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The German Automotive Industry under Geo-Economic Pressure: From Hegemony to Structural Vulnerability

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Abstract: While the automotive industry has historically been at the core of Germany's economic strength and acted as a major driver of the country's export performance, it now reveals some of the most significant challenges facing the national growth model. Against this backdrop, the article examines how the traditional advantages of Germany's automotive industry have gradually turned into structural vulnerabilities, arguing that its current difficulties cannot be reduced to a cyclical downturn or to a delayed transition to electromobility and digitalisation. Instead, this evolution reflects a more profound transformation in the factors that have long sustained German manufacturing performance. Conventