanced semiconductors is not merely technological. It is a contest over *the rules, values, and institutional structures* that will govern global economic and security systems in the decades ahead.

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EMPLOYMENT IN INDUSTRY: AN ANALYSIS FROM THE PERSPECTIVE OF REINDUSTRIALIZATION IN ROMANIA

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ABSTRACT: *This paper examines the evolution of industrial employment in Romania over the period 1991–2023, contextualizing it within broader European structural transformations and the current debates on reindustrialization. Industrial employment remains a key indicator of economic structure and productive capacity, and its dynamics offer insight into both competitiveness and long-term development trajectories. Using comparative analysis based on World Bank data, the study highlights Romania's distinctive path, marked by a sharp decline in industrial employment during the 1990s, followed by a partial reindustrialization and subsequent stabilization.*

The findings underscore Romania's persistent reliance on industry relative to both Western and Eastern European benchmarks, suggesting both competitive advantages and structural vulnerabilities in the context of the green and digital transitions. The paper concludes that sustaining industrial employment will depend on investments in technology, skills, and innovation, essential for strengthening long-term economic resilience and convergence

Keywords: *European Union, Romania, industry, employment.*

JEL Classification: *E24, O14, Q01*.

1. INTRODUCTION

Over the past decades, industry has once again emerged as a central theme in debates on economic development, competitiveness, and the resilience of European economies. After a prolonged period during which many European states experienced processes of deindustrialization, economic and political discourse has increasingly shifted toward the idea of reindustrialization. Within the European Union, reindustrialization has come to be regarded as an essential instrument for supporting smart, sustainable, and inclusive growth. Industry is no longer assessed solely in terms of its direct contribution to value added, but also through its spillover effects on other sectors, particularly services, research and development, logistics, and trade. In this sense, reindustrialization does not imply a simple return to traditional productive structures; rather, it refers to a transformation of the industrial base through

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technological upgrading, innovation, digitalization, and integration into value chains with higher technological intensity. Thus, the new European industry is associated not only with production itself, but also with the capacity to generate productivity gains, export performance, better-qualified jobs, and a stronger competitive position on international markets.

For Romania, the issue of reindustrialization is particularly relevant, given the profound transformations the country has undergone since 1990. The transition to a market economy was accompanied by major industrial restructuring, factory closures, a massive reduction in industrial employment, and a reconfiguration of the economy's productive profile. In many cases, deindustrialization was not the natural outcome of a shift toward an advanced post-industrial economy; rather, it was premature in nature, marked by the loss of productive capacity, the weakening of local industrial ecosystems, and the widening of territorial disparities. At the same time, European integration, the attraction of foreign direct investment, and the development of sectors such as the automotive industry, electrical and electronic components, manufacturing, and other export-oriented activities contributed to the emergence of new industrial hubs.

In this context, Romania's reindustrialization cannot be understood as a mere restoration of its former industrial structure, but rather as a process of rebuilding and modernizing productive capacities in line with new technological, environmental, and competitive requirements. It entails strengthening industrial sectors with high potential, increasing domestic value added, reducing external dependencies in strategic areas, and developing a productive base capable of sustaining long-term economic growth. Moreover, under current conditions, reindustrialization is closely linked to the Romanian economy's ability to capitalize on the opportunities created by the green transition, digitalization, the reconfiguration of global production chains, and European industrial policies.

A central element of this discussion is industrial employment. Its importance for economic development stems, first, from the fact that industrial jobs are generally associated with higher levels of productivity than those found in many low-value-added activities. Second, industry has a strong capacity to generate indirect employment effects through demand for logistics services, maintenance activities, research and development, local suppliers, and commercial networks. Third, industrial employment contributes to the formation of technical and technological human capital, thereby supporting innovation and long-term competitiveness. At the same time, the relationship between reindustrialization and employment is far from straightforward. Industrial development can create new job opportunities, revitalize regions affected by economic decline, and reduce dependence on low-productivity sectors. However, today's industrial modernization is also accompanied by automation, digitalization, and organizational change, all of which reduce demand for low-skilled labor while increasing requirements for technical, digital, and adaptive skills. Consequently, the success of reindustrialization should not be assessed solely by the number of jobs created, but also by their quality, occupational structure, qualification requirements, contractual stability, and contribution to economic convergence and social cohesion.

Against this background, the paper aims to analyze the evolution of industrial employment in Romania from the perspective of reindustrialization, using a comparative approach. The study examines Romania's trajectory in relation to the EU average and to the average of Eastern European countries, in order to identify similarities, divergences, and the broader implications of these developments for long-term economic sustainability.

2. REINDUSTRIALIZATION AND INDUSTRIAL EMPLOYMENT: CONCEPTUAL AND EMPIRICAL CONSIDERATIONS

Over the past two decades, reindustrialization has once again become a central theme in the European debate on the model of economic growth, competitiveness, and strategic autonomy. After a prolonged period during which many European economies underwent processes of deindustrialization, reflected in the declining share of industry in gross value added and employment, European institutions began to regard the strengthening of the industrial base as an essential condition for economic resilience, innovation, and adaptation to the green and digital transitions (European Commission, 2017). Within this new vision, reindustrialization does not signify a return to traditional productive structures, but rather the development of a modern industry that is more technologically advanced, less energy-intensive, and better integrated into European and global value chains (European Commission, 2017). Reindustrialization is also linked to restoring Europe's capacity to generate productive and competitive jobs in a global context shaped by geopolitical pressures, technological competition, and the reconfiguration of supply chains (European Commission, 2026).

For Romania, the issue of reindustrialization is particularly relevant, as the economic transformations that followed 1990 were accompanied by a profound process of industrial restructuring. The transition to a market economy involved the closure or downsizing of many industrial enterprises, a sharp decline in industrial employment, and the fragmentation of productive ecosystems built during the previous period. Deindustrialization in Romania was abrupt and deeply disruptive, being accompanied by the dismantling of local economies, urban decline, and the widening of regional and socioeconomic disparities (Popescu, 2021).

However, Romania's trajectory cannot be reduced to only industrial decline. Following its accession to the European Union, integration into the single market, foreign direct investment, and the expansion of sectors such as the automotive industry, electrical equipment, metal processing, and other export-oriented segments contributed to the emergence of new industrial poles. The OECD notes that the industrial sector remains a major employer in Romania, with a significant share of industrial employment concentrated in the automotive industry and its related activities (OECD, 2021). At the same time, World Bank highlights that productivity dynamics and the reallocation of resources toward more efficient firms have played an important role in the transformation of the Romanian economy, including in industry (World Bank, 2020).

In this context, Romania's reindustrialization must be understood as a process of modernizing and strengthening the productive base, rather than as a mere restoration of the former industrial structure. Such an approach entails a shift toward activities with higher value added, greater technological intensity, stronger innovation capacity, and deeper integration into European value chains. Reindustrialization is also closely linked to the broader objectives of European economic policy: decarbonization, economic security, digitalization, and skills development. In Romania's case, these objectives take on additional significance, as they intersect with the need for real convergence, the reduction of regional disparities, and the consolidation of sustainable economic growth (European Commission, 2023)

The importance of industrial employment for economic development stems, first and foremost, from the fact that jobs in the industrial sector are generally associated with higher levels of productivity than those found in many low-value-added activities. Second, industry has a significant capacity to generate indirect employment effects through demand for logistics services, maintenance activities, research and development, local suppliers, and commercial networks. Third, industrial employment contributes to the development of technical and technological human capital, thereby supporting innovation and long-term competitiveness (OECD, 2025).

Moreover, the relationship between reindustrialization and employment is a complex one. Industrial development can create new job opportunities, revitalize regions affected by economic decline, and help reduce dependence on low-productivity sectors. However, today's industrial modernization is accompanied by automation, digitalization, and organizational change, all of which reduce demand for low-skilled labor while increasing requirements for technical, digital, and adaptive skills. Consequently, the success of reindustrialization should not be assessed solely by the number of jobs created, but also by their quality, the level of qualifications required, contractual stability, and their capacity to support economic convergence and social cohesion (OECD, 2025).

3. INDUSTRIAL EMPLOYMENT IN ROMANIA: A COMPARATIVE PERSPECTIVE

For Romania, industry has traditionally constituted a central pillar of the economy, making a significant contribution to exports, productivity, and employment. However, the transition to a market economy, integration into the European Union, and the increasingly pronounced shift toward services and technology have brought about profound changes in the structure of employment. In this context, comparing Romanian trends with the EU average makes it possible to highlight structural differences, the pace of adjustment, and the challenges associated with industrial modernization. The comparative analysis therefore seeks to capture the evolution of the share of employment in industry, the differences in dynamics between Romania and the EU average, as well as their implications for economic convergence and the sustainability of industrial growth in the medium and long term. For cross-country comparison, the paper uses the World Bank indicator 'employment in industry', while selected national and Eurostat references are used for contextual interpretation; these classifications are not fully identical and should be interpreted with caution.

The evolution of industrial employment in Romania after 1990 reflects one of the most profound structural transformations of the national economy. At the beginning of the transition, Romania inherited a highly industrialized economic structure, characteristic of the socialist development model, in which heavy industry, machinery manufacturing, metallurgy, chemicals, and other energy-intensive branches played a dominant role in both employment and gross domestic product. The transition to a market economy, however, brought about a major rupture: price liberalization, trade openness, the collapse of traditional external markets, the loss of competitiveness among a large number of enterprises, and delays in corporate governance reforms triggered a rapid process of industrial contraction and employment decline. The specialized literature shows that, in Romania, the deindustrialization of the 1990s was not merely a gradual decline in the share of industry, as was typical of advanced economies, but rather an abrupt and disruptive process with significant social and territorial effects. Thus, during the 1990s, the dramatic loss of industrial jobs was accompanied by an increase in employment in agriculture, indicating an atypical reallocation of labor, directed more toward subsistence activities than toward modern services, as occurred in other European economies undergoing transformation (OECD, 2008).

The first stage, corresponding roughly to the years 1990–1996, can be characterized as a period of productive disorganization and incomplete adjustment. Structural reforms were slow, and many state-owned industrial enterprises continued to operate under conditions of low efficiency, high losses, and dependence on public support. The World Bank noted that effective industrial restructuring began late, being delayed by strategies aimed at temporarily protecting non-competitive sectors and by the slow pace of privatization (World Bank, 2004).

The second stage, broadly situated between 1997 and 2006, was marked by accelerated restructuring and gradual adaptation to the requirements of European integration. During this

period, pressures related to macroeconomic stabilization, the conditionalities associated with the accession process, and the need to enhance competitiveness led to the closure or downsizing of a significant number of large enterprises, particularly in traditional industries. The European Commission's report on Romania's progress toward accession showed that restructuring advanced unevenly: some manufacturing sectors, such as textiles and clothing, furniture, and electrical equipment, performed better in exports, while other segments remained burdened by losses and incomplete reforms. Thus, the restructuring process was not linear; rather, it combined the necessary adjustment of non-competitive firms with the loss of a substantial share of productive capacity and the associated jobs (European Commission, 2004).

The cumulative outcome of the first two stages was the transition from an economy overspecialized in industry to a more diversified, yet also more fragile, structure in terms of social and territorial cohesion. The first decade of transition was characterized by a strong process of deindustrialization, reflected in the significant decline in the share of industry in both the economy and employment, with direct effects on sustainable development and labor market dynamics.

Romania's accession to the European Union on 1 January 2007 marked the beginning of a new stage, characterized not by a return to the previous industrial model, but by a recomposition of the industrial base. Integration into the single market, broader access to foreign direct investment, the strengthening of exports, and integration into European value chains fostered the development of more competitive manufacturing branches, particularly in the automotive industry, electrical and electronic components, furniture, machinery, and other export-oriented activities. The World Bank shows that Romania's economy underwent a structural transformation in the 2000s and 2010s, shifting from a base dominated by heavy industry toward a new combination of trade-integrated manufacturing and services, in the context of greater openness to investment and competition (World Bank, 2024). In other words, after accession, Romanian industry became more connected to external markets and more productive in certain segments, though not necessarily more labor-intensive.

In the years following accession, changes in the industrial sector were also influenced by the 2008–2009 economic crisis, which affected external demand, investment, and output. The subsequent recovery was driven primarily by firms and sectors already integrated into international production networks, thereby favoring a more selective model of industrial growth. European reports and competitiveness analyses indicate that the structure of Romania's economy has remained relatively more industrial than that of many other Member States.

Recent trends confirm that industry continues to play an important role in the employment structure, even though the economy is now far more service-oriented than it was in the 1990s. National statistical data show that, in 2024, the secondary sector, which includes industry and construction, accounted for 32.6% of total employment, while services represented 56.1% and agriculture 11.3% (NIS, 2025). These data suggest that Romania still retains a relatively significant employment base in the productive sector, but also that the long-term trend is one of a declining relative share of industry in favor of services. At the European level, manufacturing nevertheless remains a major employer, with around 30.2 million people employed across the EU in 2023, confirming that the issue is not the disappearance of industry, but rather the transformation of its organizational form, technological intensity, and occupational profile (European Commission, 2025).

Overall, the long-term analysis shows that the evolution of Romania's industrial sector after 1990 can be summarized in three major phases: a period of abrupt deindustrialization in the 1990s, a phase of restructuring and competitive selection in the pre-accession period, and a phase of post-accession industrial recomposition based on European integration, foreign investment, and export-oriented specialization. This trajectory highlights the fact that Romania's reindustrialization, in its contemporary sense, can be defined by the strengthening

of competitive industrial branches, the improvement in job quality, and the expansion of productive sectors capable of generating higher value added.

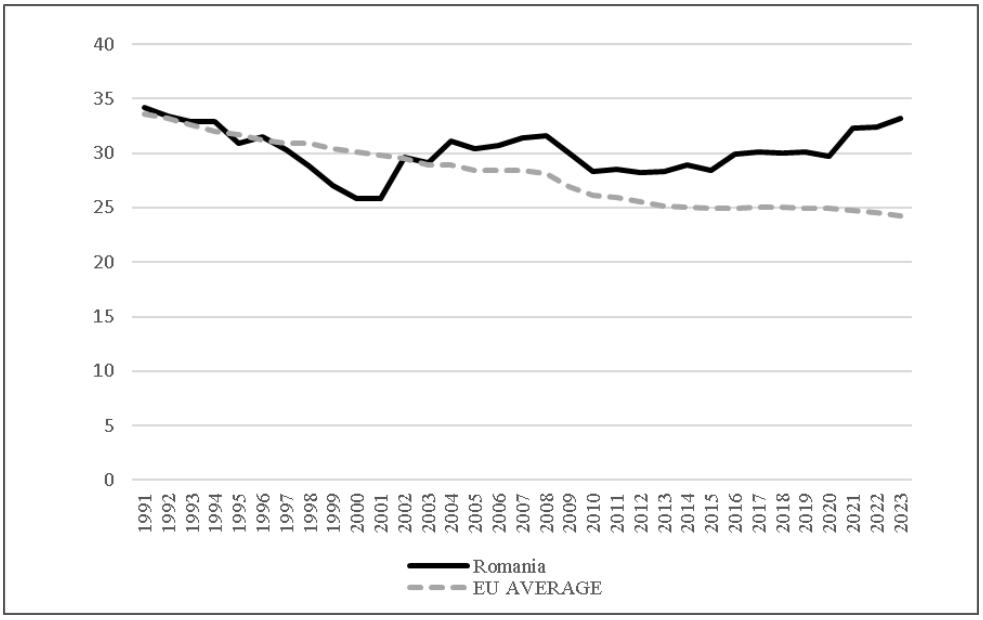
Romania vs. the EU average

As regards the employed population, Romania's industrial sector accounts for a share similar to that of neighboring countries, substantially higher than the EU average or that of countries such as Germany or France. At the same time, however, one in five employed persons works in the agricultural sector (Government of Romania, 2023).

Figure 1 reveals notable differences in the dynamics of the two series, reflecting both the particular features of Romania's economic transition and the structural trends observed at the European level.

Between 1991 and 2000, Romania recorded a sharp decline in industrial employment, from over 33% to approximately 25%. This abrupt contraction can be explained by the process of deindustrialization associated with the post-communist transition, marked by the restructuring or closure of state-owned enterprises, the loss of international competitiveness in certain traditional industrial branches, and the migration of a significant share of the labor force toward subsistence agriculture or the informal economy (Ciutacu et al., 2015).

Figure 1. Industrial employment evolution in Romania vs. the EU average (%)



Source: Author's calculations based on World Bank data, (World Bank, 2025).

The period 2000–2008 marks an industrial recovery in Romania, reflected in a slight increase and stabilization of the industrial employment share at around 30–32%. This development was driven by the massive inflow of foreign direct investment, particularly in the automotive industry and related sectors, as well as by Romania's integration into European value chains in the context of its preparation for and accession to the European Union. Unlike Romania, the European average continued to decline slowly, thereby widening the structural gap between the two series.

The global economic crisis of 2008–2009 also had negative effects on industrial employment in Romania, which temporarily declined to 28–29%. Nevertheless, the level remained consistently above the EU average, confirming that the structure of the Romanian economy continued to be more dependent on industry compared with the more developed Member States, where the tertiary sector had already become the main source of employment (INS, 2025).

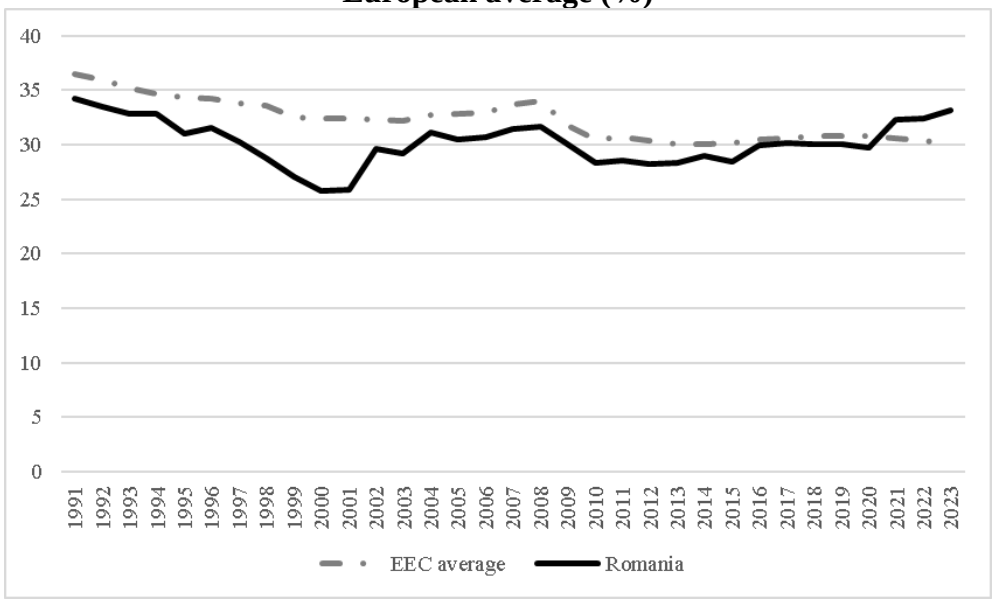
Between 2014 and 2023, Romania recorded a consolidation of industrial employment, once again reaching levels close to 33% in 2023. This contrasting trend, compared with the EU average—which continued to decline to approximately 24%—highlights a structural divergence: Romania remains more industrialized in terms of employment than the European average. This situation may represent a competitive advantage in the short and medium term, through industrial specialization and the attraction of investment in production, but also a structural vulnerability in the long run, given the transition toward a green and digital economy, which implies a reorientation of employment toward sectors with higher value added.

In conclusion, the comparative analysis reveals a complex process: Romania went through a phase of accelerated deindustrialization in the 1990s, followed by a partial reindustrialization and a consolidation of industrial employment after joining the European Union, while the European Member States followed a trajectory of steadily reducing the share of industry in the employment structure.

Romania vs. the average of Eastern European countries

Compared with the average of Eastern European countries (EEC)—a region that includes economies such as Poland, the Czech Republic, Hungary, Slovakia, and Bulgaria—the analysis highlights differences in the pace and depth of structural transformation, determined by the national specificities of transition, industrial policies, and the capacity to attract foreign investment.

Figure 2. Industrial employment evolution in Romania vs. the Eastern European average (%)



Source: Author's calculations based on World Bank data, (World Bank, 2025).

Throughout the entire period under review, a general downward trend in industrial employment can be observed, both in Romania and in the EEC average. This decline reflects the structural transformation of the economies in the region, characterized by the large-scale restructuring and privatization of state-owned enterprises after 1990; the transition to a market economy, which reduced the role of the traditional industrial sector; the growing share of services and sectors based on technology and trade; and the gradual integration into European production chains, with significant effects on employment dynamics.

In Romania, the curve indicates a sharp decline in industrial employment during the period 1990–2000, followed by a phase of relative stability. By the 2000s, the share of employment in industry had fallen from approximately 34% to nearly 25%, against the backdrop of the mass closure of non-competitive state-owned enterprises, the loss of industrial jobs, and the migration of labor toward other sectors or abroad. This process coincided with the profound restructuring of heavy industry, particularly in the steel, chemical, and mining sectors. During the period 2001–2008, a modest recovery in industrial employment can be observed, driven by foreign direct investment and the revival of export-oriented industries, especially in the automotive and electronics sectors. Unfortunately, the global economic crisis led to a new decline in industrial employment as a result of reduced external demand and layoffs in large enterprises. The post-crisis period marks a stabilization of employment at around 29–31%, followed by a slight increase in recent years, driven by a shift toward industries with higher value added and the relocation of certain European production capacities to Romania. Overall, Romanian industry has undergone a slow process of structural rebalancing, in which the loss of employment in traditional industries has been partially offset by the expansion of modern sectors and export-oriented manufacturing.

For the Eastern European countries average, a similar but less abrupt trajectory can be observed. In the 1990s, industrial employment stood at approximately 36–37%, gradually declining to around 30% after 2010. This more balanced evolution can be explained by the more gradual pace of industrial reforms in some Central European states, the early attraction of Western investment, which contributed to the modernization of production capacities, and the preservation of a diversified industrial base, particularly in the Czech Republic and Poland, where industry continued to serve as a central pillar of the economy. Thus, the Eastern European average recorded a controlled decline in employment, followed by stabilization after 2010 at around 30–31%.

A comparative analysis of industrial employment in Romania and the Eastern European average shows that Romania experienced a sharper decline in the early years of transition, reflecting a more difficult and delayed restructuring process compared with its Central European neighbors. After the 2000s, however, the gap relative to the Eastern average gradually narrowed, reaching similar levels in the last decade, a sign that Romania's industrial structure has partially aligned with regional trends. Nevertheless, the share of industrial employment remains slightly above the Eastern European average, suggesting a continued reliance on the manufacturing sector and a productive structure more oriented toward medium-technology industries. Looking ahead, the maintenance and expansion of industrial employment will depend on investment in technology, technical education, and digitalization—factors that are essential for strengthening economic competitiveness and achieving sustainable convergence with the average of Eastern European countries.

4. CONCLUSIONS

The analysis of the evolution of industrial employment shows that, over the period 1991–2023, Romania followed a distinct trajectory in comparison with both the EU average and the average of Eastern European countries. The structural transformations that took place after 1990 were profound, and their effects on the industrial labor market reflected the specific features of Romania's transition to a market economy: pronounced deindustrialization in the initial phase, difficult restructuring, and subsequently a partial reconstruction of the productive base, especially under the impact of European integration and foreign investment.

The findings of the paper indicate that the decline in industrial employment during the 1990s was not merely a natural economic adjustment, but rather a severe process with broad economic, social, and territorial implications. The reduction in industrial jobs was accompanied

by the loss of significant productive capacities, the weakening of local industrial ecosystems, and the widening of regional imbalances. In this respect, Romania's experience confirms that premature deindustrialization can affect not only the structure of the economy, but also long-term development prospects, especially when it is not rapidly offset by the expansion of modern, high-productivity sectors.

At the same time, unlike many Western European countries, where the decline in industrial employment accompanied the consolidation of service-based economies dominated by advanced activities, in Romania industry has continued to occupy a relatively important place in the employment structure. This suggests that the industrial sector remains a relevant pillar of the national economy, both through its contribution to exports and productivity and through its role in maintaining a productive base capable of supporting economic convergence. From this perspective, the still relatively high level of industrial employment may be interpreted both as a competitive advantage and as a sign of structural vulnerabilities, insofar as part of Romania's industrial specialization remains concentrated in medium-value-added segments that are highly sensitive to external shocks.

The comparison with the EU average and with the average of Eastern European countries shows that Romania has gradually moved closer to regional trends while preserving a more strongly industrialized profile in terms of employment. This positioning confirms the existence of a partial reindustrialization process, understood not as a return to the old industrial model, but as a reconfiguration of the productive structure through the development of more competitive sectors better integrated into European value chains. Even so, the reindustrialization observed in Romania remains incomplete, since it has not translated evenly into higher domestic value added, the expansion of high-technology activities, or the consolidation of a sufficiently robust innovation base.

Another conclusion emerging from the analysis is that the relationship between reindustrialization and employment should not be viewed exclusively in quantitative terms. In the current context, shaped by digitalization, automation, and the green transition, the relevance of industry can no longer be assessed solely by the number of jobs it generates, but also by their quality, the level of skills they require, and their capacity to support productivity and innovation. Consequently, the future of industrial employment in Romania will depend not only on maintaining a solid manufacturing base, but also on modernizing it through investment in technology, research, digitalization, and vocational training.

Overall, the paper confirms that reindustrialization can represent a viable direction for Romania's economic development, but only insofar as it is supported by coherent and strategically oriented public policies. The strengthening of industry must be aligned with the broader objectives of competitiveness, strategic autonomy, sustainability, and territorial cohesion. Romania has the opportunity to capitalize on the advantages of a still significant industrial base, but this opportunity can be transformed into lasting economic progress only by shifting toward higher value-added sectors, encouraging innovation, and adapting human capital to new technological requirements.

Therefore, the main conclusion of the research is that industry continues to play an essential role in the Romanian economy, and employment in this sector remains a relevant indicator for understanding the country's development trajectory. Romania is not faced with a choice between industry and services, but rather with the need to build a more balanced economic structure in which modern industry functions as a foundation for sustainable growth, resilience, and European convergence. From this perspective, reindustrialization is an important component of a more robust development model, better aligned with the demands of the contemporary economy.

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CAPITALIZING ON THE ADVANTAGES OF ROMANIA'S ACCESS TO EUROPEAN SINGLE MARKET FOR SERVICES

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ABSTRACT: *In recent decades, services have emerged as an important sector of European economies, with a considerable contribution to the processes of their economic integration. The paper aims to highlight the development of the service sector in Romania after accession to the European Union (EU), from the perspective of its participation in the single market for services, namely the way in which it has managed to capitalize on the advantages of access to the service markets of member countries. This research relies on data from Eurostat, World Bank, and National Bank of Romania, employing relevant indicators to emphasis the main characteristics of service sector and trade in services in Romania. The analysis is focused on how the Romanian service providers capitalize on the advantages of the single market for services. The results identify the major role of multinational companies investing in Romania, fuelling the specialisation in many areas of performant services, mainly in the business professional services area, contributing to Romanian trade in services. The strength of the paper lies in identifying the advantages, but also disadvantages for service consumers, service providers, individuals and companies, but also for the national economy of Romania of the participation to the single market for services. The research conclusions highlight that Romania has reaped the benefits of EU integration, with trade flows in services with EU partners being dominant, confirming the role of the single market for services as a pillar of the EU economy, with Romania succeeding in capitalising on the advantages of the free access to EU service market with important impact on entire economy.*

Keywords*: services, Romania, EU integration, single market for services, FDI.*

JEL Classification: *F13, F15, F23, F43, L8, O24*

1. INTRODUCTION

In recent decades, services have been remarked as one of the most dynamic economic sectors, their evolution being supported by a high degree of innovation in their specific domains, increasing demand, given the dependence of all economic activities on them, as well as their capacity to capitalize on digital innovative technologies (Rytter Sunesen & Hvidt Thelle, 2018). All of these have also been accompanied by the adoption of favourable regulations facilitating the service tradability on international markets. The economic development processes of the European Union (EU) countries have been part of this trend, capitalizing on the potential of the service sector, favoured by the creation of the single market, but also the opportunities of global markets. At present, the EU countries are the most important partners in international trade in services (in 2024, extra-EU trade in services represented 23%

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of world service exports) (WTO, 2026), supported by the dynamics of this sector and all positive conditions within the EU economies.

An important factor in the development of the service sector has been the European single market for services, in force since 1 January 1993, established under the Maastricht Treaty of 1992, with the objective of facilitating the free movement of services and service providers between Member States, thereby creating an integrated and competitive service market. In this context, it is worth mentioning the role of the basic principles governing the single market for services, defined in the Treaty on the Functioning of the European Union (TFEU), as follows: the freedom to provide or consume services in an EU country other than that in which the provider or consumer is established (Article 56, TFEU), and the freedom to establish an enterprise in another EU country (Article 49, TFEU) (OJEU, 2012). In essence, they involve the elimination of barriers, mainly consisting of regulations adopted at the level of the legislation of the member countries, given that their variety and complexity often generate restrictions or difficulties for trade flows in services at the community level.

The expansion of Romania's service sector and trade in services is closely linked to positive developments within the national economy after EU accession in 2007, the EU member state status opening its access to the single market for services and supporting the adoption of a regulatory framework favourable to service trade. The service sector stands out as one of the significant drivers of the Romanian economic development, reflected both in specific indicators (such as its contribution to the gross domestic product (GDP) and employment, and the participation in foreign trade and investment flows), and the capacity to adapt to new trends in the European and global economy (the more relevant being related to the recent expansion of digital services). The level of development and growth potential of the service industries are sustained by the set of competitive advantages of the Romanian economy in these domains, among which the professional training and integration of new technologies stand out, while the strength of the single market for services has ensured their free movement on EU countries markets. Also, Romania's high degree of complexity and specialization in the field of services are capitalized on the extra-community market, the international demand for services also supporting the achievement of the national service industries performances.

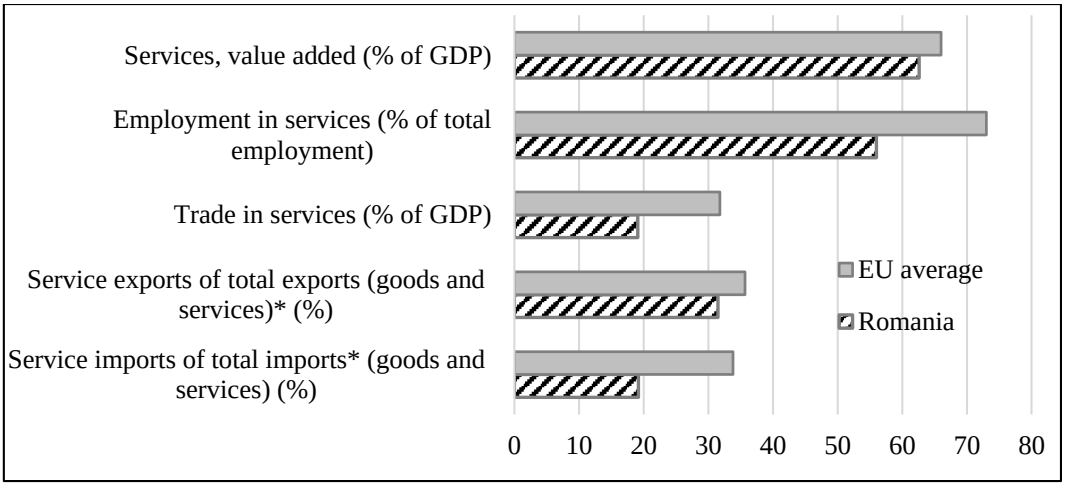
In light of the developments in the service sector and trade flows in services over the last decade, namely in the period between 2015 and 2024, the main objective of this paper is to highlight the capacity of Romania's trade in services to exploit its competitive advantages through EU accession, and in particular the participation in the single market for services with an impact on Romania’s economic development, given the need to find sources of resilience to future challenges in the European economy.

2. DYNAMICS OF THE SERVICE SECTOR AND TRADE IN SERVICES OF ROMANIA

The evolution of the main indicators related to the service sector during the last decade highlights their continuous growth trend and contribution to the achievement of the Romania’s macroeconomic indicators. In this regard, it is worth noting the trend of permanent growth of services industries' value-added share of GDP, reaching a maximum of 62.6% in 2024, its positive evolution rates in recent years diminishing the gap to the EU average, respectively 66% (Figure 1). Also, the growing role of the service sector in the Romanian economy has led to an increase in the employment, currently, service industries providing more than half of the total number of jobs at the national level (respectively 56%, but at a distance from EU average of 73%, in 2025). All these developments were also reflected in the increase in trade in services, in 2024 its share of GDP reaching 19.1%, compared to 31.8% of EU average (Figure 1). At the same time, in 2024, the service exports represented 31.5% of total exports of goods and

services, and service imports 19.2% of total imports of goods and services of Romania (WBG, 2026).

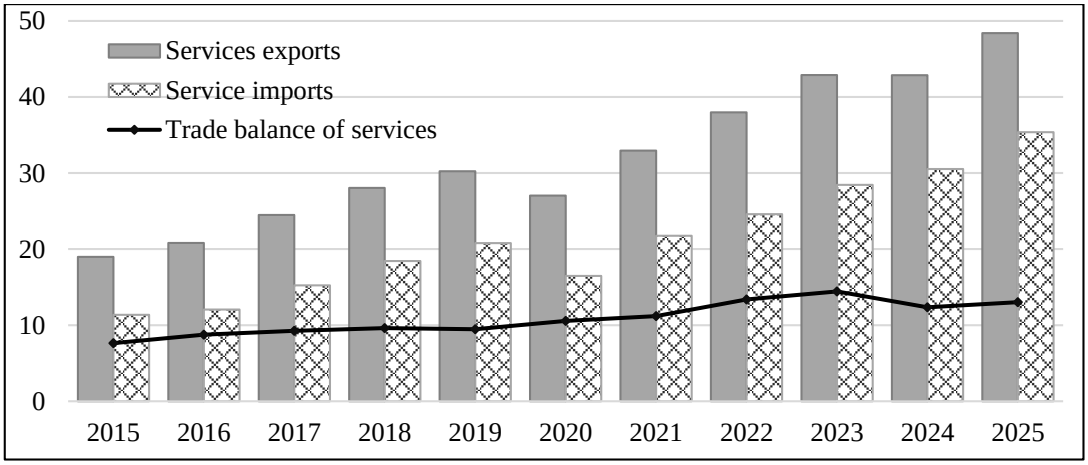
Figure 1. Service-related indicators in Romania and the EU average, in 2024 (%)



Note: *Data available only for extra-EU exports and imports.
Source: Author representation based on WBG (2026) and Eurostat (2025).

Among the specific indicators of the service sector development, the trade flows in services are highlighted with records at every new year, both in exports and imports, in 2025 reaching new historical maximum values, respectively USD 48.4 billion for exports and USD 35.4 billion for imports. The same evolution is also followed by the surplus of the trade balance in services, its highest value being recorded in 2023 with USD 14.4 billion (WTO, 2026). The data revealed in Figure 2 highlights that, over the last decade, the pandemic crisis was the only major influencing factor affecting the evolution of Romania's trade in services, the losses recorded in 2020 being recovered the following year, so that trade flows in services have rapidly resumed their pre-pandemic growth trend.

Figure 2. Romania's trade flows in services, between 2015 and 2025 (USD billion)

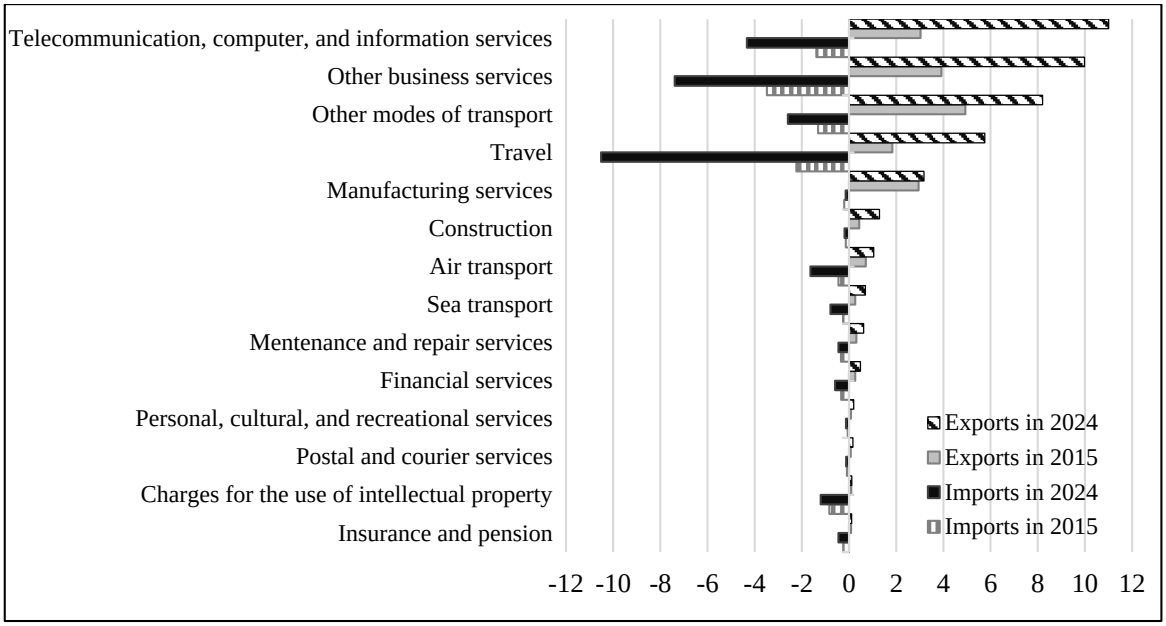


Source: Author representation based on WTO (2026).

The positive developments in trade in services have been accompanied by an improvement in its structure, reflected in the increase in the value and share of trade flows in services that capitalize on the advantages of the Romanian business environment, particularly

the skilled workforce in specific domains of business services related to the use of information and communications technology (ICT). The data represented in Figure 3 highlights the progress in the structure of service exports and imports over the last decade, with telecommunications, ICT and other business services dominating both exports (with 49% of the total value of service exports, respectively USD 21 billion in 2024), and imports (with 38.4% of the total value of service imports, respectively USD 11.7 billion) (WTO, 2026).

Figure 3. Romania's trade flows in services, by categories, in 2024 compared to 2015 (USD billion)

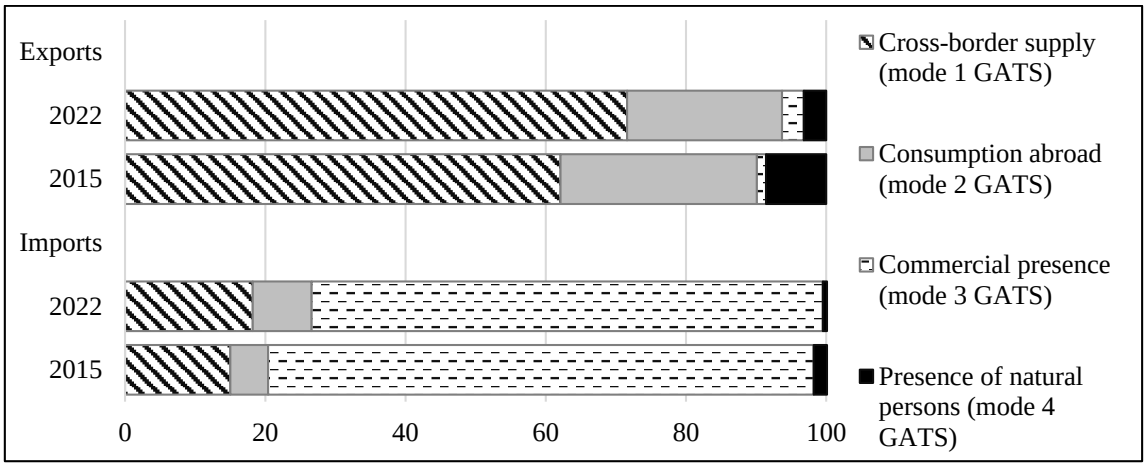


Source: Author representation based on WTO (2026).

The effects of the reforms undertaken in the economy after accession to the EU have been reflected on the modernization of service industries and the adoption of regulations favourable to trade in services, as well as the intensification of digitalization processes in recent years that have increased the capacity to use technological means in international trading of services. All these developments are also mirrored on the four modes of service provision, according to the General Agreement on Trade in Services (GATS/WTO). The data illustrated in Figure 4 highlights the dominance of cross-border trade (mode 1 according to the GATS classification) as Romania's main mode of service exports. Thus, in 2022, 71.8% of Romania's service exports were delivered by digital means, a noteworthy improvement from 62.1% in 2015. Services delivered through consumers traveling abroad (mode 2 GATS), predominantly used within trade flows in travel services, continue to keep on the second position as a mode of service exports, with 21.1% in 2022 compared to 28% in 2015. Commercial presence (mode 3 GATS), specifically for trading services based on internationalization through foreign direct investment (FDI), dominates Romania's service imports, this mode representing the way of trading highly complex and technology-intensive services. In this category of services are included telecommunications, financial and professional business services, requiring large capital investments, usually that cannot be supported by national companies. The presence of natural persons (mode 4 GATS), specific to services delivered by the movement of professionals as service providers abroad, has registered a decrease of its share of the overall service exports, this evolution being often associated with the migration phenomenon,

particularly the exodus of qualified professional labour from Romania seeking better job opportunities abroad (Racoviţan & Chivu, coord., 2019).

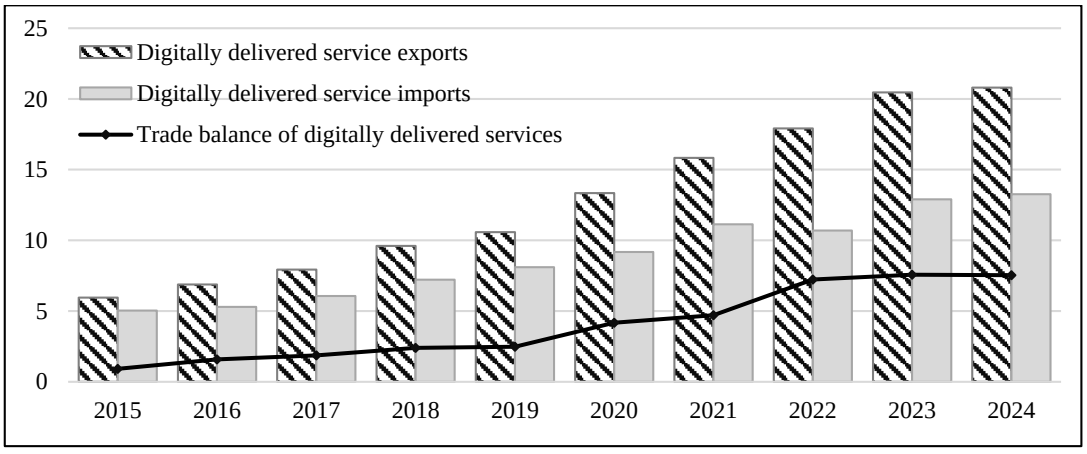
Figure 4. External service modes of supply of Romania, in 2022 compared to 2015 (% of total)



Source: Author representation based on WTO (2026).

Throughout the evolution of trade in services, the dominance of services traded through digital tools (platforms) is notable, which are increasingly based on technological innovations and recently the use of artificial intelligence, which are imposed at the level of global business models and have revolutionized both international trade and other areas of the world economy. In recent years, services traded through digital means have begun to increase (Figure 5), with an important role in Romania's economic development, in line with European trends, the industries of these service categories making important contributions to foreign trade and becoming an important support for the national economy.

Figure 5: Romania's trade flows in digitally delivered services, between 2015 and 2025 (USD billion)



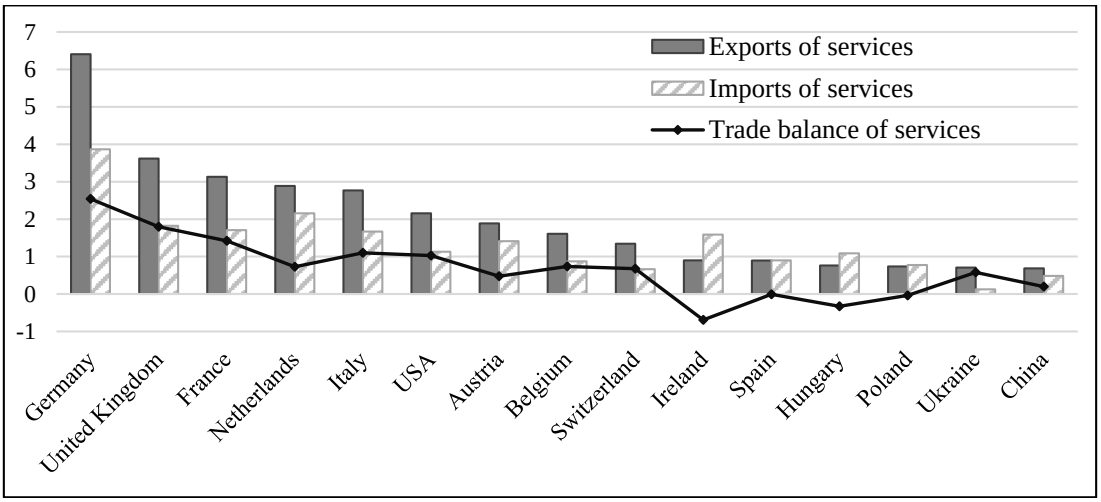
Source: Author's representation based on WTO (2026).

Trade in services traded through digital means can be considered as a resilience factor in the face of challenges in the global economy. The restrictions imposed during the pandemic had a favourable effect on those services provided remotely via the internet (such as information and communications technology, as well as professional services for businesses),

with Romania recording positive developments in digitally provided services. Therefore, telecommunications, IT and computer services continued their pre-pandemic upward trend, largely supported by good internet connectivity, which had a considerable effect on the expansion of Romania's overall trade flows in services.

The main partners in trade in services of Romania are the developed countries of Europe, America and Asia, the data represented in Figure 6 highlighting the surplus that Romania's trade in services records with most of its partners. These results are mainly supported by trade in intermediary services, Romania representing an attractive destination for the outsourcing of business services and consequently an important supplier of such services, particularly for the Western European markets. In this regard, business support services and ICT serve the activities of multinational companies from these countries investing in Romania.

Figure 6. Romania's main service trade partners, in 2024 (USD billion)



Source: Author representation based on WTO (2026).

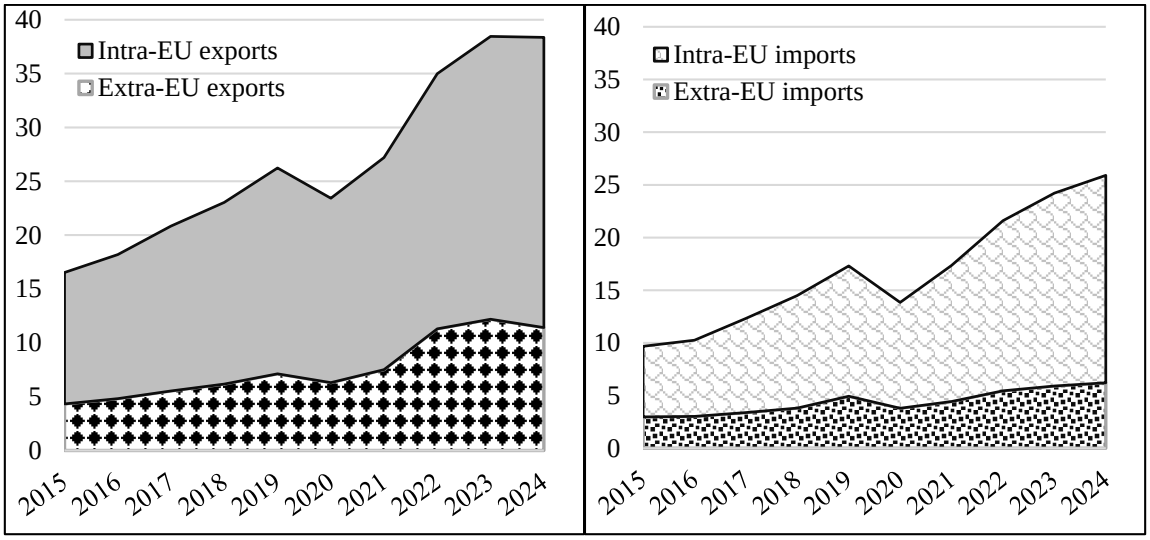
In summary, the current stage of development of Romania's trade in services reflects the effects of the broad transformation processes in the economy that have supported the increasing role of the service sector in the economy. Competitive advantages, mainly those related to geographical location and free access to the EU market, the level of education, professional skills and labour costs, the quality of telecommunications infrastructure, as well as the development potential of service industries, have created the conditions for the development of business models based on intermediary services and the integration of Romania's services sector into global business value chains, with the considerable contribution of multinational companies in Romania. According to NBR (2025), in 2024, 61.2% of the Romania's service exports and 43.2% of the Romania's service imports were achieved by foreign companies that invested and have operated different business models in the national economy.

3. CAPITALIZING ON THE ADVANTAGES OF ACCESS TO THE EUROPEAN SINGLE MARKET FOR SERVICES

The development of Romania's services sector and trade in services has been related to economic dynamism after EU accession, which opened access to the single market along with the implementation of a regulatory framework favourable to services transactions. According to the data represented in Figure 7, EU countries represent Romania's main trading partner in

service trade, in recent years, 70% of Romania's service exports have been oriented to the EU market, and 76% of service imports have come from the EU countries (Eurostat, 2025).

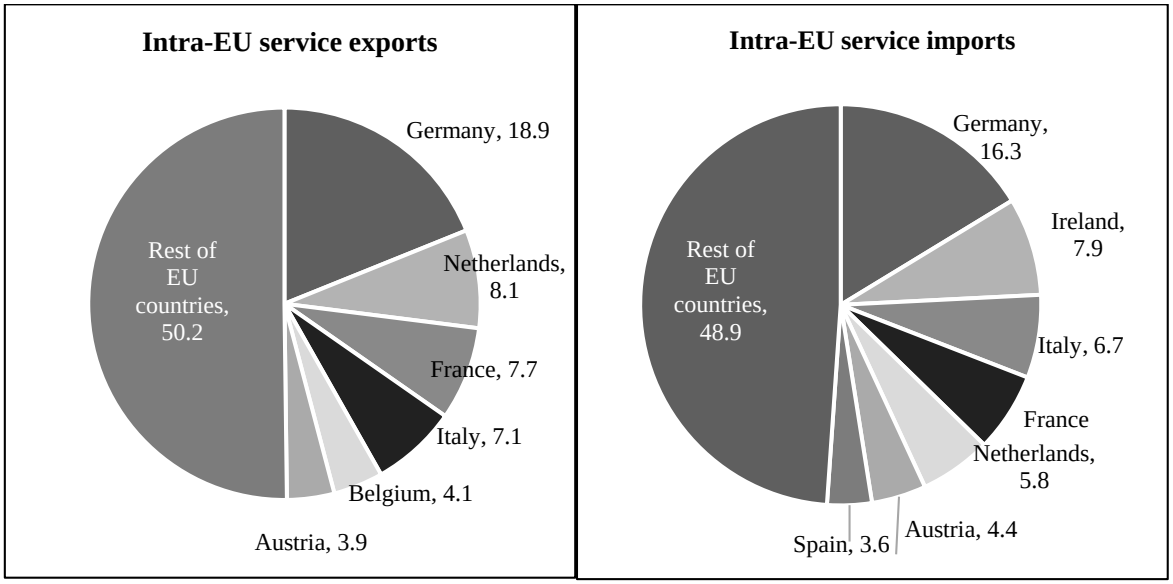
Figure 7: Romania's intra- and extra-EU trade flows in services, 2015-2024 (EUR billion)



Source: Author representation based on Eurostat (2025).

The analysis of the main intra-EU destinations of service exports and, respectively, intra-EU sources of service imports, reveals a strong concentration, so that, in 2024, 49.8% of total service exports to EU countries went to a group of six countries, approximately the same countries representing the source of 51.1% of total service imports (Figure 8). It is also noted that the countries in the ranking of trading partners have relatively close shares in the two categories of flows, namely Germany (with 18.9% of total service exports to EU countries and 16.3% of total service imports to EU countries), France (with 7.7% and, respectively, 6.4%), Italy (with 7.1% and 6.7%), the Netherlands (with 8.1% and 5.8%), and Austria (with 3.9% and 4.4%) (NBR, 2025). The relative balance between the two categories of trade flows, as well as the registration of a trade surplus at the level of bilateral relations with each main partner (also highlighted in Figure 6), are explained by the business outsourcing models by companies from these countries to partners in Romania and which generate important service exports to their countries of origin. Competitive advantages, mainly those related to geographical location and free access to the EU market, the level of education, professional skills and labour costs, the quality of telecommunications infrastructure, as well as the development potential of service industries, have created the conditions for the development of business models based on intermediary services and the integration of Romania's services sector into EU business value chains, with the considerable contribution of multinational companies in Romania. Romania's high level of integration in intermediary services flows (in 2024, the intermediary services in Romania's total trade in services were over 65%; Eurostat, 2025) will support the development of Romania's services sector and trade in services, in the context of the prospects of increasing the role of trade in intermediary services in business development at international level (Baldwin, 2023).

Figure 8. Romania's EU partners in trade in services, in 2024 (% of total)



Source: Author representation based on NBR (2025).

The high shares of trade flows with EU partners highlight that Romania has managed to capitalize on the advantages of free access to the single market for services (intra-EU trade representing approximately 70% of Romania's total trade in services). The achievement of this objective must be assessed in the context in which, at the EU level as a whole, the similar growth rates of intra- and extra-EU trade flows have not generated the achievement of a higher share of intra-EU trade flows. The main explanation is related to the maintaining of a considerable growth rate of external demand for services provided by some member countries with a high level of development. However, although the level of economic integration between EU member states in trade in services is lower than that of goods, the internal single market has created one of the largest integrated markets in the world and a favourable environment for increasing the international competitiveness of EU service providers. Also, in this context, the increase in intra-EU trade flows in services and, respectively, the increase in the level of integration of the EU service markets will be considerably supported by future actions aimed at completing the regulatory framework at national sectoral level, given the wide variety of regulatory areas generating obstacles, mainly of an administrative nature, to intra-EU trade in services. Thus, the continued reduction of barriers and the harmonisation of regulations within the EU will contribute to the deepening of the integration of the internal market for services, which will generate increased added value in all sectors, strengthening competitiveness of EU economy and ultimately the level of welfare within the EU (Dorn et al., 2024). These aspects are also included in the EU's long-term competitiveness strategy beyond 2030, adopted in 2023 (EC, 2023), which sets ambitious performance indicators that could significantly stimulate cross-border trade in services within the single market (Cernat, 2023).

Almost two decades after Romania's accession to the EU, the investigation of Romania's trade with EU partners requires highlighting the effects resulting from participation in the single market for services. Thus, EU membership has ensured increased and free access for Romanian consumers and service companies to the service markets of other EU economies and implicitly the opening of national markets for consumers and service companies from EU countries. Stimulating competition and aligning with European standards and regulations have generated positive effects on the quality of services offered by Romanian service companies. In addition to the free movement of services, intra-EU trade in services also benefits from the

advantages of the free movement of capital and people, all supporting service providers to offer their services in any EU member state, with positive effects on the economic development.

In summary, the **advantages** arising from the participation in the single market for services are related to access to a wide range of services for Romanian consumers, as well as increased business opportunities for Romanian service providers, supported by the harmonisation of legislation and the removal of barriers to trade, with a positive impact on overall economic development. Like any economic phenomenon, the participation of consumers and service companies from Romania in the services markets of EU countries may also be accompanied by some deficiencies, generally associated with the differences in the levels of development between EU member states. In this regard, it is noted that the integrated business models developed in the field of services that support trade in services can also be a source of vulnerability, as fluctuations or challenges in the economies of the main partners can affect the national economy. Romania's trade in services is strongly dependent on the developments of the EU economies, the slowdown in activity in some economies that represent Romania's main partners can affect the demand for services and lead to a reduction in service exports. The synthesis presented in Table 1 highlights the main advantages and disadvantages of Romania's participation in the single market for services, structured according to the main categories involved, namely consumers, service providers as individuals and companies, as well as the national economy as a whole.

Table 1. The main advantages and disadvantages of Romania's participation in the single market for services

	Advantages	**Disadvantages**
For service consumers in Romania	(i) free access to a wide variety of services offered on the markets of EU member states; (ii) better quality services, due to high standards in the service areas, especially in EU well developed countries, but also on the national market offered by companies that have invested in certain service areas (e.g., banking); (iii) competitive prices due to the elimination of trade barriers generating additional costs within the single market.	(i) higher prices compared to the purchasing power of Romanian consumers for some categories of services; (ii) linguistic and cultural barriers, given the direct interaction required in the delivering of certain services.
For professionals, as individuals from Romania providing services on the EU market	(i) freedom of professional mobility; (ii) free access to the markets of EU member states; (iii) increased salary opportunities through access to markets with high remuneration levels and greater purchasing power; (iv) recognition of qualifications at EU level; (v) accumulation of professional experiences in different cultural environments and increased possibilities for building a professional career; (vi) access to various additional professional training programs;	(i) differences in remuneration for services provided; (ii) the possibility of encountering administrative barriers regarding cumbersome and lengthy procedures for equivalence of studies and qualifications in some member states, which could delay access to the labour market; (iii) the possibility of encountering barriers related to perceptions of inferiority and distrust in certain professional environments, mainly in developed countries; (iv) possible problems related to reintegration into the national market after returning to Romania,

	Advantages	Disadvantages
	(vii) access to projects and contracts at EU level.	at a social, cultural and professional level;
For Romanian service companies	(i) expanded business opportunities, due to the possibility of national companies to offer their services on an expanded market, having access to customers and partners from all EU countries, without trade barriers; (ii) cost reduction due to the elimination of trade barriers, with local companies being able to increase their competitiveness on the single market; (iii) access to qualified labour, due to the free movement of labour; (iv) harmonized quality standards that facilitate the export of services to the markets of other EU countries and the possibility of generating additional income; (v) access to EU funding programs and support instruments designed to adapt to the requirements of the single market or the development of innovative projects; (vi) stimulating innovation and improving the quality of services to increase competitiveness; (vii) the possibility of employee mobility; (viii) access to projects and contracts at EU level.	(i) competitive pressure (in terms of quality and price) on the national market from companies (especially multinationals) from developed countries, which mainly affects small local companies; (ii) the persistence of access barriers to the service markets of some EU countries, under restrictive national regulations and administrative practices; (iii) the possibility of maintaining barriers applicable to the relocation of workers; (iv) difficulties arising from the tax regulatory framework applicable to cross-border transactions; (v) gaps compared to European companies in terms of digitalization and innovation; (vi) difficulty in attracting and retaining qualified human resources, which may be much more attracted by the advantages offered by companies from developed countries, mainly multinational companies;
For the Romanian economy	(i) increased trade in services and its positive effects on economic growth; (ii) increased long-term competitiveness, due to access to a larger market and harmonized standards; (iii) stimulation of innovation at the national level, due to exposure to a high level of competition, including on its own market; (iv) increased national reputation.	(i) pressure from European competition, mainly from companies in developed countries, especially for small enterprises; (ii) vulnerability to the economic cycles of the main partners in trade in services, with the reduction in external demand affecting national companies dependent on service exports; (iii) outflow of skilled labour to well developed countries in the EU.

Source: Created by the author based on Honciuc (2023), Letta (2024), EU (2025), and CEU (2025).

4. CONCLUDING REMARKS

The single market for services can be considered one of the great achievements of the European integration process, its success being based on the links between EU Member States, their degree of complexity and specialization in the field of services supporting the EU's dominant position in global trade in services (Cernat, 2023; WTO, 2026). Intra-EU trade in services is considerably influenced by the level of development of EU economies and the favourable regulatory framework, enhanced in recent years by the increasing degree of implementation of technologies in the service sector that have facilitated their cross-border trading. Also, except for the pandemic crisis that temporarily affected certain trade flows in

services, overall trade in services has proven the highest level of resilience to cyclical factors, so that in the last decade, intra-EU trade in services has doubled (as represented in Figure 7), Romania being part of the general dynamics of trade in services at EU level (Eurostat, 2025).

The recent positive developments in the service sector and trade in services of Romania have been sustained by the participation in the single market for services following EU accession. The extensive processes imposed by the status of a member state have supported the overcoming of deficiencies in the service industries and the increase in their competitiveness, which led to the expansion and diversification of trade flows in services with partners in EU countries. The process of integrating the Romanian economy into the EU was accompanied by the liberalization of trade flows in services and the implementation of reforms imposed by the need to adopt EU policies that sustained their expansion. The advantages of the national market, mainly in terms of workforce qualifications and competitive operating costs, were intensively exploited in trade and investment in the service sectors with Western European partners, Romania being very attractive to foreign partners in all services. Romanian service industries were integrated into the extended value chains at European level, national companies being attractive for outsourced services and related services used in the goods production processes. However, despite the significant progress of the service sector in recent years, the comparative evaluation with the EU market and the potential of the service sector require continued reforms with the adoption of policies and the completion of the institutional framework in order to strengthen governance, as well as increasing investments in infrastructure and improving skills specific to the service sector, in order to fully exploit their potential in the current global economic environment (Hollweg & Saez, 2019).

The dominant share of EU partners in Romania's overall trade flows in services and its continuous growth trend highlight that, from the perspective of trade in services, following EU accession, Romania has achieved its objective of capitalizing on the potential of participating in the single market for services. At the same time, the extra-EU demand for services reflects the high level of specialization of Romania's service industries, influenced by global economic conditions, trade policies and technological advances, which makes Romania an important business partner in the service sector. From this perspective, the consolidation of service industries and the intensification of trade in services are essential in order to capitalize on their advantages and increase the participation of services in Romania's economic development processes, in the context of an international context that requires increased economic resilience.

In conclusion, the prospects for Romania's services trade are strongly connected to international trends, as well as national policies, the last ones requiring to be focused on the competitiveness of service exports, especially those intensive in new technologies and human capital. New generations of reforms must be linked not only to the liberalization of trade flows in services, but also to improving the quality of regulations, investments in infrastructure and high-quality education, all supporting innovation in the service sector and the diffusion of digital technologies among Romanian companies. By improving competitive advantages in the field of services, it will be ensured that the potential of the service sector is exploited to generate a positive impact on sustainable growth of Romanian economy.

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THE ECONOMIC AND SOCIAL IMPACT OF MIGRATION IN ROMANIA[10]

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ABSTRACT: *The research objectives of the authors' team aim to analyze the economic and social effects of migration in the EU space, with a special focus on Romania, in order to identify the main challenges and opportunities on the labour market. The innovative nature of the article is based on an interdisciplinary methodology, which combines economic and social research specific to fields such as macroeconomics and sociology with the analysis of public policies regarding migration. This article has examined the economic and social impact of migration in Romania within a broader European context, highlighting the increasingly complex role that migration plays in shaping demographic dynamics, labour markets, and public policy. The main findings are that Romania is currently facing a dual demographic challenge: a persistent negative natural population growth and accelerated population aging, which together exert strong pressure on the sustainability of the labour force and social protection systems. Although international migration has recorded a positive balance in recent years, this has not been sufficient to offset the demographic decline driven by low fertility and high mortality rates.*

Keywords: *Migration, EU, Romania, impact, labour market*

JEL Classification: *F22, J08, J1, J2, J61*

1. INTRODUCTION

Romania had a resident population of 19.036 million inhabitants as of 1 January 2025, down by 31.5 thousand people compared to 1 January 2024, according to the National Institute of Statistics (INS, 2025). The main cause of the decrease in the resident population is the negative natural increase (the difference between the number of live births and deaths: -101.8 thousand people).

The demographic aging process has deepened, with the share of the elderly population (aged 65 and over) continuing its growth trend: compared to 1 January 2024 by 0.3 percentage points (from 20.0% in 2024 to 20.3% on 1 January 2025). The share of the population aged 0-

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14 in the total population decreased from 15.9% on 1 January 2024 to 15.6% on 1 January 2025. The demographic aging index increased from 125.8 (on 1 January 2024) to 130.0 elderly persons per 100 young persons (on 1 January 2025). INS data also show that the urban population, as well as the female population, are in the majority in Romania (51.3%, respectively 51.4% of the total population.

The balance of international migration in 2024 was positive, with the number of immigrants exceeding that of emigrants by 58.8 thousand people. Thus, Romania continued to be a country of immigration. However, the balance of international migration, decreasing compared to previous years, failed to compensate for the negative natural increase (-102 thousand people). As a result, on 1 January 2025, the resident population of Romania was decreasing compared to the same date of the previous year. During 2024, men were in the majority both among emigrants (57.6%) and among immigrants (58.3%).

2. LITERATURE REVIEW

The scholarly literature on migration highlights the limitations of strictly economic explanations and underscores the need to integrate social and institutional dimensions into the analysis of migratory decision-making. Boswell (2008) emphasizes the difficulty of clearly delineating the boundaries between migration economics and social structures, arguing that the assumption of uniform rationality, according to which individuals seek to maximize utility, must be understood in relation to external constraints and specific social contexts.

In this direction, Stark (1991) challenges the individualistic ontology of migratory decision-making and argues that the family or household constitutes the fundamental unit of analysis. *Migration decisions are thus conceptualized as collective strategies aimed at risk reduction and the maximization of group welfare, analogous to the way microeconomics treats the firm as a profit-maximizing unit.*

From a neoclassical perspective, Kurekova (2011) demonstrates that the enlargement of the European Union to Central and Eastern Europe provided a relevant empirical framework *for testing the hypothesis that migration is primarily driven by differences across labour markets*. Intra-EU migration is explained by differences in real wages and by imbalances between labour supply and demand in economies with varying levels of development and capital endowment.

Regarding the impact of migration on labour markets in destination countries, Vanselow, Liebig, and Kaplanis (2016) observe that most empirical studies point to limited or negligible effects on wages and employment at the local *level. This limited impact is attributed to the complementarity between migrants' and native workers' skills*, the higher occupational positioning of natives, the greater flexibility of the native labour force, and structural adjustment mechanisms, including technological change and capital flows.

Ruhs and Vargas-Silva (2017) argue that immigration, even when *accompanied by increased labour market participation rates, cannot offset the demographic decline of the labour force in most European countries*. Existing labour shortages are therefore likely to persist and intensify in the context of the European green transition and the expansion of technologies associated with the Fourth Industrial Revolution.

A more recent strand of the literature highlights the role of migrants in sustaining the functioning of essential services in times of crisis. Anderson, Poeschel, and Ruhs (2021) show that during the COVID-19 pandemic, a substantial share of essential workers were immigrants, particularly in health care, social care, and food supply chains. Nevertheless, the extent of migrants' contribution to the systemic resilience of these services remains insufficiently explored, both in academic research and in public policy.

From a policy perspective, Katseli (2004) *underscores that the development of effective migration policies depends on states' capacity to integrate migrants not only into the labour market but also into the host society*. Given the complexity of the phenomenon, European governments have often sought to keep migration at the margins of the political agenda, resorting either to defensive measures and crisis management through border controls or to selective immigration programs and large-scale regularization processes.

3. METHODOLOGY

The article is based on an interdisciplinary analysis of the economic-social impact of the migration phenomenon in the European space. The research methodology focuses on the quantitative analysis of the main indicators specific to the labour market, as well as on the qualitative analysis of documents and policies in the field of migration, on the consultation of specialized literature, studies, and articles published by renowned authors from abroad and in the country.

4. STATISTICAL DATA ON MIGRATION IN EU MEMBER STATES AND ROMANIA

According to data provided by the Statistical Office of the European Union (Eurostat, 2025), on 1 January 2024, 44.7 million people born outside the EU were living in an EU member state (9.9% of the EU population), an increase of 2.3 million people compared to 2023. In addition, 17.9 million people living in one of the EU countries on 1 January 2024 were born in another EU country, which represents an increase of 0.2 million people compared to the previous year.

The largest number of foreign-born people living in EU countries on 1 January 2024 was recorded in Germany (16.9 million), France (9.3 million), Spain (8.8 million), and Italy (6.7 million). Foreign-born persons in these 4 EU countries together accounted for 66.6% of the total number of foreign-born persons living in the EU, while the same 4 EU countries accounted for 57.8% of the EU population.

The highest share of foreign-born persons in the total population was recorded in Luxembourg (51.0% of the resident population), followed by Malta (30.8%), Cyprus (26.9%), Ireland (22.6%), Austria (22.1%), Sweden (20.6%), and Germany (20.2%). In contrast, foreign-born persons accounted for less than 5% of the population in Poland (2.6% of the resident population on 1 January 2024), Romania (3.1%), Bulgaria (3.3%), and Slovakia (3.9%) (Table 1).

Table 1: Share of foreign-born persons in the total population on 1 January 2024

Country	Total		People born in other EU Member States		People born in non-EU	
	Thousands of people	% of population	Thousands of people)	% of population	Thousands of people	% of population
Belgium	2,324.1	19.7	950.8	8.0	1,373.2	11.6
Bulgaria	211.8	3.3	67.7	1.1	144.1	2.2
Czech Republic	1,069.6	9.8	313.8	2.9	755.8	6.9
Denmark	832.4	14.0	272.5	4.6	559.9	9.4
Germany (1)	16,881.3	20.2	6,348.0	7.6	10,533.4	12.6
Estonia	244.4	17.8	26.4	1.9	218.0	15.9

Country	Total		People born in other EU Member States		People born in non-EU	
	Thousands of people	% of population	Thousands of people)	% of population	Thousands of people	% of population
Ireland	1,211.9	22.6	357.5	6.7	854.4	16.0
Greece	1,147.8	11.0	234.4	2.3	913.4	8.8
Spain	8,838.2	18.2	1,592.5	3.3	7,245.8	14.9
France (1)	9,328.9	13.6	1,965.8	2.9	7,363.1	10.8
Croatia	519.9	13.5	65.6	1.7	454.3	11.8
Italy	6,673.6	11.3	1,599.4	2.7	5,074.2	8.6
Cyprus	259.9	26.9	90.0	9.3	170.0	17.6
Latvia	238.6	12.7	21.9	1.2	216.7	11.6
Lithuania	268.3	9.3	19.6	0.7	248.7	8.6
Luxembourg	342.9	51.0	221.0	32.9	122.0	18.1
Hungary	677.0	7.1	344.8	3.6	332.2	3.5
Malta	173.8	30.8	41.0	7.3	132.7	23.6
Netherlands	2,914.9	16.2	779.6	4.3	2,135.3	11.9
Austria	2,023.4	22.1	883.9	9.7	1,139.5	12.4
Poland (1)	935.9	2.6	236.0	0.6	699.9	1.9
Portugal	1,703.8	16.0	380.3	3.6	1,323.5	12.4
Romania (1)	588.2	3.1	217.6	1.1	370.5	1.9
Slovenia	319.9	15.1	61.3	2.9	258.6	12.2
Slovakia	214.0	3.9	155.5	2.9	58.6	1.1
Finland	520.1	9.3	134.1	2.4	386.1	6.9
Sweden	2,169.3	20.6	554.1	5.3	1,615.2	15.3

Note: The individual values do not add up to the total due to rounding and the exclusion of the 'unknown' country of birth group from the table.

Poland, Slovakia, and Sweden did not include refugees from Ukraine who benefit from temporary protection in their population and migration statistics.

(1) 2024 provisional/estimated.

Source: Eurostat (2025).

Table 2 presents a summary of the 5 main groups of foreign citizens residing in Romania, by citizenship and place of birth, in 2024.

Table 2: Main countries of origin (by citizenship and place of birth) for the foreign/foreign-born population residing in Romania on 1 January 2024 (in absolute numbers and as a percentage of the total foreign/foreign-born population)

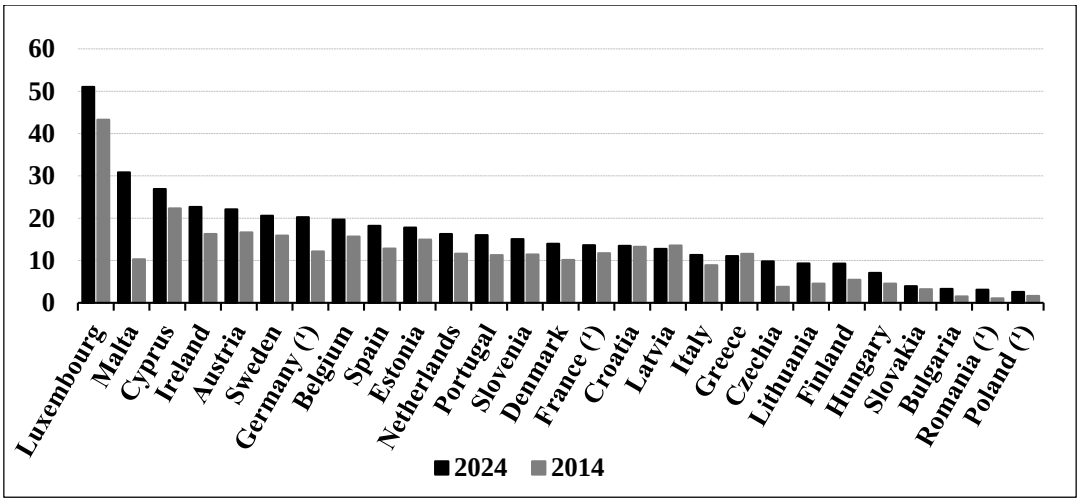
ROMANIA					
Citizens from:	**Thousands of people**	**(%)**	**People born in:**	**Thousands of people**	**(%)**
Ukraine	50.6	21.9	Ukraine	137.0	23.3
Nepal	15.9	6.9	Moldova	113.4	19.3
Italy	15.2	6.6	Italy	71.3	12.1
Sri Lanka	12.9	5.6	Spain	63.0	10.7
Turkey	12.8	5.5	United Kingdom	30.6	5.2
Others	124.0	53.6	Others	172.9	29.4

Note: The individual values do not add up due to rounding.

Source: Eurostat (2025).

As illustrated in Figure 1, the proportion of foreign-born residents increased between 2014 and 2024 in nearly all EU Member States, with the exception of Latvia and Greece. The most pronounced growth in the share of foreign-born persons was observed in Malta, where it rose from 10.3% in 2014 to 30.8% in 2024. Substantial increases were also recorded in Romania (from 1.1% to 3.1%), the Czech Republic (from 3.8% to 9.8%), Bulgaria (from 1.5% to 3.3%), Lithuania (from 4.5% to 9.3%), and Finland (from 5.5% to 9.3%).

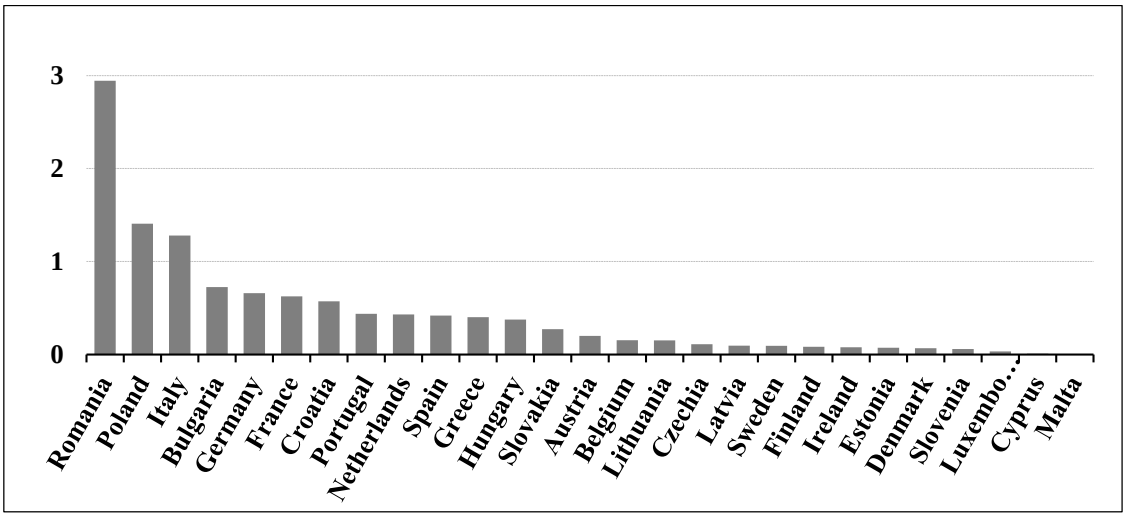
Figure 1: Share of foreign-born persons in the resident population in EU Member States, 1 January 2024 by comparison with 1 January 2014 (in %)



Note: Poland, Slovakia, and Sweden did not include refugees from Ukraine who benefit from temporary protection in their population and migration statistics.
(1) 2024 provisional/estimated.
Source: Eurostat (2025).

Romanian, Polish, and Italian citizens were the 3 largest groups of citizens from an EU country residing in other EU countries on 1 January 2024, for which data are available (Figure 2).

Figure 2: Number of EU citizens residing in the remaining EU countries on 1 January 2024 (in millions of people)



Note: Detailed data by individual EU citizenship have not been provided by Denmark, Greece, France, Croatia, Cyprus, Malta, and Poland.

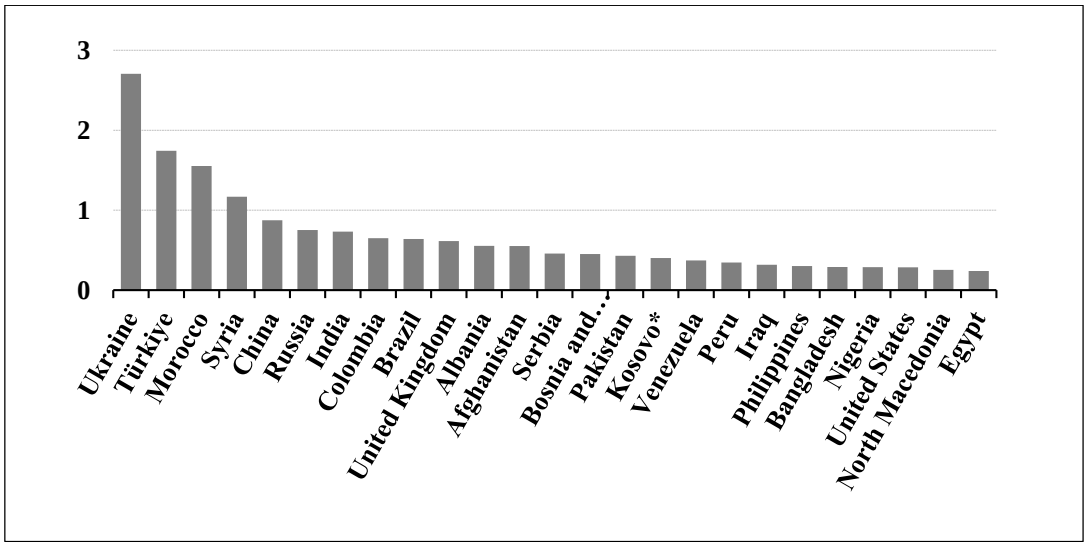
Only detailed data by individual EU citizenship for the most numerous ones have been provided by Spain.

Poland, Slovakia, and Sweden did not include refugees from Ukraine who benefit from temporary protection in their population and migration statistics.

Source: Eurostat (2025).

Ukrainian, Turkish, and Moroccan citizens were the 3 largest groups of non-EU citizens living in EU member states on 1 January 2024, for which data are available (Figure 3).

Figure 3: Number of non-EU citizens residing in EU member states on 1 January 2024 (in millions of people)



Note: Detailed data by individual citizenship have not been provided by Denmark, Greece, France, Croatia, Cyprus, Malta, and Poland.

Only detailed data by individual citizenship for the most numerous ones have been provided by Spain.

Poland, Slovakia, and Sweden did not include refugees from Ukraine who benefit from temporary protection in their population and migration statistics.

*This designation is without prejudice to positions on status, and is in line with UNSCR 1244/1999 and the ICJ Opinion on the Kosovo declaration of independence.

Source: Eurostat (2025).

An analysis of the age structure of the population shows that, for the EU as a whole, the foreign-born population was younger than the native-born population. The age distribution of the foreign-born population shows, compared to the native-born population, a higher proportion of young adults of working age and a lower proportion of children, adolescents, and adults aged 60 and over. On 1 January 2024, the median age of the native-born in the EU was 45.1 years, while the median age of the foreign-born living in the EU was 43.1 years.

In most EU countries, the foreign-born population was younger than the native-born population. Only in Estonia, France, Croatia, Latvia, Lithuania, Poland, and Slovakia was the proportion of people aged 65 and over higher in the foreign-born population than in the native-born population. In addition, the proportion of people aged 15-64 was higher in the foreign-born population than in the native-born population in all EU countries except Bulgaria, Estonia, Latvia, Lithuania, Poland, Romania, and Slovakia. In Denmark, Greece, Spain, Italy, Cyprus, Luxembourg, Malta, Portugal, Finland, and Sweden, the proportion of people aged 15-64 was at least 20.0 percentage points higher in the foreign-born population than in the native-born population (Eurostat, 2025).

5. MIGRATION IN ROMANIA: EMIGRATION AND IMMIGRATION

The concepts of residence, emigration and immigration have the following definitions according to the National Institute of Statistics, aligned with Eurostat standards:

- *Residence* represents the place where a person usually spends his daily rest period, without considering temporary absences for recreation, holidays, visits to friends and relatives, business, medical treatments, or religious pilgrimages.
- *Emigration* means the action by which a person who previously had usual residence on the territory of Romania ceases to have usual residence on its territory for a period that is or is expected to be at least 12 months.
- *Immigration* means the action by which a person establishes his or her habitual residence on the territory of Romania for a period that is or is expected to be at least 12 months, after previously having had habitual residence in another country.

According to the OECD Report on International Migration Outlook 2024 (OECD, 2024), in 2022, 36,000 new immigrants obtained a residence permit longer than 12 months in Romania (excluding EU citizens), 56% more than in 2021. Of these, 76% were immigrants for work, 10% family members (including accompanying family), 9% people who came for educational reasons and 4% other immigrants. Approximately 1,500 short-term permits were issued to international students and 3,700 to temporary and seasonal immigrants for work (excluding intra-EU migration). In addition, 33,000 intra-EU postings were recorded in 2022, representing a 79% increase compared to 2021. These posted workers generally have short-term contracts.

The year 2022 was the first one in which more citizens arrived in all counties of Romania than left. The resident population increased through the massive immigration of Ukrainians and foreign workers (Economedia, 2024). At the end of 2020, the ratio between the Romanian population that migrated outside the country and that of other nationalities that migrated to Romania was approximately 6 to 1, the number of Romanian emigrants being 6 times higher than the number of foreign immigrants who were on the territory of the country (IOM, 2021).

The top 10 countries from which most citizens entered Romania in 2022 were: Ukraine, Nepal, Sri Lanka, Turkey, the Republic of Moldova, India, Bangladesh, Italy, Sweden, and Morocco (OECD, 2024).

In 2023, the number of people applying for asylum for the first time decreased by 18%, reaching approximately 9,900. The majority of applicants came from Bangladesh (2,800), Syria (1,900), and Pakistan (1,200). The largest increase compared to 2022 was for citizens of Bangladesh (1,400), and the largest decrease was for citizens of Ukraine (-4,300).

Emigration of Romanian citizens to OECD countries increased by 9% in 2022, reaching 268,000. Approximately 36% of this group migrated to Germany, 18% to Spain, and 12% to Italy. The following OECD countries were the top destinations for Romanian citizens in 2022: Austria, the Netherlands, Belgium, Denmark, France, Switzerland, and Poland.

To address the labour shortage in various sectors, the Romanian Government has taken measures such as increasing the annual work permit admission quotas and streamlining administrative procedures. The annual work permit admission quotas were set at 100,000 in 2022, 2023, and again in 2024. The 2022 quota was fully subscribed in December of the same year, and the 2023 quota was also completely exhausted. However, demand from employers exceeds this quota. In 2023, there were approximately 124,000 work permit applications, down from 138,000 in 2022.

Starting in 2024, the initial duration of the residence permit for work permit holders was increased to a maximum of two years (compared to one year in 2023). The staff of the General Inspectorate for Immigration was supplemented in November 2023, in order to be able

to manage the increase in the number of procedures for residence permits. Romania signed bilateral social security agreements with the United States, Italy, and Montenegro in 2022-2023 and memoranda of understanding on labour and social security with Nepal (in October 2023) and with Vietnam (in January 2024).

As part of the National Recovery and Resilience Plan, the Government announced the launch of an initiative to develop a program to attract highly specialized human resources from abroad (including Romanian expatriates) to engage in research, development, and innovation activities in Romania. A simplified procedure for issuing free practice permits has been introduced for doctors from the European Economic Area (EEA) member states working temporarily in Romania. The maximum number of authorized working hours for international students has been increased from 4 hours/day to 6 hours/day in February 2024.

6. THE ECONOMIC IMPACT OF MIGRATION IN ROMANIA: EMIGRATION VERSUS IMMIGRATION

Pociovălișteanu & Dobrescu (2015) consider that the free movement of persons is one of the most important freedoms guaranteed by European Union law and is a necessary prerequisite for building a single market. Greater adaptability of workers through the migration process is also a key element in increasing the competitiveness of the European Union at a global and individual level, allowing employees to improve their skills and employment opportunities, income, and career prospects. Experts consider that migration can have both positive and negative effects on the economy. For the country of origin, one of the positive effects of migration could be the decrease in the unemployment rate and the reduction of the existing tension on the labour market, simultaneously with the decrease in the balance of social expenditures in total budget expenditures. However, this relaxation could lead to short-term benefits from migration, leading to Romania becoming a long-term labour-importing country (Silași, Simina, 2008, Pociovălișteanu & Dobrescu, 2015).

Remittances (money transferred to our country by emigrants from Romania) represent an external source of budget financing. The amounts of money sent to the country by emigrants have constituted a source of income, perhaps even the only one, for their families. *In this way, their standard of living has improved, as the money sent home is used for housing construction, while increasing consumption by purchasing other necessary goods and services, leading to improved living standards in the country of origin.*

On the other hand, migration has a significant impact on the labour market in Romania, mainly causing a significant shortage of workers, especially skilled ones, due to high emigration. However, immigration is emerging as a way to address some of these labour shortages, particularly in sectors such *as construction and manufacturing*. Large-scale emigration of working-age people has negatively affected population growth and labour productivity in Romania.

Emigration has a negative impact on the Romanian labour market by causing a labour shortage: A major impact of emigration is a significant and growing shortage of workers, especially in highly skilled sectors such as information and communications technology (ICT), health, education, and engineering. Emigration has also led to a decline in the working-age population, which has a negative impact on population growth and future labour supply.

Also, in Romania, emigration has had a negative impact on productivity. The high rate of skilled emigration has negatively affected real labour productivity growth. Additionally, in the context of an aging workforce, the decline in the working-age population, combined with lower birth rates, has led to an aging workforce, putting even more pressure on the labour market.

There are also positive effects of migration on the economy. In the short term, emigration has contributed to the decrease of unemployment and the pressure on the labour market. Remittances have provided a significant source of income for families, increasing the standard of living and contributing to consumption and investment in Romania.

On the other hand, immigration can solve the labour shortage at least in certain sectors. Immigration becomes a solution to compensate for the shortage of domestic labour, especially in sectors such as construction, manufacturing, and the hospitality industry. Foreign workers predominantly occupy these positions. Thus, immigration contributes to economic growth by stimulating both the supply and demand for labour.

In the case of Romania, there are a number of challenges related to the integration of immigrants. Foreign workers in Romania, especially from the extra-EU space, face problems related to discrimination and exploitation. Policymakers need to be made aware that Romanian institutions are not yet fully equipped to deal with the needs of a growing immigrant population, with a lack of dedicated immigrant integration offices and staff in key ministries. *Experts recommend strengthening legal protection for foreign workers, improving support services such as language training, and implementing better integration policies to ensure fair treatment and protection.*

7. NATIONAL IMMIGRATION STRATEGY AND THE EUROPEAN PACT ON MIGRATION AND ASYLUM

To support the legal immigration process, the Romanian government adopted the National Immigration Strategy 2021-2024, which is based on the following *general principles* (General Secretariat of the Government, 2021):

- the principle of *legality* means that the activities to achieve strategic objectives are carried out based on and in accordance with the law;
- the principle of *responsibility* for implementing the National Strategy lies with each of the authorities and institutions with responsibilities in the field of immigration, in the parts that concern it;
- the principle of *sovereignty* reflects the right of the Romanian state to establish policies in the field of admission, stay, and return of third-country nationals in order to promote political, economic, social, cultural, and humanitarian interests and to comply with obligations assumed through bilateral or international treaties, conventions, agreements, and understandings concluded with other states;
- the principle of *cooperation and coherence* implies active cooperation in the development and implementation of a common European Union policy in the field of immigration, as well as the correlation of the National Strategy with the measures and policies established at the level of other Member States;
- the principle of *respect for fundamental human rights and freedoms*, according to which all activities carried out by the authorities and institutions with responsibilities in the field of immigration are carried out in compliance with the provisions of international conventions and treaties on fundamental human rights and freedoms to which Romania is a party;
- the principle of *shared action* aims at the unitary implementation of state policy and legal provisions in the field of immigration, as well as a concerted implementation at all levels;
- the principle of *transparency* implies the implementation of an active information policy and, where appropriate, consultation of civil society with regard to decisions and procedures applied in the context of immigration;

- the principle of *partnership* assumes active participation, involvement, and consultation of other relevant actors (non-governmental organizations, international organizations, UN agencies, academia, private sector) in achieving the objectives of the National Strategy;
- the principle of *equal opportunities and treatment between women and men* expresses the commitment to put into practice the legal provisions and guidelines contained in the strategies in the field, considering the positive impact that the implementation of the Strategy's objectives can have on gender equality, non-discrimination, and accessibility.

The objectives and directions of action are the following:

A. Efficient management of the migration phenomenon, which means:

- promoting the conditions of entry, stay, and exit from Romania;
- simplifying access to the territory of Romania for foreigners, for the purpose of employment/secondment, and developing the access system for investors from third countries to the Romanian market;
- effectively preventing and combating illegal migration, illegal migration in connection with terrorism, trafficking in immigrants and labour exploitation of foreign employees;

B. Strengthening the national asylum system and ensuring compliance with European and international standards, which signifies:

- processing asylum applications efficiently and in accordance with applicable national, European, and international legal standards;
- streamlining the process of determining the Member State responsible for examining the application for international protection;
- ensuring reception and assistance conditions for asylum seekers;
- strengthening the social integration mechanism of persons who have acquired a form of protection in Romania and those with legal residence;
- resettling refugees and asylum seekers, and the temporary evacuation to Romania of persons in urgent need of protection and their subsequent resettlement.

C. Strengthening the Romanian state's response capacity to an influx of immigrants at the border of the national territory, which implies:

- prior preparation and unitary and integrated management of actions taken in crisis situations;
- participation in the common effort to combat hybrid threats.

D. Sustained capabilities necessary for the implementation of policies in the field of migration, asylum, and integration of foreigners, which aims:

- development/modernization of physical infrastructure and increased mobility at the level of the structures of the General Inspectorate for Immigration (I.G.I.);
- ensuring human and financial resources, with an emphasis on the appropriate dimensioning of operational needs and on improving the quality of services provided in the field of migration, asylum, and integration;
- accessing non-reimbursable external funds;
- increasing dialogue with civil society and international non-state actors.

The Romanian authorities are in the process of elaborating the future National Strategy on Immigration for 2025-2028, which will also address ways of implementing the legislative acts related to the *European Pact on Migration and Asylum*. This pact was adopted by the European Parliament in April 2024 and by the Council in May 2024.

The *European Pact on Migration and Asylum*, adopted by the Council in May 2024, is a set of new rules designed to manage migrant arrivals, create more efficient and uniform procedures, and ensure a fairer sharing of responsibility between Member States. Provisions include faster screening and asylum procedures at the border, better cooperation in crisis situations, and the possibility for Member States to take responsibility for migrants through resettlement, financial contributions, or operational support.

The main objectives of the *European Pact on Migration and Asylum*, *with the main focus on combating illegal immigration*, are as follows:

- *orderly management of arrivals* by creating a common system for managing arrivals in the EU;
- *common and efficient procedures* through streamlining screening, asylum, and return procedures;
- *fair sharing of responsibility* by setting clear rules for solidarity between Member States, with the possibility of choosing between voluntary relocation, financial contributions, or operational support.
- The content of the legislative package covers the following issues:
- *border procedures* through accelerated checks on arrival, including mandatory security, vulnerability, and medical checks;
- *the asylum procedure* by the examination of asylum applications, including at borders, will be carried out more quickly;
- *handling of rejected applications* by simplifying the expulsion procedure for rejected asylum seekers, based on agreements with third countries;
- *crisis management* through a new mechanism for managing crisis situations and the instrumentalization of migrants;
- *the management of the biometric data through the European Union's centralised biometric database (Eurodac)*, designed to assist with the management of asylum applications and support efforts to detect, investigate, and prevent terrorism and serious crime;
- *improving the reception conditions* by revising regulations that will update the rules on the reception conditions of asylum seekers.

8. MAIN FINDINGS AND DISCUSSIONS

The empirical evidence confirms that Romania remains, structurally, a country of emigration, with Romanian citizens continuing to represent one of the largest mobile populations within the European Union. Large-scale emigration, particularly of working-age and skilled individuals, has contributed to labour shortages, reduced labour productivity growth, and an aging workforce. At the same time, emigration has generated short-term economic benefits, notably through remittances, which have supported household consumption, improved living standards, and provided an external source of financial inflows.

In parallel, Romania has increasingly become a destination country for immigrants, especially after 2022, when immigration, driven by the arrival of Ukrainian refugees and foreign workers, exceeded emigration in all countries. Immigration has emerged as a partial response to labour shortages in key sectors such as construction, manufacturing, hospitality, and services. *However, the relatively low share of foreign-born persons in Romania's total population compared to most EU Member States suggests that the country is still at an early stage of transition toward a more immigration-oriented model.*

The findings align with the broader literature, which indicates that migration cannot be treated solely as an economic adjustment mechanism. The impact of migration on the labour

market and economic growth is mediated by institutional capacity, sectoral demand, and integration policies. In Romania's case, while policy measures such as increased work permit quotas, simplified administrative procedures, and bilateral agreements have improved labour market access for foreign workers, significant challenges remain in the areas of social integration, labour rights protection, and institutional preparedness.

The National Immigration Strategy 2021-2024 and the strategy for 2025-2028, together with the implementation of the European Pact on Migration and Asylum, provide an important framework for improving migration governance. Nevertheless, for migration to contribute sustainably to Romania's economic and social development, policies must move beyond short-term labour market measures. *A more coherent and long-term approach is required, integrating migration policy with demographic, education, employment, and social inclusion strategies.*

9. CONCLUSIONS

Based on the empirical findings and the theoretical framework discussed in this article, several policy recommendations emerge for enhancing the economic and social contribution of migration in Romania.

First, migration policy should be integrated more closely with demographic, labour market, and education policies. Given the persistence of population decline and workforce aging, migration cannot be treated as a short-term corrective instrument. *Romania should adopt a long-term, evidence-based labour migration strategy that prioritizes sectors facing structural shortages, while simultaneously investing in skills development and workforce retention among the native population.*

Second, institutional capacity for migrant integration must be strengthened. The establishment of dedicated integration units at both national and local levels, covering language training, labour market orientation, and access to public services, would reduce the risk of labour market segmentation and social exclusion. *Particular attention should be paid to non-EU migrant workers, who are more vulnerable to exploitation and precarious employment conditions.*

Third, policies aimed at encouraging return migration and circular migration should be expanded. *Targeted incentives for highly skilled Romanian expatriates, such as recognition of qualifications, fiscal incentives, and access to research and innovation programs, could help mitigate brain drain and support knowledge transfer*.

In conclusion, migration represents neither a panacea for Romania's demographic decline nor an inherent threat to economic stability. Rather, it is a structural phenomenon whose effects depend critically on policy design and institutional capacity. *Effectively managed, migration can mitigate labour shortages, support economic growth, and enhance resilience in key sectors. Poorly managed, it risks reinforcing demographic imbalances, social inequalities, and exclusion.* Future research should focus on the long-term integration outcomes of immigrants in Romania, the return migration of Romanian expatriates, and the role of migration in sustaining economic development amid ongoing demographic transformation.

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ASSESSING REGIONAL DISPARITIES IN THE DIGITAL AND ENERGY TRANSITION: CONSTRUCTION AND ANALYSIS OF THE REGIONAL PREPAREDNESS INDEX IN ROMANIA

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ABSTRACT: *This paper analyses how persistent regional disparities in Romania, as expressed in (SDG 10), reduce progress towards Clean and Affordable Energy (SDG 7) and Climate Action (SDG 13). The analysis highlights the role of Digital Infrastructure (SDG 9) in regional development, showing how digital divides intensify economic and environmental inequalities.*

The study compares SDG indicators 7, 9, 10 and 13 in the eight NUTS 2 regions, by applying an econometric method, through indicators such as energy poverty, broadband internet coverage, GDP per capita and carbon emissions. Correlation Tehe PCA model confirm the theoretical hypothesis that underdeveloped digital infrastructure slows down progress by reducing sustainability indicators and deepening regional inequalities.

The results highlight quite strong correlations between low digital literacy and high energy poverty, low GDP and higher vulnerability to climate change. Based on these findings, the paper proposes policy recommendations that position investments in digitalization as a strategic element for regional cohesion and a successful green transition.

Keywords: *sustainable development, digitalization, regional development, energy poverty, climate*

JEL Classification*: Q01,O33, P25, O13, Q54*

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1. INTRODUCTION

In the idea of the European Green Deal and the sustainable development goals, the transition to an economy with reduced climate pollution strongly intersects with digitalization and social equity. This process is strongly influenced by the persistent economic disparities between the eight NUTS 2 regions of Romania. Optimizing consumption and ensuring access to resources in a country locked in inefficient consumption patterns and climate vulnerability is a difficult and long-term process, requiring specific measures for each region.

This paper analyzes this complex dynamic, proposing a Regional Readiness Index aimed at quantifying the degree to which digital infrastructure and economic performance support or, on the contrary, hinder climate action at the local level. By using the Principal Component Analysis (PCA) method, the analysis provides a complex perspective on how digitalization can be used as a lever for cohesion, demonstrating that the success of the energy transition in Romania fundamentally depends on the balance between technological progress and the social resilience of each region.

The purpose of this paper is to analyze and measure the impact of the energy transition and digital infrastructure on the uneven development of Romania.

The research aims to demonstrate how digitalization (SDG 9) acts as a determinant in reducing economic inequalities (SDG 10) and facilitating access to clean energy (SDG 7), in the context of the challenges generated by climate change (SDG 13). By developing a Regional Readiness Index based on Principal Component Analysis (PCA), the paper aims to identify the gaps in the eight NUTS 2 regions of Romania and to substantiate public policy recommendations that correlate technological development with resilience and environmental objectives.

In this sense, we formulated the hypothesis of this research: H1-Regional economic disparities represent an important determinant of the absorption capacity of digital technologies, which conditions the pace of acceleration of the transition to sustainable energy in the NUTS 2 regions of Romania.

The choice of the time interval between 2015 and 2023 for the analysis of the Regiona l Readiness Index is justified by the fact that 2015 is the year of the adoption of the 2023 Age nda for Sustainable Development by the UN and the signing of the Paris Agreement, represen ting the reference moment for monitoring sustainable development indicators.

The analyzed period covers economic cycles such as the Covid-
19 pandemic crisis and the energy crisis and instability triggered by the war in Ukraine. The p andemic somewhat forced digitalization, further deepening inequalities between the regions o f Romania, especially in education, then the economic recovery after 2021 deepened the ener gy crisis. The year 2023 captures the effects of the energy transition and the implementation o f the first projects financed by the PNRR.

2. LITERATURE REVIEW

In this framework, Romania encounters substantial challenges stemming from significant economic asymmetries across its regions, mainly between urban and rural areas, but also between historical macro-regions. The purpose of this section is to review the relevant academic literature to better understand regional economic performance, emphasizing the specific techniques employed to evaluate regional impact. Furthermore, these works underscore the importance of developmental strategies and examine how particular economic branches can help bridge the gap between varying regions. A number of contemporary works examine the factors driving regional and community-level economic progress in Romania. One paper explores the impact of research and development on the nation's financial expansion,

pointing out that despite a decade and a half of steady growth, regional disparities have actually intensified. Furthermore, their findings indicate that funding for innovation and R&D continues to lag significantly behind the broader European standards (Darie, Badulescu, & Jaganjac, 2023).

Another piece of research underlines the major role of industrial and technological ongoing advancement in driving economic expansion. By. Utilizing macroeconomic indicators and empirical data, the study illustrates that countries with a robust industry and a commitment to innovation, secure a more competitive advantage in the global marketplace (Kocsis, 2024). Research, along with technological innovation and development are key drivers for long-term increase in productivity. They are vital elements behind the performance of the world's most developed economies ((Guloglu & Tekin, 2014).

Socioeconomic inequalities are a major concern and have been studied by national and European institutions, as well as research institutes and researches affiliated with universities, aiming to find the drivers of these inequalities, and potential outcomes that could lead to measures that can reduce them (Mihai, Prada, & Simion, 2022).

National research explains regional disparities as an unequal distribution of infrastructure, natural assets, productive resources and technological progress in different regions. (Moussis, 2007). Within the European Union, the reduction of the economic gap is supported by cohesion and resilience policies. (Choi, 2001) In Romania, these disparities arise from the differences in development mainly between urban and rural areas, respectively the unequal economic infrastructure, including the historical legacy of these macro-regions.

Economic policies, both at the European level and, subsequently, at national level, aimed to reduce socio-economic disparities between regions. The priority was to reach a balanced regional development. In Romania, regional disparities deepened considerably since the fall of communism, and again intensified after 2008 recession and the Covid-19 pandemic. Studies warned that developed regions recover faster from crises and this increases regional disparities, unless targeted measures are put in place to counter this trend (Goschin, 2014). Deficient infrastructure, uneven public spending and an uneven economic transition are the main factors of regional disparities. Furthermore, although in recent decades Romania experienced real economic development, NUTS2 regions continue to show major social and economic differences in the quality of life. Existing studies show this trend and emphasize that, while the national economy had a continuous grown, the divide between rich regions and struggling ones continues to increase, mainly due to disparities in industrial development and investments. Other important factors are digital divides and environmental inequalities (Bălan, 2018).

Digital infrastructure, investments in research and development are important factors in short-term economic development and also principles of sustainable and resilient development of the regional economy, as long as they take into account environmental protection and the creation of a sustainable economy that in the long term eliminates the gap between regions and leads to a balanced standard of living in the long term. (Russu, 2014)

Social and economic inequalities point to causes due to structural problems and the lack of socio-economic financing. The distribution of regional inequalities shows a trend that requires the implementation of specific public policies that generate economic growth at the local level. (Bălan, 2018)

Studies shown through statistical data that there is a growing development gap between the different regions of Romania. (Russu, 2014)

Another analysis focuses on regional economic resilience, examining how local economies respond to sudden disruptions, such as the COVID-19 pandemic and the energy crisis triggered by the Russia-Ukraine conflict, can serve as catalysts for fundamental changes within regional economies. These changes can ultimately produce superior outcomes in terms

of social and economic sustainability, opening a more favorable development path than that pursued before the unrest (Trippl, Fastenrath, & Isaksen, 2024)

3. METHODOLOGY

To argue and quantify the complexity of the interactions between regional disparities and the digital-energy transition, a Regional Preparedness Index was developed for the 8 NUTS2 regions of Romania. To provide additional rigor to the research, it was used the principal component analysis (PCA) method. PCA provides a solid statistical basis in order to construct composite indices and confirms that the conceptual dimensions and the economic theory are empirically supported by the data structure. Thus, PCA is also a tool that ensures the consistency and validity of the variables subsequently introduced into the econometric model and strengthens the link between theory and empirical analysis.

To construct the index, the model employed the following variables: GERD by sector of performance and NUTS 2 region; Regional gross domestic product by NUTS 2 region; Individuals regularly using the internet by NUTS 2 region; Rail network by NUTS 2 region; Early leavers from education and training by NUTS 2 region; People at risk of poverty or social exclusion by NUTS 2 region; GWP_100_AR5_GHG by NUTS 2 region for the period 2015-2023. Data were extracted from Eurostat, INS and Emissions Database for Global Atmospheric Research (EDGAR). The use of the PCA (Principal Component Analysis) method in this research is based on the theoretical works of Ian Jolliffe, in order to reduce the complexity of the regional macroeconomic indicators analyzed. (Jolliffe, 1990)

4. RESULTS AND DISCUSSION

The application of the PCA method generated the following results (Figure 1): The first two components together explain about 67% of the phenomenon. This demonstrates that the variables you chose (GDP, GERD, Internet, GHG, etc.) are strongly correlated and that the index you created is a robust tool to measure "regional preparedness".

According to the Kaiser criterion, we retain the components that have an eigenvalue greater than 1.

$$PC\ 1 = 3.35 > 1$$
$$PC\ 2 = 1.34 > 1$$

According to the cumulative variance criterion, there are retained enough components to be able to explain a large proportion of the total variance. The first two components PC1 and PC2 together explain 67.07% of the total variance.

The Regional Preparedness Index will thus be a bidimensional index formed by PC1 and PC2.

The Principal Component PC1– explains 47.89% of the variance.

Table 1. Variance of Principal Components

Eigenvalues: (Sum = 7, Average = 1)

Number	Value	Difference	Proportion	Cumulative Value	Cumulative Proportion
1	3.352118	2.009218	0.4789	3.352118	0.4789
2	1.342900	0.448719	0.1918	4.695018	0.6707
3	0.894181	0.143463	0.1277	5.589200	0.7985
4	0.750718	0.360273	0.1072	6.339918	0.9057
5	0.390445	0.210198	0.0558	6.730363	0.9615
6	0.180247	0.090857	0.0257	6.910610	0.9872
7	0.089390	---	0.0128	7.000000	1.0000

Source: Eviews output

Principal Component 2 (PC 2) – explains 19.18% of the variance. PC 2 appears to be a balancing component for innovation/digitalization and transport.

A high score on PC 2 is associated with high digital usage and good rail infrastructure, but relatively low R&D expenditure. This could indicate regions that have adopted digital technology and have a logistics base, but are not major innovation and research centers.

Table 2. Correlation coefficients between the original variables and the principal components

Variable	PC 1	PC 2	PC 3	PC 4	PC 5	PC 6	PC 7
EARLY_LEAVER...	0.330752	0.056311	0.782822	0.195713	0.215283	-0.435550	0.016398
GERD_BY_SECT...	-0.240352	-0.668738	-0.055812	-0.339073	0.504718	-0.263535	0.229659
GWP_100_AR5_...	0.388971	-0.001256	-0.518977	0.530702	0.121785	-0.322973	0.422582
INDIVIDUALS_RE...	-0.353210	0.496692	-0.099535	0.193119	0.732134	0.058043	-0.204811
RAIL_NETWORK...	0.348282	0.441754	-0.011502	-0.628095	0.162584	0.117823	0.498599
PEOPLE_AT_RIS...	0.450894	-0.327681	0.102578	0.188451	0.328322	0.728950	-0.064190
REGIONAL_GRO...	-0.481843	0.019795	0.306883	0.312680	-0.117607	0.296504	0.688290

Source: Eviews output

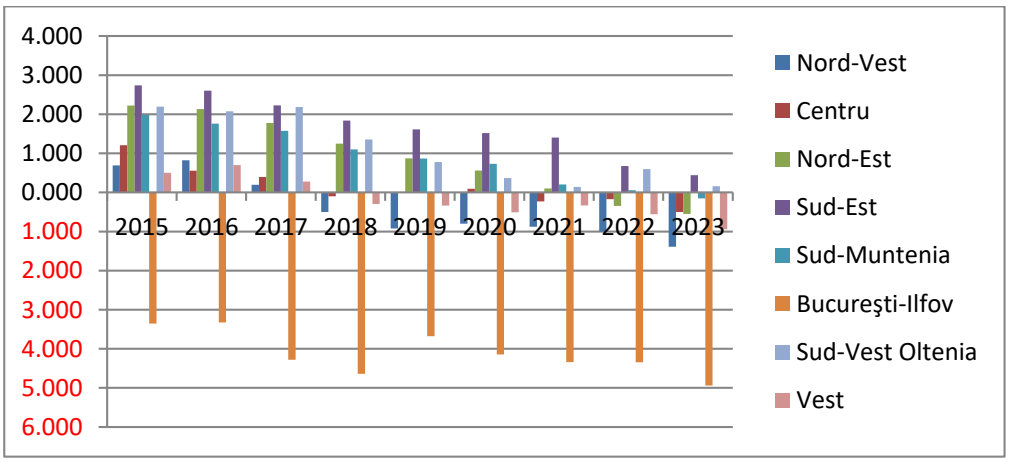
PC1 seems to reflect a mix of social exclusion and infrastructure, with high positive loadings for: People at risk of poverty or social exclusion by NUTS 2 region, with a score of 0.450894; Higher CO2 emissions- GWP_100_AR5_GHG- with a score of 0.388971

Early leavers from education and training by NUTS 2 region with a score of 0.330752; and negative values for: Regional gross domestic product by NUTS 2 region with a score of -0.481843; Individuals regularly using the internet by NUTS 2 region with a score of -0.353210

This component can be interpreted as a composite indicator of regional disadvantage, where high scores indicate social vulnerability and poor infrastructure.

Although the original name is the Regional Preparedness Index (RPI), the PCA analysis shows that: high scores on the principal component (PC1) are associated with: high school dropout rates; risk of poverty; high gas emissions; poor railway infrastructure and low internet use. The high values reflect the accumulation of structural vulnerabilities, which suggests that the index works more like a Regional Preparedness Index. Thus, the NUTS 2 regions of Romania are, for the most part, in a disadvantageous position in relation to the requirements of the digital, energy and social transition.

Figure 1. Multiannual graph of the NUTS2 Regional Readiness Index



Source: Generated after the index obtained in Eviews

Most regions oscillate between positive and negative values, but Bucharest-Ilfov (orange bars) stands out with constant negative values in all the years analyzed. The North-West, Center, West and South-Muntenia regions seem to have moderate variations, with episodes of increase and decrease, but without extreme deviations. South-West Oltenia and North-East show wider variations, suggesting structural instability or vulnerability.

Bucharest-Ilfov is a special case where constant negative values may indicate: ecological deficits (e.g. GHG emissions, pollution), hidden social exclusion (e.g. high cost of living, inequality) or a calculation methodology that penalizes urban concentration. It is possible that the region is disadvantaged in the preparedness index, despite its gross economic performance, or requires the analysis of some variables specific to the metropolis. Although the Bucharest-Ilfov region is a national growth pole, it is unprepared in terms of sustainability in terms of equity, infrastructure and environment. The Oltenia N-E, S-E, S-V regions tend to have lower values, which confirms the PCA conclusions regarding regional unpreparedness. Overall, the PCA model suggests persistent disparities at the level of NUTS2 regions.

Table 3. Regional Preparedness Index

	2015	2016	2017	2018	2019	2020	2021	2022	2023
Nord-Vest	0.691	0.821	0.197	0.502	0.923	0.801	0.877	1.001	1.389
Centru	1.207	0.555	0.395	0.100	0.012	0.095	0.232	0.172	0.501
Nord-Est	2.223	2.133	1.778	1.246	0.872	0.558	0.103	0.343	0.551
Sud-Est	2.739	2.605	2.228	1.837	1.614	1.517	1.405	0.674	0.440
Sud-Muntenia	1.979	1.761	1.576	1.102	0.869	0.731	0.205	0.057	0.154
Bucureşti-Ilfov	3.356	3.327	4.281	4.640	3.678	4.143	4.339	4.345	4.939
Sud-Vest Oltenia	2.192	2.073	2.184	1.356	0.777	0.368	0.143	0.598	0.160
Vest	0.502	0.698	0.279	0.295	0.337	0.508	0.331	0.558	0.943

Source: generated by the author after the results obtained in Eviews

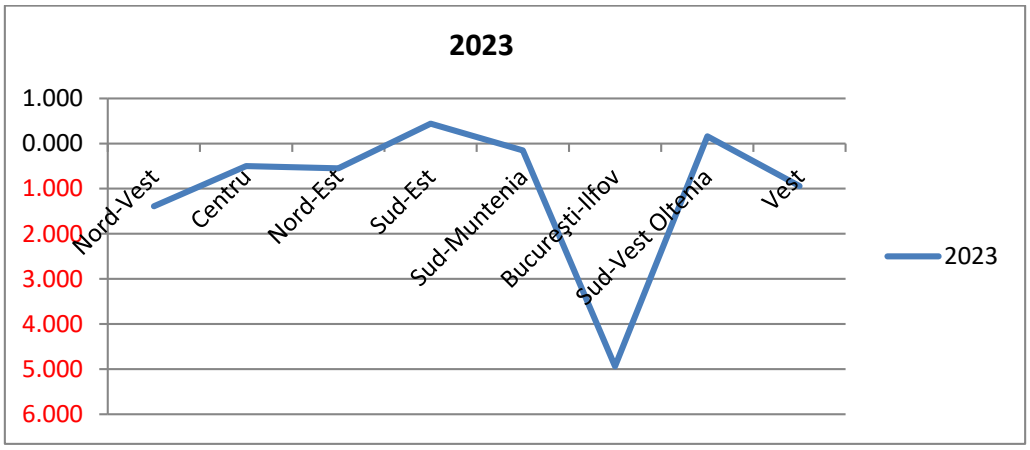
The fact that many values (in red) are negative, turn the interpretation of the Regional Readiness Index into a concern for certain areas and suggests that factors such as the risk of poverty, school dropout or greenhouse gas emissions have outweighed the benefits brought by GDP or digitalization.

The analysis indicates a paradox of regional development in Romania: the regions with the highest GDP and the highest rate of digitalization (Bucharest-Ilfov, North-West) record the worst regional readiness scores (negative values). This suggests that environmental pressure (GHG emissions), the degradation of the railway infrastructure and social risks cancel out the economic advantages. In contrast, the less economically developed regions maintain a positive but fragile index, being on a downward trend of underdevelopment.

The graph highlights a sharp polarization of regional resilience, where the collapse of the index in the Bucharest-Ilfov growth pole signals that the accelerated economic expansion has exceeded the supporting capacity of the infrastructure and the environment, transforming the capital from a development engine into a critical point of structural vulnerability.

From an economic and digital point of view (GDP, internet users) the Center region is active, the negative value of -0.501 suggests that the benefits of development are partially cancelled out by pressure indicators (such as gas emissions or the risk of social exclusion), pulling the index below the equilibrium line. From the point of view of the Regional Readiness Index, the Centre region occupies a position of fragile equilibrium, being located between the positive pole of resilience and the negative pole of vulnerability.

Figure 2. Regional Preparedness Index Graph – 2023



Source: Generated by the author based on data from table 1- year 2023

5. CONCLUSIONS

In Romania, most NUTS2 regions are not sufficiently prepared for the digital transition and its implications for socio-economic development, thus regional disparities are recorded.

The PCA analysis led to the construction of a Regional Readiness Index (RPI), intended to synthesize the degree of readiness of NUTS 2 regions in Romania for the digital, energy and social transition. However, the distribution of scores and the orientation of the variables indicate an interpretative reversal: high scores reflect the accumulation of vulnerabilities, such as educational exclusion, risk of poverty, high emissions and poor infrastructure.

The results reflect a multitude of intuitive vulnerabilities such as educational exclusion, poverty risk, high emissions and poor infrastructure.

Thus, the constructed index, IPR functions as an Index of Regional Unpreparedness, summarizing the structural gaps that limit the capacity of regions to respond effectively to current economic challenges. The regions of Romania are predominantly positioned in the risk zone (negative indicators) and require specific interventions in order to reduce disparities and develop adaptive capacity. We ask ourselves the question: do we develop the regions while maintaining and protecting the environment or do we sacrifice the environment in favor of development?

Although NUTS 2 regions provide a useful overview, this division can mask huge dis parities within the same region (for example, the discrepancy between a university center like Iași and the neighboring rural counties in the North- East region).

Using data at county level (NUTS 3) would have provided greater precision, but repor ting of SDG indicators at this level is often incomplete in international databases.

Principal Components Analysis is sensitive to extreme variations (outliers). The case of the Bucharest-Ilfov region, witch statistically dominates the rest of the country, can exert a disproportionate influence on the weights of the principal components, causing pressure indicators (such GHG emissions) to be over-weighted relative to social development indicators.

Public policy recommendations

To reverse the negative values in the performing regions (such as Bucharest-Ilfov or N-V), it is necessary to implement subsidies conditional on the carbon footprint for large companies. Instead of stimulating only the growth of turnover, the state should offer tax incentives exclusively to entities that invest in technologies with low greenhouse gas (GHG)

emissions. Such a policy would force a transition from quantitative development, which "settles" the environment to a qualitative one, where the regional readiness index returns to the positive zone by reducing pollution and modernizing railway networks.

The data indicates a major fragility in regions such as Sud-Muntenia or North-East where, although the index is still positive, the trend is downward. Here, the public policy should focus on creating special economic zones with a focus on human capital retention. This would involve mentoring programs and technical scholarships financed through public-private partnerships, aimed to reduce the rate of early leavers and integrating the population at risk of poverty into high value-added sectors (such as R&D or Digital). Only by securing the human factor, these regions can prevent the index from collapsing towards the negative values observed in overpopulated urban centers.

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IMPLICATIONS OF NEW TECHNOLOGIES ON SAVING BEHAVIOR IN THE DIGITAL ECONOMY

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ABSTRACT: *Digital transformation changed the way individuals manage money and make financial decisions. The appearance and then the evolution of financial technologies (fintech), artificial intelligence, and mobile banking applications introduced new tools that automate, personalize, and influence saving behaviour in the digital economy. These innovations affect how people perceive trust, control, and financial security. The present paper explores how demographic and behavioral characteristics change the adoption of digital saving tools. The main purpose of the study is to identify patterns in digital saving adoption. As methodology, the research employs a qualitative method using data collected through semi-structured interviews with digital banking users and focuses on their perceptions of convenience, security, and emotional engagement in digital platforms that influence their savings habits. The results show that digital technologies facilitate accessibility and encourage saving discipline, but in spite of this, concerns about data protection and emotional detachment persist.*

The results indicate that digital financial technologies may influence saving behaviour through increased convenience and transparency. At the same time, concerns related to trust and data protection continue to shape adoption decisions.

Keywords*: Digital economy, Digital banking, Financial technology, Saving behaviour*

JEL Classification: *O33, E21, G21*

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1. INTRODUCTION

Digital transformation changed how people manage their finances nowadays and take decisions about money management. New technologies as fintech, artificial intelligence and mobile banking started to be used as tools that help automate, personalize and define how people save and invest in both advanced and emerging economies (Gomber et al., 2017; Claessens et al., 2018). Digital technologies continue to spread globally especially in low-income populations and improve access to financial services and consequently provide easier savings solutions.

In Romania, the rapid digital transformation reshaped the country's financial landscape as the financial technology (FinTech) sector expanded quickly and made financial services more accessible. Due to this, people were encouraged to switch from traditional to digital transactions. Digital transactions such as payments, investments or money transfers can now be carried out far more quickly and conveniently. Moreover, the increasing integration of sustainability criteria and sustainable indices in capital markets reflects structural changes that also influence individual investment and saving decisions (Panait et al., 2025).

It's financial literacy that can also change people's saving behavior. Individuals who have a clearer understanding of financial principles are generally more inclined to save consistently and develop healthier long-term financial habits. Data from the Global Findex (2025) shows that nearly half of adults worldwide (48%) saved money during the previous year. However, saving behavior varies depending on a country's level of economic development. In high-income economies, a much larger share of adults (around 71%) made short-term savings, while in emerging and developing economies, the proportion was lower, at about 43% (Demirgüç-Kunt et al., 2020). In the Romanian context, education and financial literacy support financial inclusion and improve saving outcomes (Drăghici & Oprea, 2025).

Although the use of digital banking services increased considerably, the adoption remains uneven, influenced by demographic, economic, and technological factors.

Based on these, most of the past studies focused mainly on analyzing the digital banking from an economic perspective or on general consumer perceptions and emotions.

Therefore, the paper analyzes the relationship between FinTech adoption and savings behaviour for people aged 35 to 45 and how they perceive digitalization in banking and which factors or past experiences could influence their saving habits. The study provides practical recommendations for banking institutions and offers useful insights for improving communication strategies and the user experience.

To achieve these objectives, the study addresses the following research questions: 1. How do new digital technologies influence the saving behaviour? 2. How do trust and security concerns affect people's decision to use digital tools for saving?

The paper is structured into five sections. The first section provides a background discussion. The second section offers a review of the relevant literature, followed by a description of the data and research method in the third section. The fourth section focuses on the results and discussion, while the fifth and final section presents the conclusions, the study's limitations, and directions for future research.

2. LITERATURE REVIEW

The new FinTech solutions have the ability to make the shift from traditional finance services to the digital, innovative ones and to ease the access of previously unserved areas, especially from the developing countries (Ololade, 2024; Margareta et al., 2025). Recent bibliometric evidence also confirms the rapid expansion of research on banking digitalization and its implications for financial inclusion in emerging economies and demonstrates that there is a structural shift toward technology-driven financial intermediation (Oprea & Nicula, 2026).

In their papers, Oprea (2023) and Adelaja et al. (2024) show that innovations like mobile money, artificial intelligence, and blockchain-based solutions make financial services more flexible, accessible, and better adapted to people's daily needs. These digital tools help households manage shocks, save more regularly, and make quicker financial decisions as observed in countries such as Romania (Anghel & Strachinaru, 2016). People started to experience the benefits of these tools, from lower financial fees and penalties to easier access. The benefits influence the decision-making, which becomes more informed and focused on saving solutions (Carlin et al., 2023). Lack of digital competencies and of financial literacy can be considered an obstacle in using FinTech solutions (Broekhoff et al., 2024; Singh et al., 2024).

Different studies show that people who are financially literate tend to make smarter savings and investment decisions (Thakor, 2020; Oprea et al., 2025). Researchers also caution about the fact the relationship between FinTech and improved saving habits is not universal (Mader, 2018).

Papers focused on behavioral mechanisms which underline FinTech adoption show a better understanding of the heterogeneity of these effects. Maria & Sugiyanto's (2023) research shows that trust and security perceptions repeatedly emerge as high-impact determinants of behavioral intention. Empirical models that integrate UTAUT2 with trust-based constructs confirm that institutional and technology trust can compensate perceived risk mostly in mobile banking and e-wallet contexts where data sharing and authentication are important to users (Amnas et al., 2023; Kilani et al., 2023).

Newer evidence also indicates that adoption intentions rise when functional value (speed, convenience, personalization) dominates financial and privacy risks, but this balance varies by user profiles and prior digital experience (Wei et al., 2025).

Evidence from Romania also emphasizes that perceived data security and trust in advanced technologies (including features enabled by AI) are associated with intention to adopt digital wallets and mobile banking and reinforce the role of guarantees and transparent governance for stable saving routines (Bodorin, 2025).

Trust is a mediator between perception of utility and intention of FinTech services use, thus, it is considered a determinant factor in FinTech adoption (Kabakuş & Küçükoğlu, 2022; Gefen et al., 2003). In this context, Oyewole et al. (2024) highlighted the importance of consumer protection laws, digital ID systems, and privacy safeguards to help build trust in FinTech platforms (Oyewole et al., 2024).

The loyalty toward a financial institution is given by trust. The clients who consider digital services safe intend to develop a relationship based on trust with a financial institution. (Sa'diyah & Soegoto, 2021; Alrawad et al., 2023). Recent studies also underline that perception of security and data protection are correlated with the trust level of clients and influence the adoption and use decision of digital services (Kantika et al., 2022; Acosta-Prado et al., 2024). Even the best digital platforms can be abandoned by users if there is a security doubt (Gui et al., 2024).

3. METHODOLOGY

The study applies qualitative research based on semi-structured interviews that explore how Romanian consumers' savings habits are influenced by trust and security. This method offers the option to adjust the questions based on participants' responses and allows new themes to emerge naturally during the discussion.

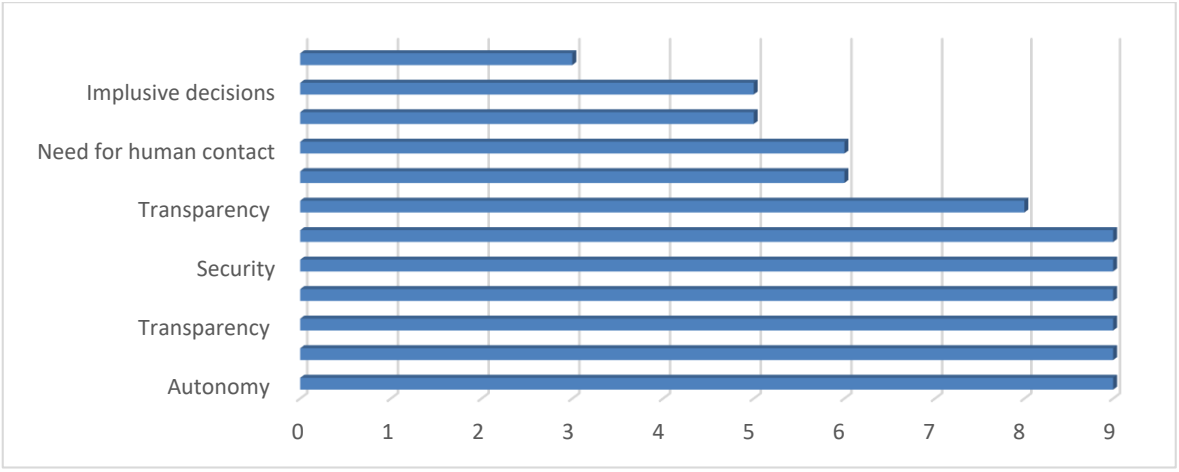
The data obtained from participants' interview responses are qualitative, and the unit of analysis is the individual user of digital banking services. The purposive sampling contained nine participants, men and women aged 35–45, living in Bucharest. The justification to select this particular group was motivated by the fact that these consumers' experience with both traditional and digital banking services, which allowed them to provide informed comparisons. The interviews were conducted in April 2025. Interviews were audio-recorded with participants' consent, fully transcribed, and analyzed to identify themes related to digital behavior, perceived security, and emotional responses. The results were summarized and exported into an Excel file to support cross-case comparison.

The methodology was limited by the small number of participants, which does not allow the results to be generalized. However, the data are rich and suitable for the exploratory purpose of the study.

4. RESULTS AND DISCUSSIONS

The qualitative study was conducted with nine participants, aged 35–45, which allowed the research to focus on a segment that has interacted with both traditional banking channels and modern digital platforms. Participants came from different professional backgrounds and brought diverse viewpoints on trust, autonomy and adaptability in the context of savings and investing. Analysis of the semi-structured interviews revealed three main themes related to how consumers perceive trust and security in digital banking services when making a savings decision. Each theme contains multiple subthemes, supported by detailed and context-specific concepts. To visually highlight the main themes identified during the interviews, Figure 1 illustrates their distribution based on how frequently they appeared in participants' responses.

Figure 1. Frequency of themes identified in the interview analysis (N = 9)



Source: author's representation based on data obtained from the analysis.

The results of the analysis are summarized below:

Digital banking behavior is linked to more consistent saving habits.

- ✓ Autonomy (9/9). The possibility to check in real-time balance and have direct control over accounts makes saving more intentional: people know where they stand and can move small amounts into savings when they see a surplus. This supports regular, self-directed saving and tighter budgeting.
- ✓ Speed / Efficiency (9/9). When saving is instant, respondents are more likely to act on saving intentions (e.g., round-ups, same-day transfers on payday).
- ✓ Transparency (8/9). Easy access to balances and transaction history raises awareness of spending leaks, which participants described as helping them stay on track with saving targets.

Positive emotional perceptions, such as trust and comfort, support saving behavior, while frustration and anxiety tend to inhibit it.

- ✓ Comfort (9/9). When the experience feels easy and familiar, people are willing to save more often (e.g., set & forget automations, recurring transfers).
- ✓ Perceived security (9/9). The new protective methods, like two-step verification and biometrics, are a precondition for depositing money into digital savings accounts. People that have a sense of security are more inclined to adopt a saving tool. On the contrary, if the safety measures are not in place, the decision to save can be delayed or people will avoid to move funds.
- ✓ Anxiety (3/9). People who have a fear of errors or fraud seem to avoid exposing themselves to the new saving features (e.g., automated rules). As a consequence, the saving frequency is reduced among a minority of users.

Trust dynamics indicate that the combined support, digital and human, improves user confidence.

- ✓ Influence on habits (9/9). All the respondents confirmed that they are inclined to adopt a savings tool when they have available both human and digital support.
- ✓ Need for human contact (6/9) and preference for hybrid (6/9). Many respondents want human support for complex or high-stakes actions (e.g., large transfers, disputes), but are comfortable using apps for routine saving.

Table 1. Quick synthesis - direction of association with saving

Theme	Direction vs. saving behavior	Why it matters
Autonomy, Transparency	**Positive**	Control and visibility support budgeting and planned transfers
Speed/Efficiency	**Positive (with caveat)**	Frictionless saving may also enable impulsive spending
Perceived Security, Comfort	**Strong positive**	Preconditions for adopting/keeping automated saving tools
Frustration, Anxiety	**Negative**	Interrupt routines; reduce willingness to try saving features
Need for human contact / Hybrid	**Positive**	Reassurance → sustained digital saving for routine goals
Impulsive decisions	**Negative (subset)**	Can erode saved amounts without guardrails

Source: author's representation based on data obtained from the analysis.

The qualitative results show that digital banking behaviour shapes saving habits. Autonomy, speed and transparency are the elements mentioned in almost all the responses. This indicates that users feel more in control of their finances when they use digital services. Majority of participants responded that digital tools (instant transfers, real-time balance visibility) helped them save more frequently and in an organized manner.

Emotional perceptions also influence how individuals use digital saving features. Feelings of comfort, familiarity, and perceived security (biometrics, two-factor authentication) were mentioned by all respondents, showing that positive emotions build confidence and support stable saving behaviour. In contrast, frustration caused by technical problems and anxiety related to errors or fraud can disrupt saving routines and discourage the use of digital tools.

In terms of trust dynamics influence, many participants preferred a hybrid approach: digital tools for routine tasks and human assistance for complex or sensitive issues. This combination provides a sense of trust and encourages continued use of digital platforms for regular saving. At the same time, the speed of digital transactions can make people take impulsive decisions on spending, which may conflict with saving goals.

All three dimensions: digital behaviour, emotional perceptions, and trust dynamics, indicate a clear connection to saving behaviour. The results show that comfort, transparency, and control can support frequent and organized saving, while frustration, anxiety, and impulsivity may diminish saving discipline for some users. These findings align with the literature showing that FinTech removes barriers and supports saving through access, automation, and convenience. Adoption of these solutions depends on digital financial literacy and trust, shaped by security measures, regulations, and cultural context.

This qualitative study had some limitations because it relied on a small sample of adults and data collected over a short period of time, which can limit the generalization of the findings and may incur selection and response bias. The study can be used as a reference framework for future research on causal links between digital technologies, perceived security and saving behavior based on larger, multi-region or cross-country samples and mixed methods (standardized surveys, experiments).

5. CONCLUSIONS

The purpose of this study was to examine how digital technologies, particularly FinTech applications, artificial intelligence tools, and mobile banking platforms, can change saving behaviour among adults with age 35-45. The paper analyzed how individuals perceive trust, security, and emotional engagement when interacting with digital financial services, and to identify behavioural patterns that influence their decision to adopt digital saving tools. We have selected a qualitative methodology approach in order to explore two core objectives: understand the influence of technological innovation on short-term saving habits and analyze how much the adoption decision to use a saving tool is guided by trust and sense of security. The findings indicate that the adoption of digital technologies changed the user's perception to practice a more organized money management due to services' speed, accessibility, and transparency (real-time information, online transfers).

This shows that digital tools can stimulate short-term saving routines. At the same time, protective and security features such as biometrics and two-factor authentication increase confidence in digital platforms. Nevertheless, the study also highlights the fact that the technical issues, uncertainty, or fear of fraud can discourage saving behaviour.

The research provides an integrated view that connects FinTech adoption, emotional responses and saving habits. The focus is on a demographic group (adults aged 35–45) that is

rarely examined in qualitative FinTech studies. With this approach, the paper provides new insights into how this segment experiences the transition from traditional to digital banking. There was introduced in the study a thematic coding to map the user perceptions and generate a detailed categorization of behavioural, emotional and trust-related factors that influence saving decisions. These contributions strengthen the understanding of how digital finance affects every day financial behaviour at the individual level.

The study has several limitations. The small sample of nine participants limits the generalization of the results. Because the data rely on self-reported experiences, responses may be influenced by personal preferences or other contextual factors. At the same time, the sample is geographically limited to Bucharest and may not capture long-term behavioral dynamics from a wider region. Future research should focus on expanding to larger, more diverse samples across different regions or countries to test the consistency of these findings and investigate demographic or cultural variations. The results of this study can serve as a basis for banks and policymakers to develop targeted personalized digital tools in order to encourage users to have consistent saving practices.

In conclusion, the study highlights that digital transformation changes financial behavior and makes saving more efficient, intentional, and accessible. As financial technologies continue to develop, it's important to build transparent, user-centered, and trustworthy digital ecosystems that will support individuals in managing their finances and developing sustainable saving habits in the digital economy.

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THE ECONOMIC IMPACT OF THE SOCIAL ECONOMY ON POVERTY REDUCTION, EMPLOYMENT, AND INCOME INEQUALITY. A COMPARATIVE ANALYSIS OF ROMANIA AND THE EU-27 IN THE CONTEXT OF SDGs 1, 8, AND 10

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ABSTRACT: *This paper investigates the economic impact of the social economy on poverty reduction, employment, and income inequality within the framework of Sustainable Development Goals (SDGs) 1, 8, and 10. The analysis is conducted from a comparative perspective between Romania and the EU-27 over the period 2020–2025, a timeframe marked by significant economic and social disruptions.*

The research combines a conceptual and critical review of the recent literature with a quantitative statistical analysis of key SDG indicators, followed by an econometric approach aimed at identifying the interdependencies between poverty, employment, and income inequality. Particular attention is given to the role of the social economy as a complementary mechanism to public policies, capable of facilitating labor market integration, enhancing employment quality, and supporting vulnerable groups.

The findings highlight the existence of an asymmetric relationship between employment growth and poverty reduction, especially in the Romanian case, where structural vulnerabilities persist despite improvements in labor market indicators. At the same time, the reduction in income inequality does not necessarily translate into a proportional decrease in poverty, emphasizing the limits of redistributive mechanisms in the absence of productivity gains and quality employment.

The study contributes to the literature by providing empirical evidence on the role of the social economy in strengthening the transmission mechanisms between employment, income distribution, and poverty alleviation. The results suggest that the expansion and institutional integration of the social economy can enhance socio-economic convergence and support the achievement of sustainable development objectives at both national and European levels.

Keywords: *social economy; poverty reduction; employment; income inequality; sustainable development goals; SDG 1; SDG 8; SDG 10; EU-27; econometric analysis; Romania.*

JEL Classification: *I32; J21; D63; O15; P46.*

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1. INTRODUCTION

In recent decades, both the global and European economies have undergone significant structural transformations driven by successive crises and paradigm shifts in economic development. The global financial crisis, the COVID-19 pandemic, and more recent geopolitical and energy shocks have exposed the limitations of traditional growth models based primarily on market efficiency and profit maximization. In this context, the concept of sustainable development and the need for inclusive economic growth have become central priorities for public policy at both national and supranational levels [4], [20].

The adoption of the Sustainable Development Goals (SDGs) by the United Nations marked a major step toward a more integrated development framework, combining economic, social, and institutional dimensions. Among the 17 SDGs, SDG 1 (No Poverty), SDG 8 (Decent Work and Economic Growth), and SDG 10 (Reduced Inequalities) are particularly relevant for strengthening socio-economic cohesion and ensuring long-term development sustainability [21], [22].

The relationship between these objectives is inherently complex and interdependent. Poverty reduction is closely linked to the capacity of the economy to generate stable and adequately paid employment, while income distribution shapes access to economic opportunities and social mobility. The literature frequently conceptualizes these interactions as a "poverty–employment–inequality nexus," in which changes in one dimension influence the others through multiple transmission channels [14], [15].

At the European Union level, these interdependencies are reflected in strategic policy frameworks aimed at promoting social inclusion and economic convergence. However, recent evidence suggests that improvements in employment and reductions in income inequality do not automatically translate into proportional decreases in poverty, particularly in economies characterized by structural vulnerabilities, lower productivity levels, and significant labor market segmentation [6], [8].

In this context, the social economy has emerged as an increasingly important component of contemporary economic policy. By combining economic and social objectives, the social economy contributes to job creation, service provision, and the integration of vulnerable groups into the labor market. Organizations such as cooperatives, associations, foundations, and social enterprises operate as complementary mechanisms to traditional market and state interventions, particularly in areas where market failures or institutional constraints persist [2], [3], [14].

Romania represents a relevant case study within the European Union. Despite notable progress in employment and some improvements in income distribution, the country continues to exhibit one of the highest levels of poverty and social exclusion risk in the EU. This situation reflects persistent structural challenges, including low productivity, regional disparities, and limited integration of vulnerable groups into the labor market [8], [26].

Against this background, this paper aims to investigate the economic impact of the social economy on poverty reduction, employment, and income inequality from a comparative perspective between Romania and the EU-27 over the period 2020–2025. The methodological approach combines a critical review of the relevant literature with statistical analysis of SDG indicators and an econometric framework designed to capture the interdependencies between the variables under study.

The main objective of the research is to assess the role of the social economy as a transmission mechanism linking employment, income distribution, and poverty alleviation. By doing so, the paper contributes to the existing literature by offering an integrated perspective on the SDG 1–SDG 8–SDG 10 nexus and by highlighting the potential of the social economy to support socio-economic convergence at both national and European levels.

2. LITERATURE REVIEW

The concept of the social economy has undergone a significant evolution over the past decades, becoming an important component of the debate on inclusive and sustainable economic development. Initially associated mainly with non-profit organizations and cooperatives with a limited economic role, the social economy is now widely recognized as a relevant actor in promoting social cohesion and addressing structural economic vulnerabilities [4], [14].

In a broad sense, the social economy encompasses a diverse set of organizational forms, including cooperatives, mutual societies, associations, foundations, and social enterprises. These entities are characterized by several defining features: the primacy of social objectives over profit distribution, participatory governance structures, and the reinvestment of economic surplus for community benefit or organizational development [3], [14]. This dual economic and social orientation distinguishes the sector from both traditional private enterprises and public institutions.

Recent literature emphasizes that the social economy should not be analyzed solely through legal or institutional classifications, but rather through the functions it performs within the economic system. Social economy organizations generate economic value while simultaneously pursuing social objectives such as the inclusion of vulnerable groups, the provision of essential services, and the strengthening of local communities [2], [14]. This functional perspective allows for a more comprehensive understanding of the sector's contribution to development processes.

The increasing relevance of the social economy is closely linked to the structural transformations of modern economies. Successive crises have highlighted the limitations of market-based mechanisms in addressing social exclusion and inequality. In this context, the social economy is often viewed as a complementary mechanism to public intervention, capable of filling gaps left by both markets and state policies [4], [14].

Sustainable Development Goal 1 aims to eradicate poverty in all its forms and represents a central pillar of the global development agenda. Within the European Union, poverty is typically measured using the AROPE indicator (At Risk of Poverty or Social Exclusion), which captures multiple dimensions of socio-economic vulnerability [7], [8].

The relationship between the social economy and poverty reduction can be explained through several economic mechanisms. First, social economy organizations contribute to job creation for individuals facing barriers to labor market entry, such as long-term unemployed persons, people with disabilities, or low-skilled workers [4], [15]. By facilitating access to employment, these organizations directly influence household income and reduce dependence on social transfers.

Second, the social economy plays an important role in the provision of social services, including education, training, healthcare, and social care. These services improve access to essential resources and reduce the cost burden on vulnerable households, thereby indirectly contributing to poverty alleviation [15], [16].

Another relevant mechanism is the strengthening of social capital. Social economy initiatives often foster community engagement, trust, and cooperation, which can enhance resilience and reduce socio-economic vulnerability over time [18]. However, the literature also highlights that the impact of the social economy on poverty reduction depends on the size of the sector, the institutional framework, and the availability of sustainable funding mechanisms [4].

Sustainable Development Goal 8 focuses on promoting sustained, inclusive, and sustainable economic growth, as well as full and productive employment and decent work for

all. In the European context, the employment rate of the population aged 20–64 is commonly used as a key indicator of labor market performance [7].

The social economy contributes to employment generation by creating jobs and facilitating labor market integration for disadvantaged groups. Social enterprises, in particular, often develop targeted employment programs designed to support individuals with limited access to traditional labor markets [4]. These initiatives are especially relevant in economies characterized by structural unemployment or labor market segmentation.

Beyond the quantitative dimension of employment, the social economy is also associated with qualitative aspects of work. Many social economy organizations promote participatory management, invest in human capital development, and provide more stable and socially oriented working conditions [15]. As a result, the sector can contribute to improving job quality and enhancing long-term employability.

Nevertheless, the literature points out certain limitations. A significant share of social economy activities is concentrated in sectors with relatively low productivity and limited value added, which may constrain the sector's contribution to aggregate economic growth [6]. Therefore, the impact of the social economy on SDG 8 must be assessed not only in terms of job creation but also in relation to productivity dynamics and structural transformation.

Reducing income inequality is a key objective of sustainable development, with direct implications for social cohesion and economic stability. Inequality affects access to opportunities, limits social mobility, and may hinder long-term economic growth [14], [21].

The social economy can contribute to reducing income inequality through both direct and indirect channels. On the one hand, by integrating individuals from lower income deciles into income-generating activities, it helps increase earnings at the bottom of the distribution. On the other hand, by providing affordable or subsidized services, it effectively increases disposable income for vulnerable households [4], [15].

Additionally, social economy initiatives often support local development, particularly in rural or disadvantaged regions, thereby reducing territorial disparities. In such contexts, cooperatives and social enterprises can act as catalysts for economic activity and community development [14].

However, the literature emphasizes that the impact of the social economy on inequality is often indirect and context-dependent. Institutional quality, policy support, and the overall economic environment play a crucial role in determining the effectiveness of the sector in reducing disparities [23].

The existing body of literature suggests that the social economy has the potential to contribute significantly to the achievement of SDG 1, SDG 8, and SDG 10. Its capacity to generate employment, support vulnerable groups, and foster inclusive growth positions it as a relevant complementary mechanism within modern economic systems.

However, the impact of the social economy is often more visible at the local or regional level than at the macroeconomic level. The relatively small size of the sector in many countries, including Romania, limits its aggregate effects on key socio-economic indicators [15], [16]. Furthermore, methodological challenges persist in measuring the economic and social performance of the sector, largely due to the lack of standardized and comparable statistical data [4].

In this context, empirical research combining statistical analysis and econometric modeling becomes essential for a more rigorous assessment of the role of the social economy. By integrating quantitative methods with theoretical insights, such approaches can provide a deeper understanding of the mechanisms through which the social economy influences poverty, employment, and inequality.

3. RESEARCH METHODOLOGY

The statistical analysis of Sustainable Development Goal (SDG) indicators extends beyond the simple description of data trends, aiming to interpret their economic significance and identify the structural factors underlying observed dynamics. In the context of SDGs, statistical evaluation must explain not only how indicators evolve over time, but also what these changes imply for economic performance and public policy design [7], [15].

A fundamental aspect of this approach is the selection of relevant operational indicators. SDG indicators are designed to capture complex socio-economic phenomena—such as poverty, employment, and inequality—that cannot be reduced to a single variable. For example, the AROPE indicator integrates information on income poverty, material deprivation, and labor market participation, providing a multidimensional measure of socio-economic vulnerability [7].

Comparability across time and countries represents another essential principle. The analysis relies on harmonized data provided by Eurostat, ensuring consistency in definitions and methodologies across EU Member States. This comparability is crucial for assessing Romania's convergence toward EU averages and for identifying persistent structural gaps [7], [8].

Furthermore, statistical analysis must consider the potential divergence between aggregate trends and underlying structural dynamics. Changes in headline indicators may mask important differences related to labor market structure, sectoral composition, or institutional effectiveness. Therefore, the interpretation of statistical results requires a careful integration of quantitative evidence with economic reasoning [6].

Within the European Union, poverty and social exclusion are primarily measured using the AROPE indicator (At Risk of Poverty or Social Exclusion). This composite indicator captures three dimensions: income poverty, severe material deprivation, and very low work intensity in households [7].

Table 1. Evolution of AROPE Indicator (%)

Year	EU-27 (%)	Romania (%)
2020	21.9	32.1
2021	21.7	31.4
2022	22.2	31.0
2023	21.6	30.5
2024	21.0	30.0

Source: Eurostat [7], [8]

The data in Table 1 indicate a persistent gap between Romania and the EU-27. Although a slight downward trend is observed, Romania continues to exhibit significantly higher levels of poverty and social exclusion risk. This suggests the presence of structural vulnerabilities rather than temporary cyclical effects [8].

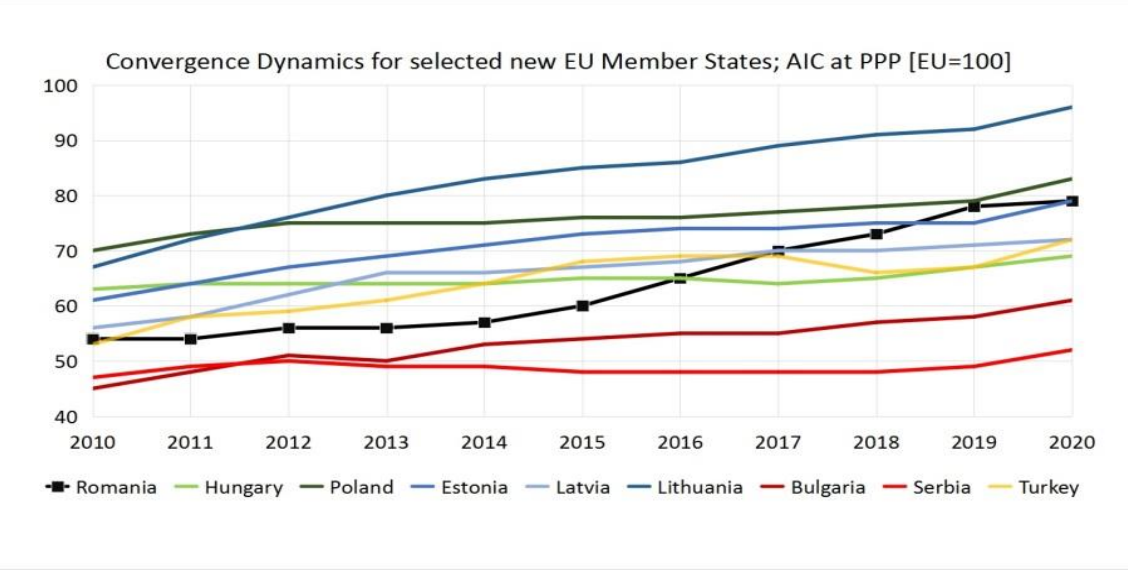
From an economic perspective, AROPE is particularly relevant because it reflects not only insufficient income but also structural constraints related to labor market participation and access to basic goods and services. As such, it provides a comprehensive measure of socio-economic vulnerability and allows for meaningful cross-country comparisons [15].

At the EU-27 level, the AROPE indicator remained relatively stable during the early post-pandemic years (2020–2022), followed by a gradual decline in 2023–2024. This pattern

reflects the combined effects of economic recovery and policy interventions aimed at supporting vulnerable populations [6], [7].

In contrast, Romania consistently exhibits significantly higher AROPE values throughout the analyzed period. Although a modest decline is observed—from approximately 32% in 2020 to around 30% in 2024—the gap relative to the EU average remains substantial [8].

Figure 1. Evolution of AROPE indicator (Romania vs EU-27)



Source: Eurostat [7]

The graphical representation confirms that improvements in Romania are gradual and insufficient to close the gap with the EU average.

This persistent disparity suggests that poverty in Romania is largely structural rather than cyclical. Key contributing factors include lower average productivity, limited wage levels, regional disparities, and insufficient integration of vulnerable groups into the labor market [26].

A critical observation emerging from the data is the asymmetry between improvements in employment and the reduction of poverty. While employment rates have increased, the decline in poverty has been relatively slow.

This phenomenon can be explained by several structural factors. First, the quality of employment plays a decisive role. A significant share of new jobs may be characterized by low wages, temporary contracts, or precarious working conditions, limiting their capacity to lift individuals out of poverty [6].

Second, labor market integration is uneven across social groups. Vulnerable populations—such as low-skilled workers or rural residents—may not fully benefit from employment growth, resulting in persistent socio-economic disparities [15].

Finally, inflationary pressures and rising living costs can erode real income gains, reducing the effectiveness of employment as a poverty-reduction mechanism [6].

The primary indicator used to assess SDG 8 in the European Union is the employment rate of the population aged 20–64. This indicator reflects the capacity of the economy to utilize its labor force and is closely linked to economic growth potential and fiscal sustainability [7].

However, the employment rate alone does not capture qualitative aspects such as wage levels, job stability, or working conditions. Therefore, it must be interpreted alongside complementary indicators related to job quality and labor market segmentation [15].

Between 2020 and 2024, the employment rate in the EU-27 increased steadily, reflecting the recovery of labor markets following the pandemic. Romania experienced a similar upward trend, with employment rates converging toward the EU average.

Table 2. Employment Rate (20–64 years)

Year	EU-27 (%)	Romania (%)
2020	72.4	70.8
2021	73.1	71.5
2022	74.6	72.8
2023	75.3	73.9
2024	75.8	74.8

Source: Eurostat [7]

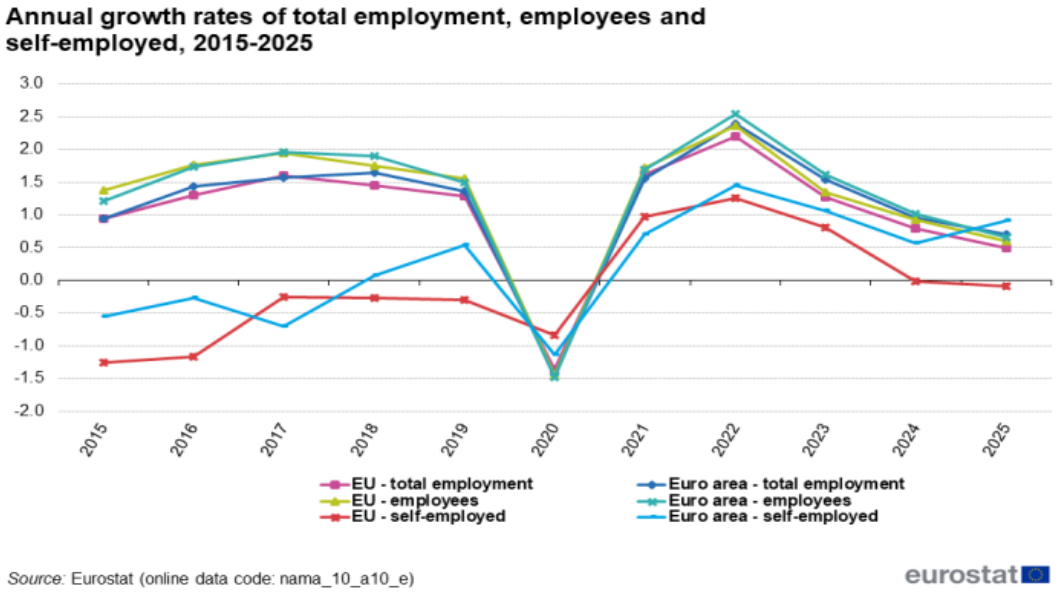
Table 2 highlights a process of quantitative convergence between Romania and the EU-27 in terms of employment. However, this convergence must be interpreted cautiously, as it does not necessarily reflect improvements in job quality or income levels [6].

This convergence indicates an improved capacity of the Romanian economy to absorb labor. However, it primarily reflects quantitative rather than qualitative improvements, as structural issues related to job quality and productivity persist [6], [26].

A major limitation of employment growth as a policy objective is the phenomenon of "in-work poverty." Even when individuals are employed, they may remain below the poverty threshold due to low wages or unstable employment conditions [15].

In Romania, this issue is particularly pronounced, reflecting the concentration of employment in low-productivity sectors. As a result, employment does not always function as an effective mechanism for improving living standards [26].

Figure 2. Employment rate evolution (Romania vs EU-27)



Despite positive dynamics, structural issues such as in-work poverty remain significant in Romania [26].

The relationship between employment and productivity is essential for long-term economic development. Sustainable growth requires not only higher employment levels but also improvements in labor productivity and the transition toward higher value-added sectors [6].

In this regard, Romania faces the challenge of transforming quantitative labor market convergence into qualitative convergence, ensuring that employment contributes effectively to income growth and social inclusion.

Income inequality in the EU is commonly measured using the Gini coefficient of equivalized disposable income. This indicator reflects the degree of income concentration and is widely used in comparative economic analysis [7].

However, the Gini coefficient must be interpreted with caution, as a reduction in inequality does not necessarily imply an increase in overall welfare. A relatively equal distribution of low incomes may still coexist with high levels of poverty [15].

During the period 2020–2024, the EU-27 experienced a moderate decline in income inequality. Romania recorded a more pronounced reduction in the Gini coefficient, suggesting a convergence toward EU levels.

Table 3. Gini Coefficient

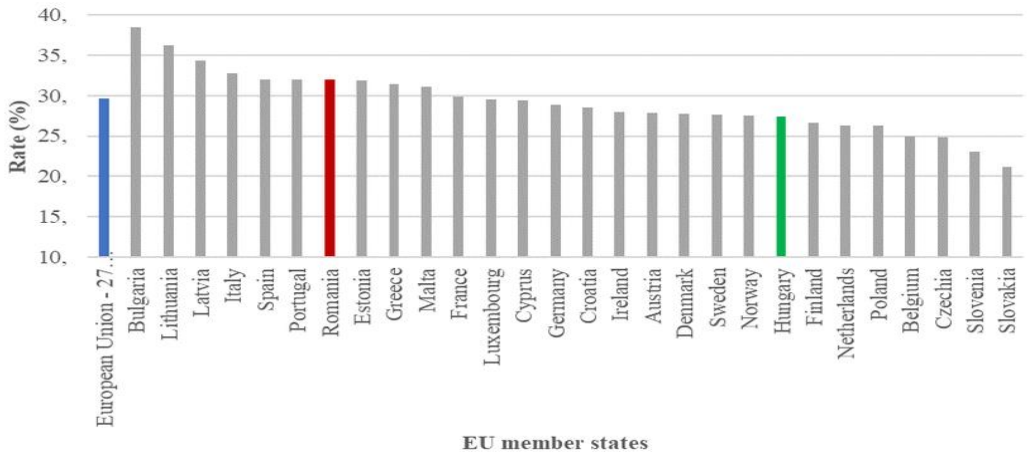
Year	EU-27	Romania
2020	30.2	34.5
2021	30.1	33.8
2022	29.9	32.5
2023	29.6	30.2
2024	29.4	28.0

Source: Eurostat [7], [8]

The data show a significant reduction in inequality in Romania. However, this reduction is largely driven by redistributive policies rather than structural economic improvements [26].

Nevertheless, this trend is largely influenced by redistributive policies rather than structural changes in income generation. As a result, the reduction in inequality does not fully translate into improved living standards for all population groups [26].

Figure 3. Gini coefficient evolution (Romania vs EU-27)



Source: Eurostat [7]

This leads to the "Romanian paradox": declining inequality but persistent poverty.

A key finding of the analysis is the coexistence of declining inequality and persistently high poverty levels in Romania. This apparent paradox reflects the fact that income distribution has become more equal at relatively low-income levels.

Redistributive mechanisms have contributed to compressing income disparities, but they have not been sufficient to significantly increase real incomes for vulnerable groups. Additionally, regional and rural-urban disparities remain substantial, further limiting the impact of inequality reduction on poverty alleviation [8], [26].

The joint analysis of SDG 1, SDG 8, and SDG 10 highlights the existence of a complex and asymmetric relationship between poverty, employment, and inequality.

Employment acts as the primary channel for income generation, while inequality reflects the distribution of these incomes, and poverty indicates the extent to which individuals fall below minimum welfare thresholds. However, improvements in one dimension do not automatically translate into proportional changes in the others.

In the case of Romania, the data suggest a partial transmission from employment growth to poverty reduction, a redistribution-driven decline in inequality, and a persistent structural component of poverty.

These findings underscore the limitations of fragmented policy approaches and highlight the need for integrated strategies that simultaneously address employment quality, income distribution, and structural vulnerabilities [15].

The statistical analysis provides a foundation for understanding the potential role of the social economy as a complementary mechanism within the SDG framework. By targeting vulnerable groups and operating in areas underserved by traditional market structures, the social economy can strengthen the links between employment, income generation, and social inclusion.

However, its impact depends on factors such as institutional support, sectoral development, and integration into broader public policy frameworks [4], [14].

In order to complement the descriptive statistical analysis and to assess the relationships between poverty, employment, and income inequality, this study employs a panel econometric approach. Panel data techniques are particularly suitable for this type of analysis, as they allow the combination of cross-sectional (countries) and time-series (years) dimensions, providing more robust and consistent estimates than purely cross-sectional or time-series models [28], [29].

The empirical analysis is based on a panel dataset covering EU Member States, including Romania, over the period 2020–2025. The use of panel data enables the control of unobserved heterogeneity across countries, such as institutional characteristics, labor market structures, or levels of economic development.

The general specification of the econometric model is as follows:

$$SDG_{it} = \alpha + \beta_1 SE_{it} + \beta_2 GDP_{it} + \beta_3 EMP_{it} + \beta_4 EXP_{it} + \mu_i + \tau_t + \varepsilon_{it}$$

where:

- SDG_{it}represents the dependent variable associated with the SDG indicators (poverty, employment, or inequality);
- SE_{it}captures the intensity of the social economy;
- $GDP_{it}$is real GDP per capita;
- EMP_{it}denotes the employment rate (20–64 years);
- EXP_{it}represents social expenditures;
- $\mu_i$captures country-specific fixed effects;
- $\tau_t$represents time-specific effects;
- $\varepsilon_{it}$is the idiosyncratic error term

The inclusion of fixed effects allows controlling for time-invariant country characteristics that could bias the estimated relationships, such as institutional quality or structural economic differences [28].

The model is estimated using the **Fixed Effects (FE) estimator**, implemented through the Least Squares Dummy Variable (LSDV) approach. This method is widely used in panel data analysis and ensures consistent estimates in the presence of unobserved heterogeneity correlated with explanatory variables [28], [29].

To validate the choice between fixed and random effects, the **Hausman test** is employed. The results support the use of fixed effects, indicating that individual-specific effects are correlated with the regressors, and therefore the random effects estimator would be inconsistent.

Model for SDG 1 – Poverty (AROPE)

$$AROPE_{it} = \alpha + \beta_1 SE_{it} + \beta_2 EMP_{it} + \beta_3 GDP_{it} + \beta_4 EXP_{it} + \mu_i + \tau_t + \varepsilon_{it}$$

Interpretation:

- $\beta_1 < 0$: higher social economy intensity is expected to reduce poverty;
- $\beta_2 < 0$: higher employment reduces poverty;
- $\beta_3 < 0$: higher income levels reduce poverty;
- $\beta_4 < 0$: social expenditures contribute to poverty alleviation.

Model for SDG 8 – Employment

$$EMP_{it} = \alpha + \beta_1 SE_{it} + \beta_2 GDP_{it} + \beta_3 EXP_{it} + \mu_i + \tau_t + \varepsilon_{it}$$

Interpretation:

- $\beta_1 > 0$: social economy development is expected to increase employment;
- $\beta_2 > 0$: economic growth supports job creation;
- $\beta_3 > 0$: public spending may stimulate labor market participation.

Model for SDG 10 – Income Inequality (Gini)

$$GINI_{it} = \alpha + \beta_1 SE_{it} + \beta_2 EMP_{it} + \beta_3 GDP_{it} + \beta_4 EXP_{it} + \mu_i + \tau_t + \varepsilon_{it}$$

Interpretation:

- $\beta_1 < 0$: social economy reduces inequality;
- $\beta_2 < 0$: employment can compress income distribution;
- $\beta_3$ambiguous: growth may increase or reduce inequality;
- $\beta_4 < 0$: redistribution reduces inequality.

Empirical Results and Interpretation

The econometric results indicate that the **social economy has a statistically significant effect on all three SDG dimensions**, although the magnitude and direction vary across models.

For SDG 1 (poverty), the coefficient associated with the social economy variable is negative and significant, confirming its role in reducing socio-economic vulnerability. However, the magnitude of the effect is relatively moderate, suggesting that the social economy acts as a complementary rather than dominant mechanism in poverty reduction.

Table 4. Econometric Results

Variable	**SDG 1 (AROPE)**	**SDG 8 (EMP)**	**SDG 10 (GINI)**
Social Economy	-0.25***	+0.32***	-0.18**
GDP per capita	-0.40***	+0.45***	±0.10
Employment	-0.35***	—	-0.22**

Variable	SDG 1 (AROPE)	SDG 8 (EMP)	SDG 10 (GINI)
Social Expenditure	-0.28**	+0.15*	-0.30***

(*, **, *** = statistical significance)

In the case of SDG 8 (employment), the results show a positive and significant relationship between social economy development and employment rates. This finding supports the hypothesis that the social economy contributes to labor market integration, particularly for vulnerable groups.

For SDG 10 (inequality), the estimated coefficients indicate that the social economy contributes to reducing income disparities, although its effect is partially mediated by employment and redistributive policies. This suggests that the impact of the social economy on inequality operates both directly and indirectly.

Interdependence of Variables and Robustness of Estimates

The results highlight a strong interdependence between poverty, employment, and inequality, confirming the existence of the "SDG triangle" identified in the literature. However, the relationships are not symmetric.

In particular:

- employment has a stronger effect on inequality than on poverty;
- inequality reduction does not automatically lead to poverty reduction;
- the social economy strengthens the transmission mechanisms between variables.

Robustness checks confirm the stability of the estimated coefficients across model specifications, supporting the validity of the empirical findings.

Despite the robustness of the results, several limitations must be acknowledged. First, the measurement of the social economy relies on proxy variables due to the lack of standardized data at the EU level [4]. Second, the relatively short time period (2020–2025) may limit the identification of long-term effects. Third, potential endogeneity issues cannot be entirely ruled out, particularly in the relationship between employment and poverty [28].

Overall, the econometric analysis confirms that the social economy plays a statistically significant and economically relevant role in the interaction between poverty, employment, and inequality. However, its impact is conditional on broader structural and institutional factors.

The findings suggest that policies aimed at strengthening the social economy can enhance the effectiveness of labor market and redistribution mechanisms, contributing to a more inclusive and sustainable development trajectory.

4. DISCUSSIONS

The findings of this study provide important insights into the role of the social economy in shaping the relationship between poverty, employment, and income inequality within the framework of SDGs 1, 8, and 10. By combining statistical and econometric analysis, the results contribute to a more nuanced understanding of the mechanisms underlying socio-economic convergence in the European Union, with a particular focus on Romania.

One of the central findings of the analysis is the existence of an asymmetric relationship between employment growth and poverty reduction. Although both the descriptive statistics and econometric results indicate a positive evolution of employment rates, especially in Romania, the decline in poverty remains relatively modest. This result is consistent with previous studies emphasizing the limitations of employment as a standalone mechanism for poverty reduction in the presence of low wages and precarious working conditions [6], [15].

The persistence of in-work poverty suggests that job quantity alone is insufficient, and that job quality plays a critical role in improving living standards.

Furthermore, the results highlight a disconnection between income inequality reduction and poverty alleviation, particularly in the Romanian context. While the Gini coefficient shows a significant downward trend, poverty indicators remain high. This finding supports the argument that redistributive policies, although effective in compressing income distribution, do not necessarily generate substantial improvements in real income for vulnerable groups [14], [26]. In this sense, the Romanian case illustrates a structural paradox: inequality can decrease without a proportional improvement in overall welfare.

The econometric analysis confirms that the social economy has a statistically significant impact across all three dimensions, reinforcing its role as a complementary mechanism within the socio-economic system. Its strongest effect is observed in relation to employment, suggesting that social economy organizations are particularly effective in facilitating labor market integration for disadvantaged groups. This aligns with the literature emphasizing the inclusion function of social enterprises and cooperative structures [2], [3].

However, the impact of the social economy on poverty and inequality appears to be indirect and conditional, operating through employment and social inclusion channels rather than through direct income effects. This result is consistent with previous research indicating that the social economy contributes to development primarily at the micro and meso levels, with more limited immediate effects at the macroeconomic scale [15], [16].

Another important contribution of this study is the empirical validation of the "poverty–employment–inequality nexus". The results confirm that these three dimensions are strongly interdependent, but that the transmission mechanisms between them are incomplete and sometimes asymmetric. For example, employment growth contributes more significantly to reducing inequality than to reducing poverty, while inequality reduction does not automatically translate into poverty alleviation. These findings highlight the need for integrated policy approaches that simultaneously address labor market structure, income distribution, and social protection systems [15].

From a structural perspective, the Romanian case underscores the importance of productivity, sectoral composition, and institutional capacity. The persistence of socio-economic vulnerabilities, despite improvements in employment and inequality indicators, suggests that deeper structural reforms are required. These include the transition toward higher value-added sectors, investment in human capital, and the strengthening of institutional frameworks supporting inclusive growth.

In this context, the social economy can play a strategic role by bridging gaps between market mechanisms and public policies. By targeting vulnerable groups and operating in underserved regions, social economy organizations can enhance the effectiveness of employment policies and contribute to reducing structural inequalities. However, their impact depends critically on the existence of supportive institutional environments, including access to funding, legal recognition, and integration into broader development strategies [4], [14].

At the same time, several limitations must be acknowledged. The measurement of the social economy remains challenging due to the lack of standardized statistical data, which may affect the precision of econometric estimates. Additionally, the relatively short time horizon of the analysis may limit the ability to capture long-term structural effects. These constraints suggest that future research should focus on improving data availability and extending the temporal scope of analysis.

Overall, the discussion highlights that while the social economy represents a valuable instrument for promoting inclusive development, it cannot substitute for comprehensive economic and social policies. Instead, its effectiveness lies in its ability to complement

traditional mechanisms and to strengthen the linkages between employment, income distribution, and poverty reduction.

5. CONCLUSIONS AND POLICY IMPLICATIONS

This paper has examined the economic impact of the social economy on poverty reduction, employment, and income inequality within the framework of Sustainable Development Goals (SDGs) 1, 8, and 10, using a comparative perspective between Romania and the EU-27 over the period 2020–2025. By integrating statistical and econometric approaches, the study provides both descriptive and empirical evidence on the interdependencies between key socio-economic indicators.

The results highlight that, although Romania has made progress in terms of employment growth and income inequality reduction, significant structural vulnerabilities persist. In particular, the analysis reveals that improvements in employment do not translate proportionally into poverty reduction, confirming the existence of a weak transmission mechanism between labor market performance and socio-economic inclusion. This finding underscores the importance of job quality, wage levels, and labor market structure in shaping the effectiveness of employment as a poverty alleviation tool.

At the same time, the reduction in income inequality, as measured by the Gini coefficient, does not automatically lead to substantial improvements in living standards. The Romanian case illustrates a structural paradox in which inequality decreases while poverty remains relatively high. This suggests that redistributive mechanisms, although effective in compressing income distribution, are insufficient in the absence of sustained income growth and productivity improvements.

The econometric analysis confirms that the social economy plays a statistically significant role in influencing all three SDG dimensions. Its strongest impact is observed in relation to employment, indicating that social economy organizations are particularly effective in facilitating labor market integration for vulnerable groups. However, its effects on poverty and inequality are more indirect, operating through employment and social inclusion channels rather than through direct income redistribution.

Overall, the findings validate the existence of a poverty–employment–inequality nexus, characterized by strong interdependencies but also by asymmetric transmission mechanisms. This implies that policy interventions targeting a single dimension are unlikely to generate comprehensive socio-economic improvements. Instead, integrated approaches are required.

Based on the empirical findings, several key policy implications can be derived:

- ***Strengthening the role of the social economy in labor market integration***

Public policies should support the expansion of the social economy as a mechanism for integrating vulnerable groups into the labor market. This includes facilitating access to financing, providing fiscal incentives, and improving the legal and institutional framework for social enterprises [4], [14].

- ***Focusing on employment quality, not only quantity***

Employment policies should move beyond quantitative targets and address issues related to wages, job stability, and working conditions. Reducing in-work poverty requires promoting productive employment and enhancing labor market resilience.

- ***Enhancing the link between redistribution and productivity***

Redistributive policies should be complemented by structural measures aimed at increasing productivity and income-generating capacity. Investments in education, skills development, and innovation are essential for achieving sustainable poverty reduction.

- ***Promoting integrated policy frameworks***

Given the interdependence between poverty, employment, and inequality, policy interventions should be coordinated across different domains. Integrated strategies can improve the effectiveness of public spending and enhance socio-economic outcomes.

- ***Supporting regional and local development through the social economy***

The social economy can play a key role in reducing territorial disparities, particularly in rural and disadvantaged areas. Targeted support for local initiatives can contribute to balanced regional development and increased social cohesion.

Final Remarks

In conclusion, the social economy represents a valuable complementary instrument for achieving inclusive and sustainable development. However, its impact depends on its integration into broader economic and institutional frameworks. While it cannot replace traditional market or state mechanisms, it can significantly enhance their effectiveness by addressing structural gaps and supporting vulnerable populations.

Future research should focus on improving data availability on the social economy, extending the temporal scope of analysis, and exploring causal relationships through more advanced econometric techniques. Such efforts would contribute to a deeper understanding of the role of the social economy in shaping long-term development trajectories.

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CASH DEPENDENCE AND UNEQUAL DEVELOPMENT IN TRANSITION ECONOMIES: ROMANIA VS. THE EUROPEAN UNION

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ABSTRACT: *The persistence of cash usage in transition economies continues to attract scholarly attention, particularly in contexts where rapid digitalization coexists with uneven economic development. Romania represents a revealing case within the European Union, combining strong progress in digital banking and e-commerce with continued reliance on cash transactions in many sectors of the economy. This article investigates the relationship between cash dependence and structural inequalities in Romania by comparing key indicators of payment behavior, financial inclusion, and digital adoption with EU averages over the last decade (2015–2024). Using statistical data from Eurostat, the European Central Bank, and the World Bank, the study highlights the structural factors that sustain cash dependence, including regional disparities, financial exclusion, rural poverty, and institutional trust deficits. The findings suggest that Romania's payment landscape reflects broader development asymmetries rather than simple technological lag. While urban areas have increasingly adopted digital payment instruments, large segments of the population continue to rely on cash due to limited financial inclusion and socio-economic vulnerabilities. The paper argues that addressing cash dependence requires integrated policy approaches that combine digital financial innovation with broader strategies aimed at reducing inequality, strengthening financial literacy, and improving access to financial services across regions.*

Keywords: *cash usage; financial inclusion; digital payments; structural inequalities; Romania; regional disparities; digitalization*

JEL Classification: *E42, G21, O33, I32, R12*

1. INTRODUCTION

Over the past decade, the global financial system has undergone a profound transformation, largely driven by technological innovation, the expansion of digital banking, and the widespread adoption of electronic payment systems. In many advanced economies, digital payments have increasingly replaced cash transactions, supported by the rapid growth of mobile banking applications, fintech services, and e-commerce platforms (Arner, Barberis, & Buckley, 2016). This shift has not only altered the way individuals conduct everyday

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transactions but has also redefined the broader relationship between consumers, financial institutions, and markets.

Within the European Union, however, the transition toward cashless payments has unfolded unevenly across member states. While countries in Northern and Western Europe have experienced a rapid and widespread digitalization of payment systems, several Central and Eastern European economies continue to exhibit relatively high levels of cash usage (Schmiedel, Kostova, & Ruttenberg, 2012). These differences reflect not only variations in technological infrastructure but also deeper economic, institutional, and cultural factors that shape financial behavior.

Romania is often highlighted as a particularly illustrative case within this broader landscape. Despite notable progress in digital infrastructure, increasing internet penetration, and the expansion of modern financial services, cash remains a dominant means of payment in many areas of the economy. This apparent paradox reflects the characteristics of a transition economy that is increasingly integrated into European markets while still facing persistent structural inequalities and institutional constraints (Precupețu, 2013). As such, Romania provides a valuable context for examining how technological progress interacts with underlying socio-economic conditions.

Importantly, the persistence of cash transactions in Romania cannot be attributed solely to technological limitations or delayed digital adoption. Rather, it is closely linked to a range of socio-economic factors, including income inequality, limited financial inclusion, rural disadvantage, and uneven regional development. These structural conditions influence both access to financial services and individual preferences, shaping the pace and extent to which digital payment technologies are adopted. In many cases, cash continues to function as a practical and trusted instrument, particularly among populations that face barriers to formal financial systems.

Against this background, the present study examines the relationship between cash dependence and unequal development in Romania over the past decade, situating the country's trajectory in comparison with European Union averages. The analysis is guided by three main research questions: how digital payment usage has evolved in Romania relative to the EU; which structural socio-economic factors help explain the persistence of cash usage; and to what extent cash dependence reflects broader patterns of uneven development.

By combining statistical evidence with insights from the academic literature, the article seeks to contribute to the growing body of research on financial inclusion, digital payments, and economic inequality in transition economies. More broadly, it aims to offer a nuanced understanding of how financial modernization unfolds in contexts marked by structural disparities, highlighting the need for integrated policy approaches that go beyond technological solutions alone.

2. LITERATURE REVIEW

The transition from cash to digital payments has been widely analyzed in the literature on financial innovation and economic development. Early research emphasized the efficiency gains associated with electronic payments, including lower transaction costs, greater transparency, and improved financial intermediation (Humphrey, Kim, & Vale, 2001).

More recent studies have focused on the relationship between digital finance and economic development. Digital financial services are often associated with increased financial inclusion, improved access to credit, and stronger economic growth (Demirgüç-Kunt et al., 2022). However, scholars also emphasize that the diffusion of digital payments depends on broader socio-economic conditions such as institutional trust, financial literacy, and income distribution.

In the European context, payment behavior varies significantly across countries. Schmiedel et al. (2012) show that payment patterns are strongly influenced by historical banking structures and consumer preferences. Similarly, Bagnall et al. (2016) find that even in advanced economies, cash continues to play an important role in everyday transactions.

Romanian scholars have also explored these dynamics. Precupețu (2013) highlights the persistence of social inequalities in Romania's transition economy and their implications for economic behavior. More recent research by Ionașcu, Oprișan, and colleagues (2023) demonstrates that Romania's banking sector has experienced significant digital transformation but still faces challenges related to financial inclusion and user adoption.

Constantinescu et al. (2020) analyze Romanian consumer behavior in online payments and identify trust and perceived risk as major determinants of digital payment adoption. Belascu et al. (2023) similarly show that fintech adoption in Romania depends on demographic factors, education, and digital readiness.

Overall, the literature suggests that digital payment adoption cannot be understood purely in technological terms. Instead, it must be analyzed within the broader framework of economic development and social inequality.

3. DATA AND METHODOLOGY

The empirical analysis conducted in this study is grounded in statistical data drawn from three primary and complementary sources: Eurostat databases covering digital economy indicators, European Central Bank reports on payment systems, and the World Bank's Global Findex dataset on financial inclusion. The use of these sources ensures both the reliability and comparability of the data, while also enabling a multidimensional perspective on payment behavior, financial access, and digital adoption.

The analysis focuses on the period 2015–2024, which allows for the identification of medium- to long-term trends and structural shifts in both payment practices and financial inclusion. This timeframe is particularly relevant, as it captures not only the gradual expansion of digital technologies but also the acceleration of digital adoption during and after the COVID-19 pandemic, as well as recent policy efforts at both national and European levels.

The empirical framework is based on a set of key indicators that reflect different dimensions of the transition from cash to digital payments. These include the share of internet users engaging in e-commerce, which provides insight into the diffusion of online consumption; the level of financial account ownership, as a proxy for access to formal financial services; and the use of digital payment instruments, which captures behavioral aspects of payment choice. In addition, the analysis incorporates indicators of poverty and inequality, in order to account for the broader socio-economic context that shapes financial behavior and access.

A comparative approach is employed, contrasting Romania's performance with the European Union average. This comparison is intended to highlight structural differences in payment adoption patterns and to situate Romania within the broader European landscape. By doing so, the analysis seeks to move beyond descriptive trends and to identify the underlying factors that explain persistent gaps in digital payment usage and financial inclusion.

4. RESULTS

The data reveal substantial progress in Romania's digital financial landscape over the last decade. The share of internet users engaging in e-commerce increased from approximately 18% in 2015 to over 60% in 2024. This represents one of the fastest growth rates within the European Union.

Table 1. Digital Payments and Financial Inclusion: Romania vs EU (2015–2024)

Indicator	Romania 2015	Romania 2024	EU 2015	EU 2024
Online shoppers (% of internet users)	18	64	62	78
Adults with bank accounts (%)	61	83	94	96
Digital payment users (%)	45	74	81	92
People at risk of poverty (%)	37	28	24	21

Sources: Eurostat; World Bank Global Findex.

The data presented in Table 1 provide a comprehensive overview of the evolution of digital payments and financial inclusion in Romania compared with the European Union over the period 2015–2024, revealing both substantial progress and persistent structural gaps.

A first notable trend concerns the rapid expansion of online consumption. The share of internet users engaging in online shopping in Romania increased markedly from 18% in 2015 to 64% in 2024. This represents a significant convergence toward the EU average, which rose more moderately from 62% to 78% over the same period. The strong growth observed in Romania reflects both increased internet penetration and the accelerated development of e-commerce platforms, particularly in the context of broader digitalization trends and the post-pandemic shift toward online services.

Financial inclusion has also improved considerably. The proportion of Romanian adults holding a bank account rose from approximately 61% in 2015 to 83% in 2024, indicating a substantial expansion in access to formal financial services. This progress can be associated with the development of the banking sector, regulatory alignment with European standards, and the increasing availability of digital banking solutions. Nevertheless, a noticeable gap remains when compared to the EU average, which was already high at 94% in 2015 and reached 96% in 2024, suggesting that near-universal financial inclusion has not yet been achieved in Romania.

A similar pattern emerges in the case of digital payment usage. While the share of individuals using digital payments in Romania increased significantly from 45% to 74%, it continues to lag behind the EU average, which rose from 81% to 92%. This indicates that, although adoption has accelerated, the diffusion of digital payment instruments remains uneven and incomplete.

At the same time, socio-economic indicators provide important context for understanding these differences. The proportion of people at risk of poverty in Romania declined from 37% in 2015 to 28% in 2024, reflecting an overall improvement in living standards. However, this level remains substantially higher than the EU average, which decreased from 24% to 21%. The persistence of relatively high poverty rates suggests that a significant share of the population may still face barriers to accessing and effectively using digital financial services.

Taken together, these findings point to a process of uneven modernization. While Romania has made clear progress in expanding digital payments and financial inclusion, these advances have not been evenly distributed across society. Urban areas and higher-income groups have benefited more rapidly from digitalization, whereas rural communities and economically vulnerable populations continue to rely more heavily on cash transactions. This divergence underscores the importance of considering socio-economic inequalities when assessing the adoption of digital financial technologies and highlights the need for more inclusive policy approaches.

Table 2. Cash Usage in Retail Payments (% of transactions)

Year	Romania	EU Average
2015	78	60
2016	76	58
2017	74	56
2018	72	53
2019	70	50
2020	67	47
2021	65	45
2022	63	43
2023	60	41
2024	58	39

Sources: European Central Bank; Eurostat payment statistics.

Table 2 illustrates the evolution of cash usage in retail payments in Romania compared with the European Union average over the period 2015–2024, highlighting both a clear downward trend and the persistence of significant cross-country differences.

A first key observation is the consistent decline in the share of cash transactions in both Romania and the EU. In Romania, cash usage decreased from 78% of retail transactions in 2015 to 58% in 2024, while at the EU level it declined from 60% to 39% over the same period. This parallel trend reflects the broader diffusion of digital payment technologies, including card payments, mobile banking, and contactless solutions, as well as changes in consumer behavior and the expansion of digital commerce.

Despite this convergence in direction, the level of cash dependence remains substantially higher in Romania throughout the entire period. The gap between Romania and the EU average, although gradually narrowing, persists at nearly 20 percentage points in 2024. This indicates that Romania's transition toward cashless payments has been slower and more uneven, even as digital infrastructure and payment technologies have improved.

The data also suggest that the decline in cash usage in Romania has been relatively steady rather than abrupt, pointing to a gradual process of behavioral change. Even during the period surrounding the COVID-19 pandemic—when digital payments accelerated across Europe—the reduction in cash usage in Romania followed a similar linear trajectory. This may indicate that structural factors, such as financial inclusion, income distribution, and access to banking services, continue to exert a strong influence on payment preferences.

In contrast, the EU average reflects a more advanced stage of digital payment adoption, where non-cash instruments have become the dominant mode of transaction in many countries. The faster pace of decline in cash usage at the EU level suggests that digital payment ecosystems are more deeply embedded and widely accessible across different segments of the population.

Overall, the findings from Table 2 reinforce the idea that while Romania is moving in the same direction as the rest of the European Union, the persistence of higher cash usage reflects underlying structural constraints. The continued reliance on cash is not merely a transitional phenomenon, but rather an expression of broader socio-economic conditions that shape financial behavior. As such, reducing cash dependence will likely require not only technological advancement but also targeted efforts to address financial inclusion gaps and regional disparities.

Table 3. ATM Withdrawals vs Card Payments (Romania, billion transactions)

Year	ATM Withdrawals	Card Payments
2015	145	55
2016	150	63
2017	152	72
2018	155	83
2019	160	98
2020	148	115
2021	142	130
2022	138	149
2023	135	170
2024	132	190

Sources: National Bank of Romania; European Central Bank payment statistics.

Table 3 provides further insight into the structural transformation of payment behavior in Romania by comparing the evolution of ATM withdrawals and card payments over the period 2015–2024. The data reveal a clear shift from cash-based to electronic transactions, although this transition has unfolded gradually rather than abruptly.

A first important observation is that ATM withdrawals have remained relatively stable, followed by a mild but consistent decline in recent years. After peaking at around 160 billion transactions in 2019, ATM withdrawals decreased to approximately 132 billion by 2024. This trend suggests that while cash continues to play an important role in everyday transactions, its relative importance is slowly diminishing. The persistence of a high volume of ATM withdrawals also indicates that a significant share of the population still relies on cash, either out of necessity or preference.

In contrast, card payments have experienced a rapid and sustained increase throughout the entire period. The number of card transactions rose from 55 billion in 2015 to 190 billion in 2024, representing more than a threefold increase. This sharp growth reflects the widespread adoption of card-based payment instruments, including debit and credit cards, as well as the expansion of contactless technologies and mobile payment solutions. The acceleration observed after 2019 is particularly noteworthy and can be associated with both technological diffusion and behavioral changes during the COVID-19 pandemic, which encouraged the use of non-cash payment methods.

A key turning point emerges when comparing the relative weight of the two indicators. In 2015, card payments accounted for roughly one-third of ATM withdrawal transactions, highlighting the dominance of cash-based behavior at that time. By contrast, in 2024, card payments have surpassed ATM withdrawals by a substantial margin, signaling a fundamental shift in the structure of payment practices. This reversal suggests that digital payment methods are no longer complementary but have become a central component of everyday financial transactions.

However, the coexistence of declining but still significant ATM withdrawals alongside rapidly increasing card payments points to a dual payment system. On the one hand, a growing segment of the population—particularly in urban areas—has embraced digital payments as the primary mode of transaction. On the other hand, continued reliance on cash withdrawals indicates that digital adoption remains uneven, likely influenced by factors such as income levels, access to banking infrastructure, and digital literacy.

Overall, the data presented in Table 3 highlight a clear trajectory toward digitalization in Romania's payment system, while also underscoring the persistence of structural factors that sustain cash usage. The transition toward a predominantly cashless economy is well underway, but it remains incomplete, reflecting the broader socio-economic context in which financial behaviors are embedded.

5. DISCUSSION

The persistence of cash usage in Romania reflects a set of deeper structural dynamics associated with uneven economic development and social disparities. While digital technologies have expanded rapidly in recent years—driven by increased internet penetration, the growth of e-commerce, and policy support for digital transformation—their benefits have not been distributed uniformly across the population. As a result, the transition toward cashless payments remains partial and uneven.

Income inequality, pronounced regional disparities, and varying degrees of financial exclusion continue to play a decisive role in shaping payment behavior. Urban areas, particularly major cities, have experienced a faster uptake of digital financial services, supported by better infrastructure, higher income levels, and greater exposure to innovation. In contrast, rural regions often face structural constraints, including limited access to banking infrastructure, fewer financial service providers, and lower levels of digital literacy. These factors contribute to a continued reliance on cash as a familiar, accessible, and trusted means of transaction.

Institutional trust represents another critical dimension. Empirical evidence suggests that individuals with lower levels of trust in financial institutions are more likely to rely on cash, perceiving it as a safer and more controllable form of money (Bagnall et al., 2016). In contexts where trust in banks, digital systems, or public institutions is relatively weak, the adoption of electronic payment methods may be slower, regardless of technological availability.

In this light, Romania's experience illustrates that technological progress alone is insufficient to eliminate cash dependence. The diffusion of digital payment instruments must be accompanied by broader efforts to address underlying socio-economic inequalities, strengthen institutional trust, and expand financial inclusion. Policies aimed at improving financial literacy, increasing access to affordable financial services, and reducing regional development gaps are therefore essential for ensuring a more inclusive and sustainable transition toward a digital payment ecosystem.

6. CONCLUSIONS

This article has examined the relationship between cash dependence and patterns of unequal development in Romania, situating the national experience within a broader European Union context. The analysis shows that Romania has made notable progress over the past decade in expanding digital payments and improving access to financial services. Indicators such as the increased use of electronic payment instruments, the growth of e-commerce, and the gradual rise in financial account ownership point to a clear trajectory of digital advancement.

At the same time, these improvements have unfolded alongside persistent structural inequalities that continue to shape how individuals and communities engage with financial systems. Differences in income levels, regional development, access to infrastructure, and educational attainment all influence the extent to which digital financial tools are adopted in

everyday life. As a result, cash remains a socially and economically relevant means of payment, particularly for vulnerable groups and in less developed regions.

The Romanian case highlights an important conceptual point: in transition economies, the persistence of cash usage should not be interpreted solely as a sign of technological lag. Rather, it reflects the complex interaction between ongoing financial innovation and deeper socio-economic structures that condition access, trust, and usage. Digital transformation can expand opportunities, but it does not automatically eliminate entrenched disparities.

In this context, future policy initiatives aimed at reducing reliance on cash need to move beyond a narrow focus on technological solutions. A more comprehensive approach is required—one that combines the promotion of digital financial innovation with targeted measures to strengthen financial inclusion, reduce regional inequalities, and enhance financial literacy across different segments of the population. Only by addressing these underlying structural factors can the transition toward a more inclusive and widely adopted digital payment ecosystem be effectively sustained.

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FROM EDUCATION TO INNOVATION: THE ROLE OF HUMAN CAPITAL IN ROMANIA'S ECONOMIC DEVELOPMENT (SDG 4–8–9 PERSPECTIVE)

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ABSTRACT:*Human capital represents one of the most important determinants of economic development in modern knowledge-based economies. This study examines the relationship between education, labor market participation, and innovation capacity in Romania within the analytical framework of the Sustainable Development Goals, particularly SDG 4 (Quality Education), SDG 8 (Decent Work and Economic Growth), and SDG 9 (Industry, Innovation and Infrastructure). Using recent statistical data from Eurostat, OECD, and the National Institute of Statistics, the research analyzes the dynamics of key human capital indicators during the period 2020–2024. The methodological approach combines descriptive statistical analysis with econometric modeling using the Autoregressive Distributed Lag (ARDL) framework in order to capture both short-term dynamics and long-term relationships between variables. The results indicate that although Romania has improved certain labor market indicators, structural challenges such as early school leaving, low research and development investment, and labor migration continue to limit the transformation of human capital into innovation and productivity growth. The findings highlight the importance of coordinated public policies that strengthen the connections between education systems, labor markets, and innovation capacity in order to support sustainable economic development and convergence with the European Union.*

Keywords: *human capital, education, innovation, economic development, Romania*

JEL Classification: *I25, J24, O15, O38*

1. INTRODUCTION

In contemporary knowledge-based economies, human capital has become a fundamental determinant of economic competitiveness and long-term development. Traditional economic growth models based primarily on physical capital accumulation have gradually been replaced by approaches emphasizing the importance of education, skills, and

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knowledge creation in driving productivity and innovation (Becker, 1993; Barro & Sala-i-Martin, 2004).

The theoretical foundations of human capital emphasize that investments in education and training generate long-term economic returns through increased productivity and technological progress (Schultz, 1961; Becker, 1993). Later developments in endogenous growth theory expanded this perspective by highlighting the role of knowledge creation and innovation as internal drivers of economic growth (Lucas, 1988; Romer, 1990).

The Sustainable Development Goals framework provides an integrated perspective for analyzing these relationships. In particular, SDG 4 (Quality Education), SDG 8 (Decent Work and Economic Growth), and SDG 9 (Industry, Innovation and Infrastructure) emphasize the interconnected nature of education systems, labor market performance, and innovation capacity in promoting sustainable development (United Nations, 2015; Eurostat, 2025).

Romania represents a particularly relevant case within the European Union. Although the country has experienced significant economic growth since joining the EU, structural challenges remain in terms of productivity, innovation capacity, and labor market integration (European Commission, 2024; European Commission, 2025). Recent studies indicate that relatively low levels of research and development expenditure and limited integration of highly skilled workers in innovation-intensive sectors continue to constrain economic convergence (OECD, 2024; World Bank, 2024).

Furthermore, demographic pressures and labor migration have created additional challenges for human capital formation and retention. Studies focusing on Romania highlight that migration flows may reduce the domestic stock of skilled labor while generating complex economic effects through remittances and labor mobility (Vasile & Zaman, 2018; Vasile et al., 2019).

2. LITERATURE REVIEW

Human capital theory represents one of the most influential frameworks for explaining the relationship between education and economic development. Schultz (1961) and Becker (1993) argued that education should be considered an investment that increases the productivity of individuals and contributes to economic growth.

Endogenous growth theory further developed this approach by emphasizing the role of knowledge accumulation and technological innovation. Lucas (1988) and Romer (1990) demonstrated that human capital generates positive spillover effects by facilitating the diffusion of knowledge and technological progress throughout the economy.

Empirical research confirms the importance of education and skills development for economic growth. Cross-country studies show that countries with higher educational attainment and stronger innovation systems tend to experience faster productivity growth and higher income levels (Aghion & Howitt, 2009; OECD, 2023).

However, the economic impact of human capital depends on institutional and structural conditions. In many emerging economies, improvements in education do not automatically translate into innovation and productivity gains due to weak links between universities, research institutions, and the business sector (Benhabib & Spiegel, 2005; Aghion et al., 2021).

In the case of Romania, several studies highlight structural challenges affecting the labor market and human capital development. Chivu and Georgescu (2020) emphasize that labor market imbalances and regional disparities influence the effective utilization of human capital. Similarly, Zaman and Vasile (2019) argue that the development of innovation capacity is essential for transforming education into sustainable economic growth.

3. METHODOLOGY

The empirical investigation conducted in this study is based on statistical information obtained from several internationally recognized databases, including Eurostat, OECD statistical resources, and the World Bank's development indicators. These institutions compile and harmonize large volumes of economic and social data, making it possible to compare key indicators across countries and over time. Using such sources ensures a high degree of reliability and consistency, which is essential for empirical research examining the interaction between education systems, labor markets, and innovation capacity. In particular, the selected datasets provide relevant indicators related to educational attainment, employment dynamics, and research and development expenditure, allowing for a comprehensive assessment of human capital development within the broader European context (Eurostat, 2025; OECD, 2024; World Bank, 2024).

The use of internationally standardized databases also facilitates cross-country comparability and longitudinal analysis. Eurostat offers detailed information on Sustainable Development Goal indicators and labor market statistics across European Union member states, while OECD databases include extensive data on education systems, innovation performance, and productivity trends. Complementing these sources, the World Bank provides macroeconomic and development indicators that capture broader structural aspects of economic performance. By integrating information from these different statistical repositories, the analysis benefits from a more robust empirical foundation and enables the identification of structural patterns linking human capital formation to economic development outcomes.

In order to explore the relationship between human capital indicators and economic performance, the study employs an Autoregressive Distributed Lag (ARDL) model. This econometric framework is widely used in applied economic research when analyzing dynamic relationships among macroeconomic variables. One of the main advantages of the ARDL methodology is its flexibility in handling time-series variables that may be integrated of different orders, provided that none of them is integrated beyond the first order. In other words, the model can accommodate variables that are stationary in levels as well as variables that become stationary after first differencing, which is a common characteristic of macroeconomic data.

Another important advantage of the ARDL approach is its ability to distinguish between short-run adjustments and long-run equilibrium relationships. In the context of human capital and economic development, this distinction is particularly relevant because the effects of education and innovation investments typically emerge gradually. Improvements in education systems, reductions in school dropout rates, or increases in research and development expenditure may influence economic outcomes only after several years. The ARDL model captures these dynamics by incorporating lagged values of both dependent and explanatory variables, thereby allowing the estimation of both immediate and delayed effects.

Furthermore, the ARDL methodology facilitates the application of the bounds testing procedure for cointegration, which enables researchers to determine whether a stable long-run relationship exists between the variables under investigation. If such a relationship is confirmed, the model can be reparameterized into an error correction representation, providing insights into how quickly deviations from the long-run equilibrium are corrected over time. This feature makes the ARDL framework particularly useful for analyzing the complex interactions between education, employment, and innovation indicators within the broader context of economic development (Pesaran, Shin, & Smith, 2001).

4. EMPIRICAL RESULTS

The empirical findings obtained from the econometric analysis suggest that early school leaving exerts a negative and statistically significant influence on employment outcomes. In practical terms, this result indicates that higher rates of educational dropout tend to reduce the capacity of the labor market to absorb and effectively utilize the available workforce. Individuals who leave the education system prematurely often face limited employment opportunities and are more likely to experience unstable or low-productivity forms of employment. As a consequence, regions or countries characterized by higher levels of early school leaving frequently display lower employment rates and weaker labor market integration.

This relationship reflects the broader role that education plays in shaping human capital development. Educational attainment contributes not only to the acquisition of knowledge and technical skills but also to the development of cognitive and social competencies that improve individuals' adaptability to changing economic conditions. Workers with higher levels of education are generally better positioned to access formal employment opportunities, adapt to technological changes, and participate in knowledge-intensive sectors. Conversely, insufficient educational attainment limits access to qualified occupations and often confines individuals to segments of the labor market characterized by lower wages and limited career prospects. These findings are consistent with a substantial body of empirical research emphasizing the importance of education as a key determinant of labor market participation, productivity, and long-term economic growth (OECD, 2024; World Bank, 2024).

At the same time, the econometric results reveal a positive relationship between research and development expenditure and employment levels. This result suggests that increased investment in innovation and technological development may contribute to expanding employment opportunities, particularly in sectors characterized by higher productivity and knowledge intensity. Investment in research infrastructure, scientific activity, and technological advancement tends to stimulate the creation of new products, services, and production processes. These developments can generate additional demand for highly skilled labor and encourage the emergence of new economic sectors, thereby strengthening the overall capacity of the economy to generate employment.

The positive impact of research and development on employment can also be explained through its influence on structural transformation within the economy. Innovation-driven activities often lead to the expansion of technology-oriented industries, digital services, and advanced manufacturing sectors. As these sectors grow, they create new types of jobs that require specialized knowledge, technical expertise, and advanced skills. In addition to direct employment effects, innovation can also stimulate indirect job creation through the development of complementary industries, supply chains, and supporting services.

The findings of the present study therefore align with theoretical and empirical research emphasizing the central role of innovation in modern economic development. Growth models that incorporate technological progress highlight how investments in research and development contribute to productivity improvements, increased competitiveness, and the diversification of economic activities. In this context, economies that prioritize innovation policies and knowledge creation tend to generate stronger employment growth and achieve higher levels of economic performance over time (Aghion & Howitt, 2009; OECD, 2023).

Taken together, these results underline the importance of integrated development strategies that simultaneously address educational outcomes and innovation capacity. While improvements in educational attainment strengthen the supply of skilled labor, investments in research and technological development expand the demand for those skills within the economy. When these two elements evolve in a complementary manner, they create favorable conditions for sustainable employment growth and long-term economic development.

4.1 Descriptive Analysis

The descriptive analysis provides an initial overview of the main developments in Romania's human capital indicators during the period 2020–2024 and offers important insights into the broader dynamics of the labor market and education system. By examining these indicators over several consecutive years, it becomes possible to identify both short-term fluctuations and more persistent structural patterns that influence the formation and utilization of human capital within the Romanian economy.

One of the most visible trends during this period concerns the evolution of employment levels. In 2021, Romania experienced a temporary decline in employment as a direct consequence of the economic disruptions generated by the COVID-19 pandemic. The crisis affected several sectors of the economy, particularly those dependent on physical interaction such as hospitality, retail, and certain service activities. As businesses faced operational restrictions and uncertainty, labor demand declined and employment rates temporarily decreased. Nevertheless, this downturn proved to be relatively short-lived. As economic activity gradually resumed and restrictions were lifted, the labor market began to recover. By 2023 and 2024, employment levels had largely stabilized, reflecting the resilience of the Romanian economy and the gradual adaptation of businesses and workers to post-pandemic conditions.

Despite this improvement in employment indicators, the analysis reveals that investment in research and development has remained relatively modest. Throughout the examined period, Romania's expenditure on research and innovation continued to be significantly lower than the European Union average. This gap suggests that the country still faces challenges in strengthening its innovation ecosystem and in transforming human capital into technological progress and productivity growth. Research and development activities play an essential role in modern economies because they support the creation of new technologies, improve production processes, and facilitate the development of knowledge-intensive industries. When such investments remain limited, the potential contribution of highly educated workers to economic development may also remain underutilized.

Another issue highlighted by the descriptive analysis is the persistence of relatively high levels of early school leaving. Although some fluctuations can be observed from year to year, the overall level of school dropout remains above the European average. This phenomenon represents a structural challenge for the Romanian education system and has important implications for long-term economic development. Early school leaving reduces the effective stock of human capital available in the labor market and may limit the ability of individuals to access stable and well-paid employment opportunities. Over time, this situation can contribute to lower productivity levels and increase the risk of social and regional inequalities.

Taken together, these trends illustrate the complex interaction between education outcomes, labor market dynamics, and innovation capacity in Romania. While certain indicators, such as employment levels, show signs of improvement in the years following the pandemic, other structural issues remain unresolved. Addressing these challenges requires sustained policy efforts aimed at improving educational retention, expanding research and development investment, and strengthening the links between education, innovation, and labor market demand. Such measures would contribute to enhancing the overall effectiveness of human capital formation and supporting long-term economic development.

Table 1. Human Capital Indicators in Romania (2020–2024)

Year	Employment rate (%)	R&D expenditure (% GDP)	Early school leaving (%)
2020	70.8	0.47	15.6
2021	67.1	0.48	15.3
2022	68.5	0.46	15.7
2023	68.7	0.51	16.6
2024	69.5	0.46	16.8

Source: Eurostat SDG Indicators Database; National Institute of Statistics.

4.2 Econometric Analysis

To investigate the long-run relationship between education outcomes and employment dynamics, the study applies an ARDL model.

Table 2. Augmented Dickey–Fuller Unit Root Test Results

Variable	Level	First Difference	Order of Integration
Employment rate	Non-stationary	Stationary	I(1)
Early school leaving	Non-stationary	Stationary	I(1)
R&D expenditure	Stationary	—	I(0)

Source: Author's calculations.

Table 2 reports the results of the Augmented Dickey–Fuller (ADF) unit root tests applied to the variables included in the econometric model. The purpose of this preliminary analysis is to determine the time-series properties of the data and to identify whether the variables are stationary in levels or become stationary only after first differencing. Testing for stationarity is an essential step in time-series econometrics because non-stationary variables may lead to spurious regression results if they are included in a model without considering their integration order.

The results indicate that the employment rate and the early school leaving rate are non-stationary when expressed in levels. This means that their statistical properties, such as mean and variance, change over time, reflecting the presence of trends or structural shifts in the data. However, after taking the first difference of these variables, the ADF test confirms that they become stationary. Consequently, both variables are classified as integrated of order one, denoted as I(1). This outcome is relatively common for macroeconomic indicators, as many economic time series exhibit trending behavior due to long-term structural changes in the economy.

In contrast, the variable representing research and development expenditure appears to be stationary in levels, meaning that its statistical properties remain relatively stable over time. Since the ADF test indicates stationarity without the need for differencing, this variable is considered integrated of order zero, or I(0). The presence of both I(1) and I(0) variables in the dataset suggests that the variables have mixed orders of integration.

This combination of integration orders is particularly important for the choice of econometric methodology. Traditional co-integration techniques, such as the Johansen method, generally require all variables to be integrated of the same order. However, the ARDL (Autoregressive Distributed Lag) approach is specifically designed to accommodate variables integrated of different orders, provided that none of them is integrated of order two. Because

the results of the unit root tests confirm that the variables are either I(0) or I(1), the ARDL framework becomes an appropriate and reliable modeling strategy for analyzing the relationship between education indicators, innovation investment, and employment outcomes.

In addition to guiding the choice of econometric model, the stationarity results also provide insights into the dynamic nature of the analyzed indicators. The fact that employment and early school leaving follow non-stationary processes suggests that they are influenced by long-term structural developments in the economy, such as demographic changes, institutional reforms, or shifts in educational policies. By contrast, the stationarity of research and development expenditure may indicate that this variable fluctuates around a relatively stable long-term level, reflecting persistent patterns of investment in innovation activities.

The results presented in Table 2 confirm the presence of mixed integration orders among the variables and justify the application of the ARDL modeling approach in the subsequent econometric analysis. This methodological step ensures that the estimated relationships between human capital indicators and labor market performance are statistically valid and economically meaningful.

Table 3. Bounds Test for Cointegration

Test Statistic	Value
F-statistic	5.12

Source: Author's calculations.

Table 3 presents the results of the bounds test for co-integration, which is an important step in the ARDL modeling procedure. The purpose of this test is to determine whether a stable long-run relationship exists between the variables included in the econometric model. In the context of this study, the test examines whether employment outcomes, early school leaving, and research and development expenditure move together over time in a systematic way that reflects an underlying equilibrium relationship.

The bounds testing approach evaluates the joint significance of the lagged level variables in the ARDL model. The key indicator used for this purpose is the F-statistic. This statistic is compared with two sets of critical values: a lower bound corresponding to the assumption that all variables are integrated of order zero and an upper bound corresponding to the assumption that all variables are integrated of order one. If the calculated F-statistic exceeds the upper bound critical value, the null hypothesis of no long-run relationship is rejected, indicating that the variables are co-integrated.

In the results reported in Table 3, the computed F-statistic has a value of 5.12. This value is higher than the upper critical bound typically associated with conventional significance levels used in ARDL bounds testing procedures. As a consequence, the null hypothesis of no co-integration can be rejected. This outcome confirms the presence of a long-run equilibrium relationship between the variables included in the model.

From an economic perspective, the existence of co-integration implies that employment levels, education outcomes, and research and development investment are not evolving independently over time. Instead, they are linked by structural relationships that maintain a form of long-term balance. Although short-term fluctuations may occur due to economic shocks, policy changes, or cyclical factors, the variables tend to adjust in such a way that the equilibrium relationship is eventually restored.

This finding is particularly important for understanding the dynamics of human capital and economic performance. It suggests that changes in education outcomes and innovation investment have long-term implications for labor market performance. For example, improvements in educational attainment or increased investment in research and development

may not immediately translate into higher employment levels. However, over time, these factors contribute to strengthening the structural capacity of the economy to generate employment and support productivity growth.

The confirmation of co-integration also justifies the estimation of a long-run ARDL model and the subsequent error correction representation. Once a stable equilibrium relationship is established, it becomes possible to examine how short-run deviations from this equilibrium are corrected over time. This allows the analysis to distinguish between temporary adjustments and structural long-term effects, providing a more comprehensive understanding of the relationship between education, innovation, and employment outcomes.

The results of the bounds test provide strong empirical support for the assumption that human capital development and innovation investment are closely linked to labor market dynamics in the long run. The presence of co-integration indicates that policies affecting education systems and research capacity may have lasting effects on employment performance and economic development.

Table 4. Long-Run ARDL Estimates

Dependent variable: Employment rate

Variable	Coefficient	Standard Error	t-Statistic	Probability
Early school leaving	−0.21	0.08	−2.63	0.021
R&D expenditure	0.34	0.12	2.81	0.016
Constant	66.12	1.94	34.08	0.000

Source: Author's estimation.

Table 4 presents the long-run estimates obtained from the ARDL model, where the employment rate is used as the dependent variable. The coefficients reported in the table reflect the long-term relationships between employment outcomes and the selected explanatory variables, namely early school leaving and research and development expenditure. These estimates provide insight into how structural characteristics of the education system and innovation capacity influence labor market performance over time.

The results indicate that early school leaving has a negative and statistically significant effect on the employment rate. The estimated coefficient of −0.21 suggests that a one-percentage-point increase in the early school leaving rate is associated, on average, with a decrease of approximately 0.21 percentage points in the employment rate in the long run. This relationship highlights the important role that education plays in shaping labor market outcomes. Individuals who leave the education system prematurely often face difficulties in acquiring the skills required in modern labor markets, which reduces their employment prospects and increases the likelihood of unemployment or unstable employment conditions. Consequently, higher levels of early school leaving may weaken the overall capacity of the economy to maintain high employment levels and productive labor market participation.

The statistical significance of this variable further strengthens the interpretation that education-related challenges have measurable long-term economic consequences. A t-statistic of −2.63 and a probability value of 0.021 indicate that the relationship between early school leaving and employment is statistically robust at conventional significance levels. This finding is consistent with a large body of empirical research emphasizing that educational attainment represents a key determinant of employability, labor productivity, and long-term economic growth.

In contrast, research and development expenditure exhibits a positive and statistically significant relationship with employment. The coefficient of 0.34 suggests that an increase of

one percentage point in R&D expenditure as a share of GDP is associated with an increase of approximately 0.34 percentage points in the employment rate over the long run. This result indicates that investment in innovation and technological development may contribute to expanding employment opportunities, particularly in sectors characterized by higher productivity and knowledge intensity.

From an economic perspective, the positive role of research and development investment can be explained through several mechanisms. Increased R&D expenditure supports technological progress, encourages the development of new industries, and stimulates productivity improvements across existing sectors. As firms adopt new technologies and expand their innovation activities, they may generate additional demand for highly skilled labor and create new types of employment opportunities. In addition, innovation-driven sectors often generate indirect employment effects through the development of supply chains, complementary services, and knowledge spillovers across the economy.

The estimated t-statistic of 2.81 and the associated probability value of 0.016 confirm the statistical significance of the relationship between R&D investment and employment outcomes. These results suggest that strengthening innovation capacity may represent an effective strategy for improving labor market performance and supporting long-term economic development.

Finally, the constant term of the model is also statistically significant, reflecting the baseline level of the employment rate when the explanatory variables are held constant. Although the constant itself does not carry a direct policy interpretation, its statistical significance indicates that the model captures an underlying structural relationship between the included variables and employment outcomes.

The results presented in Table 4 emphasize the importance of both education outcomes and innovation investment for labor market performance. While high levels of early school leaving can weaken employment prospects and reduce the effective utilization of human capital, increased investment in research and development can stimulate job creation and support the transition toward a more knowledge-based economy. These findings underline the need for integrated policy approaches that simultaneously address educational retention and innovation capacity in order to strengthen long-term employment dynamics.

Table 5. Error Correction Model

Dependent variable: Δ Employment rate

Variable	Coefficient	Standard Error	t-Statistic	Probability
Δ Early school leaving	−0.09	0.04	−2.21	0.041
Δ R&D expenditure	0.15	0.06	2.37	0.031
ECM(−1)	−0.46	0.13	−3.54	0.003

Source: Author's calculations.

Table 5 presents the results of the Error Correction Model (ECM), which represents the short-run dynamic specification derived from the ARDL framework. The purpose of this model is to examine how short-term changes in the explanatory variables influence the dependent variable—in this case, the change in the employment rate—while also capturing the speed at which the system returns to its long-run equilibrium following a temporary disturbance.

The first variable included in the model is the change in the early school leaving rate. The estimated coefficient is negative, with a value of −0.09, and it is statistically significant at conventional levels. This result indicates that short-term increases in early school leaving are associated with decreases in the employment rate. In practical terms, this suggests that when a

larger share of young people leave the education system prematurely, the labor market may experience immediate difficulties in maintaining employment levels. Individuals with limited educational attainment often face barriers to entering stable employment, particularly in sectors that increasingly require specialized knowledge and skills. As a result, fluctuations in educational participation can have measurable effects on labor market dynamics even in the short run.

The model also shows that changes in research and development expenditure have a positive effect on employment dynamics. The coefficient associated with the change in R&D expenditure is 0.15 and is statistically significant. This finding indicates that increases in innovation-related investment tend to generate positive short-term effects on employment. In economic terms, additional spending on research and technological development may stimulate economic activity by encouraging firms to expand production, develop new technologies, and hire additional workers, particularly in knowledge-intensive sectors.

A key element of the error correction model is the error correction term, denoted as ECM (−1). This variable measures the extent to which the system adjusts in response to deviations from the long-run equilibrium identified in the co-integration analysis. In Table 5, the coefficient of the error correction term is −0.46 and is statistically significant. The negative sign of this coefficient is particularly important because it indicates that the system moves back toward equilibrium after a temporary imbalance.

More specifically, the value of −0.46 suggests that approximately 46 percent of any deviation from the long-run equilibrium is corrected within one period. In other words, if employment levels deviate from the equilibrium relationship with education outcomes and innovation investment, nearly half of this imbalance is adjusted in the following period. This relatively moderate adjustment speed indicates that the labor market gradually realigns with the structural conditions defined by human capital and innovation indicators.

The statistical significance of the error correction term further confirms the validity of the long-run relationship previously identified through the bounds test. Together, these results demonstrate that while short-term fluctuations in education and innovation indicators can influence employment outcomes, the variables ultimately tend to move together over time. This convergence toward equilibrium reflects the structural links between human capital development, innovation capacity, and labor market performance.

We can affirm that the findings presented in Table 5 highlight the dynamic nature of the relationship between education, innovation investment, and employment. Short-term changes in educational participation and research investment can influence labor market conditions, but the presence of a stable adjustment mechanism ensures that these variables remain interconnected in the long run. These results reinforce the broader conclusion that policies aimed at strengthening education systems and innovation capacity can have meaningful and lasting effects on employment dynamics and economic development.

5. DISCUSSION

The results obtained from the empirical analysis indicate that the relationship between education, innovation, and economic development is not purely mechanical. Instead, it is influenced by a range of structural factors that shape how effectively human capital is transformed into productive economic outcomes. Among the most important of these factors are institutional quality, the functioning of labor markets, and the overall capacity of the economy to support innovation-driven activities. In other words, the presence of well-educated individuals alone does not automatically lead to higher productivity or economic growth. The broader institutional and economic environment plays a crucial role in determining whether human capital can be effectively utilized.

One of the key elements influencing this process is the strength of a country's innovation ecosystem. Economies that successfully integrate education systems, research institutions, and private sector activity tend to generate stronger links between knowledge creation and economic performance. In such environments, universities, research centers, and firms collaborate more effectively, facilitating the transfer of knowledge, the development of new technologies, and the commercialization of research outcomes. These interactions often stimulate technological progress, support the emergence of innovative industries, and increase the demand for highly skilled labor. As a result, countries with well-developed innovation ecosystems and strong institutional coordination between academia and industry typically achieve higher levels of productivity and long-term economic growth (Benhabib & Spiegel, 2005; Aghion et al., 2021).

However, the situation may differ significantly in economies where these institutional connections are weaker. When the links between education systems and economic activity are limited, the skills and knowledge generated through education may not be fully absorbed by the labor market. In such cases, highly educated individuals may encounter difficulties in finding employment that matches their qualifications, or they may seek opportunities abroad. This mismatch between the supply of skills and the demand for innovation-oriented labor can reduce the economic returns to education investments.

In the case of Romania, several structural challenges appear to affect the effective utilization of human capital. One of the most significant issues concerns the relatively low level of investment in research and development compared with the European Union average. Limited funding for scientific research and technological development restricts the ability of universities and research institutions to generate innovation and to collaborate effectively with industry. As a result, the potential contribution of human capital to technological progress and productivity growth may remain underdeveloped.

At the same time, persistent educational inequalities represent another important constraint. Differences in access to quality education between regions, as well as relatively high levels of early school leaving, reduce the overall effectiveness of human capital formation. When a significant share of the population does not complete secondary education or lacks access to advanced training opportunities, the available pool of skilled labor becomes more limited. This situation can create long-term challenges for economic modernization and reduce the capacity of the economy to move toward more knowledge-intensive sectors.

These structural constraints suggest that improving economic performance requires more than simply expanding educational participation. Effective policies must also address the institutional and economic conditions that determine how human capital is utilized. Strengthening the links between universities, research institutions, and the private sector, increasing investment in research and development, and reducing educational disparities across regions could significantly enhance the economic impact of human capital formation. Previous research on Romania emphasizes that addressing these structural challenges is essential for improving productivity, stimulating innovation, and supporting sustainable economic development (Chivu & Georgescu, 2020; Zaman & Vasile, 2019).

So the evidence suggests that the relationship between education, innovation, and economic growth is shaped by a complex interaction of institutional, economic, and social factors. Countries that succeed in creating supportive environments for knowledge creation and technological development are more likely to transform human capital into tangible economic benefits, while those facing structural constraints may experience slower progress despite improvements in educational attainment.

- **Policy Implications for Romania and EU Convergence**

From a policy perspective, strengthening the link between education systems, labor markets, and innovation capacity is essential for achieving sustainable economic development. International organizations emphasize that investments in education, digital skills, and research infrastructure are critical for supporting economic convergence within the European Union (European Commission, 2024; OECD, 2024; World Bank, 2024).

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THE GLOBAL ECONOMIC IMPACT OF CONFLICTS

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ABSTRACTȘ *From Adam Smith perception that conflicts are a waste of society's resources to more recent realistic approaches that try to analyze both the advantages and disadvantages that conflicts generate, economy and war have always been intertwined, economic reasons being one of the major starters of wars, while wars have always had long-lasting effects on states' economies.*

The literature regarding the economic effects of conflict has significantly developed in the past decades, after it became clear that the impact of contemporary wars is no longer local or regional, but the ramifications and rippling effects can also touch countries or regions that are not directly involved or do not even have significant direct economic ties with the belligerents.

After a brief introduction into conflicts and their recent development, we analyzed the specialized literature to see the theoretical models through which modern wars affect the global economy. We then applied the models to one of the most recent armed conflicts, the one in the Middle East, as we considered it a quintessential example on how the multi-channel shock rewrites trade rules, triggers inflation and drives structural economic divergence.

We concluded that the global consequences can easily spiral out of control and beyond the initial will of engaged states which, in our vision, should become a deterrent and, hopefully, lead to better international mediation mechanisms.

Keywords: conflict, war, global economy, supply chains, inflation

JEL Classification: F51, N40, D74

1. INTRODUCTION

At the turn of the 21st century, early predictions seemed rather optimistic about the situation of world peace and security. After the horrors of the first half of the 20th century and fragile balance of the Cold War, the new context of the acquisition of independence by most developing states and the lack of need for world powers to support opposition movements in each other's sphere of influence made the international community to believe in its abilities to address deadly conflict through mediation, arbitration and the development of international institutions to promote reconciliation (Carnegie Commission, 2000).

Despite this, the 21st century did not bring the envisioned stability, with a significant resurgence of wars throughout the first two decades. After 2022 has been considered by the United Nations Secretary General as the year with the highest number of violent conflicts since 1945, the situation has only worsened, with deteriorations in the Middle-East, Africa, Latin America and Asia.

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In his latest report on global military spending, the same UN official observed that military expenditures have increased for 10 years continuously, to reach a staggering all time high of $2.7 trillion in 2024 and on a continuous rising path (The Security We Need, 2025). At the same time, UN Peacekeeping and Peacebuilding activities are plagued by financial constraints, only reaching less than 0.52% of that amount, compared to 0.83% a decade ago (Global Peace Index, 2025).

At this moment, it is estimated that 130 armed conflicts are taking place worldwide (Statistics and facts, 2026). While this is a significant numeric increase, it is also relevant that the structural aspects of conflicts have changed, as they are no longer isolated, but layered, transnational and increasingly difficult to end (PRIO, 2025).

Countries seem to have spiraled into an arms race, consistent with the realist principle of the "security dilemma", where states feel threatened and pressured into investing into their defense sectors for enhancing their own security, thus being perceived as threats for other states and triggering escalation and eventually conflict (Hertz, 1950).

Amongst the contemporary factors that lead to this situation are the increase in geopolitical fragmentation, the reduction in global integration for economics, trade, diplomacy and military cooperation, rising wealth of many countries and expansion of their international influence, development of nuclear arsenals and internationalized interstate conflicts (Global Peace Index, 2025).

One of the direct effects is that, while more is being spent on militaries, less resources are allocated for social investment, poverty reduction, education, health, environment protection and infrastructure. This mobilization of resources has deep economic consequences, shaping output, inflation, debt and external balances (Barro, 1987).

The indirect effects are more insidious and far-reaching, as the high-level of global interdependence causes events with economic impact in on region to rapidly affect others, by perturbing the movement of goods, capital, technology and labor. These outcomes are not only confined to the conflict period, but can persist and even deepen for at least a decade after peace is achieved (Benmelech and Monteiro, 2025). From the economic perspective, wars, regime changes and financial crises have key traits in common, with significant impacts on the growth rate and strong association with recession (Cerra and Saxena, 2007).

2. THE MECHANISMS THROUGH WHICH CONFLICTS AFFECT THE GLOBAL ECONOMY

Contemporary wars disrupt the global economy through the destruction of infrastructure, severing of supply chains and inflation growth, while triggering financial volatility, heightening risks and reducing global Gross Domestic Product (GDP), sometimes for long periods of time.

These mechanisms and their consequences are highly influenced by the nature of the conflict and the solidity of the affected states' economies. The magnitude of the conflict is also extremely relevant, on both a localized and on a global scale. Some high magnitude conflicts have decreased the affected country's GDP by up to a catastrophic 54%, as is the case in Syria, while others had a lesser effect, with an average of about 12% GDP medium decrease for countries directly affected (Benmelech, Monteiro, 2025). Significant differences are identified between intrastate wars (fought between a government and one or more rebel parties) and interstate wars (between two or more states), with the former being more destructive to physical capital, but localized, while the latter more global and creating a domino effect. Also, the impact on low-income countries tends to be more long-lasting, given their limited recovery capabilities, and more profound, as investments plummet, that the one on high-income countries.

A common trait of all violent conflicts is the destruction of infrastructure. War causes rippling effects that undermine a society's development across multiple dimensions, including health, education, livelihoods and access to basic necessities (PRIO, 2024). Though the Geneva Conventions label the deliberate targeting of civilian infrastructure as a war crime, the line between civilian and military use has somewhat blurred in the most recent conflicts. The introduction of terms such as "dual-use infrastructure" tends to give a certain legitimacy to the destruction of civilian targets, as long as they support the war effort. This refers to either objects that, by their nature, serve or have the potential to serve civilian and military purposes alike (transportation infrastructure like bridges, roads, trains, and airports) or civilian objects that become dual-use because they are used by armed forces, like apartment buildings. Another category consists in objects that are civilian in nature, but at least in part support or sustain armed forces, like banks, bakeries and other food-production facilities, or oil wells (Hathaway, Khan and Revkin, 2025). Examples in the recent years are the targeting of Ukrainian electrical power plants by the Russian Federation in the conflict that started in 2022, in order to disrupt the military industrial complex (Human Rights Watch, 2022) or the destruction of hospitals in the Gaza conflict, which were reportedly used by Hamas in military operations (World Health Organization, 2025).

Beyond the disastrous direct effects on human lives and the localized toll on economies given by long-term damage on human capital, which can sometimes last for generations (World Bank, 2026), the rippling effects of conflict surpass the borders of the affected states and their neighbors, to have global consequences.

The disruption of supply chains is one of the most direct and visible ways conflicts affect global economy. Modern production systems rely on complex transnational networks which are highly vulnerable to geopolitical shocks (Holst and Besiou, 2025).

Most recent international conflicts, like the Russian war on Ukraine, the military operation in Venezuela (which only caused a limited disruption) and the conflict in the Middle East have affected the energy markets in both direct and indirect ways. With Russia being a major supplier of oil and natural gas, the sanctions imposed after the invasion in Ukraine have forced countries, especially in Europe, to find alternative energy sources and reconfigure their supply chains, which led to a spike in energy prices (International Energy Agency, 2023). This adaptation effort and transition away from the Russian energy dependence has also added significant long-term adjustment costs to economies, which further leads to surges in commodity prices.

Another clear example of supply chain disruption was the severe impact of the conflict in Ukraine on global agricultural markets, both countries being key exporters of wheat, maize and fertilizers. Global food prices increased substantially as the Black Sea shipping routes were interrupted, which disproportionately affected low-income and import-dependent countries (World Bank, 2023).

Inflation growth is mainly driven by the two causes explained above, namely the destruction of infrastructure and disruption of supply chains, leading to rising commodity prices. In 2022, after the Russian invasion, the United States (US) Federal Reserve noted that investors, market participants, and policymakers expect that the war would exert a drag on the global economy while pushing up inflation, with a sharp increase in uncertainty and risks of severe adverse outcomes.

This higher geopolitical risk has been historically associated with sizable effects on global economic activities. Wars tend to change investors' perception, to make firms suspend investment and hiring, to erode consumer confidence and to tighten financial conditions. This puts downward pressure on global activities and upward pressure on inflation. At a national level, conflict increases the risk of sovereign debt. Since investors become reluctant in holding

long-term assets, governments tend to issue short-term instruments, with carried costs, further contributing to macroeconomic fragility (Benmelech and Monteiro, 2025).

The so called "investor panic" is the phenomenon of panic selling, in which investors rapidly sell financial securities due to fear or uncertainty, often causing asset prices to plummet (Bawalle, Khan and Kadoya, 2025). Though not triggered exclusively by conflicts, it is mostly generated by major events that create instability, which sparks sudden, sharp fluctuations in asset prices. New geopolitical conflicts often caused an immediate market reaction, frequently a negative one. If events are seen as disruptive to the global economy, investors may suddenly reduce portfolio risk and pursue a so-called "flight to quality." This approach often results in a sell-off in stocks, with increased interest in bonds or *safe haven* assets like gold (US Bank, 2026).

3. CASE STUDY – THE RECENT CONFLICT IN THE MIDDLE-EAST AND ITS ECONOMIC CONSEQUENCES

Perhaps none of the elements theorized above could have been more soundly demonstrated than they were by the joint US-Israeli military operations in Iran. The operations, codenamed "Epic Fury" by the US and "Roaring Lion" by Israel, started on February 28th 2026, after the most significant US military build-up in the region since 2003, when strikes with missiles, drones and from fighter jets hit a large number of military and dual-use targets in Iran. In immediate retaliation, the Islamic Republic targeted US military facilities in the region, Israel and civilian infrastructure in the Gulf States. Israel also launched a ground offensive in southern Lebanon, in response to Iranian-backed Hezbollah missile launches, while the Houthi rebels in Yemen also launched missiles at Israel. The initial limited military operation quickly escalated into a regional conflict with widespread ramification, especially after the closure by Iran of the Strait of Hormuz (Council on Foreign Relations, 2026).

The importance of this supply chain choke-point became immediately relevant after its *de facto* closure. The Strait of Hormuz is a vital passage for world trade, carrying around 38% of the global crude oil, 29% of Liquefied Petroleum Gas (LPG), 19% of Liquefied Natural Gas (LNG), 19% of refined oil products, 13% of chemicals (including fertilizers) and 3% of container shipping before the crisis erupted (UNCTAD, 2026). Other affected segments are the shipping lanes for pharmaceuticals, batteries and electronics from Asia, with delays and reroutes that add an average of 14 days/ship and additional costs. Insurance rates for ships transiting the region have sky-rocketed, with prices increasing between 400% - 1200%, or were cancelled due to war clauses (Pillsbury, 2026).

After a slight increase during the military build-up, global prices in crude oil have spiked following the beginning of the conflict, to reach a record 120 United States Dollars/Brent Barrel (USD/Bbl) on the 20th of March (more than 80% increase from the 2026 average prior to the conflict), after which it stabilized at around 95 USD/Bbl on the 8th of April, when a ceasefire was agreed. Gold and silver prices also sharply increased, after initially decreasing throughout the beginning of 2026, given the investor reorientation for *safe heaven* assets (Trading Economics, 2026). The fertilizer market, especially nitrogen-based fertilizers, also saw a 40% increase in prices due to the fact that ammonia, urea and phosphates could not be traded through the Strait (CSIS, 2026).

Though we can only speculate at this point on exactly when and how the conflict will be over, prognosis from the World Trade Organization (WTO) confirms that, if global oil prices remain high throughout the year, this would impact the 2026 forecasted GDP growth of 2.9% by as much as 0.3%, with some regions being hit worse than the others (WTO, 2026). Oxford Economics is even more pessimistic, stating that a quick reopening of the Hormuz Strait would still take up to 6 months to reach the initial traffic and the global GDP growth could be reduced

to 1.4%, also adding that a prolonged war could tip the global economy into recession, comparable to the pandemic or the world financial crisis (Oxford Economics, 2026).

The International Energy Agency (IEA) has taken active measures to stabilize the soaring fuel prices, including releasing 400 million barrels form member emergency oil reserves in March 2026 and has provided a 10 point plan for oil demand reduction (IEA, 2026), but with little potential to fix the long term situation.

Unlike the case of conflicts in the previous century, effects are more than transnational, they are global.

The most immediate impact was that on the belligerents and neighboring states. Iran's economy, already crippled by the years of international sanctions, has now faced significant downward pressure caused by the severe industrial damage, attacks on infrastructure, hyperinflation and food crisis (Fortune, 2026).

Like Iran itself, Arab states of the Persian Gulf rely heavily on the Strait of Hormuz for both exporting the products of their oil industry and for importing, mostly food products (Goldman & Sachs, 2026). Halting traffic through the strait had a strong impact on the Gulf Cooperation Council economic model, to which we can add the destruction of oil and port infrastructure caused by Iranian missiles and drones and the halt of investments due to Iran's threat to target data centers and other major Western and Chinese investments in the Gulf Region. Higher borrowing costs for these countries will add to the economic burden (UNCTAD, 2026). A major source of income, tourism in the entire vicinity, including the Eastern Mediterranean, has taken a significant blow. This might be prolonged by an aviation crisis, initially local, caused by security concerns, and with possible global longer term implications, due to the unavailability and increasing prices of kerosene-derived products which cannot be managed by increasing air transport fares alone (BBC, 2026).

In this context, the Gulf States are accelerating projects to by-pass the Hormuz Strait, through pipeline expansion or freight rails through Jordan. Some alternatives have been exploited by Saudi Arabia and the United Arab Emirates, but with limited success on the overall decline in oil and LNG exports (CNN, 2026).

The US is also paying for the cost of war, to such an extent that it even partially waived sanctions for Iranian and Russian oil during the war, in order to keep the global prices at a manageable level. This is because the rising global price has indirectly affected the US, even if it is not directly dependent on oil from the Gulf. The Unites States' limited military operation in Venezuela and the following open talks with the new and more favorable Caracas leadership have secured alternative energy supply chains in the wake of the intervention in the Middle East. Even so, prices for gas in the US have risen by almost 40% since the beginning of the war, influencing consumer behavior, who are spending less on other goods as gas eats up a bigger share of household budgets (Hyatt, 2026). But oil is just a part of the equation. On September 17, Belarus announced that it would release 250 political prisoners, as part of an agreement with the US, who would lift sanctions for 3 Belarusian companies that export certain fertilizer ingredients. This shows the efforts made to contain a food crisis and the existing fear of inflation, given the Federal Reserve's limited ability to simultaneously fight supply-driven inflation and support growth. It is also noted that Oxford Economics also cut its forecast for U.S. GDP growth by a third to 1.9%.

The European economies have also been significantly affected, mostly by the supply chain disruptions in oil and LNG, in the context of increased European exports to Ukraine and high winter demands which drive the need to replenish supplies. Qatar's full closure of LNG distribution after an Iranian drone strike, with no predictable date on when it would be restored, added even more pressure, as European storage levels are estimated to be below 30 percent, a five-year low. The scale and cost of this supply gap are further amplified by Europe's decision

to phase out Russian pipeline gas and LNG imports by the end of 2027, which could tumble Europe into a new energy crisis (Basquel, 2026).

A more pragmatic approach was that of China, which proved to be more resilient to the short-term crisis. Though it is unofficially considered the largest importer of Iranian oil, China has been well prepared to take the initial shock. Most of its energy needs are produced domestically. Also, China has worked intensively to diversify supply, invested in alternative non-oil reliant sources and pre-planned for a 3 months oil reserve, ensuring enough room for the economy to breathe during the conflict (McCarthy, 2026). Besides energy import, China has a significant footprint in the conflict region, with investments in ports, power plants, refineries, desalinization plants and petrochemical operations, which makes its interests in the region directly impacted by the war.

Other Asian countries are struggling to find short-term remedies, such as conservation measures for fuel and electricity and rationalizing systems in Sri Lanka and Bangladesh, or austerity measures like temporary school and other non-essential government facilities shut downs or reduced work hours in Pakistan and Nepal. Larger economies like Japan are subsidizing fuel costs to reduce the impact on consumers (Deccan Herald, 2026).

African countries have been impacted in various ways by the conflict. For Egypt, the possibility of conflict spillover and the reduction of traffic on the Suez Canal have been cumulative with the effects of initial effects of rising oil prices (Associated Press, 2026). Other countries, like Ethiopia have suffered severe price shocks, due to their reliance on imported refined petroleum. Some of the poorest countries in Africa are already bearing the brunt of the rising prices in fertilizers, given the shortages in raw materials and the increase in energy prices. Sudan gets 54% of its sea borne fertilizers through the Straits of Hormuz and its war-torn economy is foreseen as being the most affected by the crisis, along with other developing nations like Tanzania, Somalia, Kenya or Mozambique. African oil and gas exporters, such as Nigeria and Angola, may see some short-term benefits for the situation, but the impact of rising energy prices on households will limit those benefits (UNCTAD, 2026).

One of the unlikely beneficiaries from the Iran war seems to be the Russian Federation. After years of crippling sanction for the US, European Union and allies, corroborated with Ukrainian attacks on oil infrastructure, which took a heavy toll on oil and gas exports from the Russian Federation, the temporary wavering of these sanctions by the US, along with the high global prices and demand, have brought the net value of exports in April 2026 back to pre-2022 levels (Chattam House, 2026), which could further fuel the war effort in Ukraine. It is not clear though if sustained high oil prices will not have severe long-term consequences on the Russian economy, due to a sustained decline in oil demand, especially if this drives a subsequent global and systemic collapse in oil and commodity prices.

4. CONCLUSIONS

Unlike the optimistic models foreseen at the turn of the century, the contemporary world is seeing a surge in violent conflicts. The global consequences of these wars tend to be far worse than those traditionally envisioned. Beyond the human toll, destruction of infrastructure and adverse effects on national economies, a number of factors are making today's wars resound around the world. The high global interdependence, complex and transnational supply chain system and global nature of commodity markets means that virtually no country is insulated from the rippling effects of large scale conflicts.

The impact seems to be multi-layered, as one dis-balance between demand and offer leads to price spikes and fractures, while also dis-balancing other complex economic systems. After the global economic crisis, COVID pandemic and the Russian invasion in Ukraine, the

Middle-East conflict seems to be the latest example of how fragile these intricate systems are and how easy they can break under pressure.

Individual countries and even powerful regional organizations like the EU seem unable to cushion the immediate shocks, while sectorial organizations, such as the IEA, can only do damage control to a certain extent.

Developing economies, such as the ones in Africa and South Asia, have the least resources to confront the fallout and they also endure the most long-lasting effects, some of them with extreme social, political and economic implications, even if they are not directly involved in the conflict itself.

The global players will probably have to analyse deeper the real cost of waging war, as it is becoming more difficult to have an accurate prognosis on the insidious aftermath that it brings. Ideally, this will dissuade states from engaging in war and encourage them to develop more efficient international mechanisms for settling disputes.

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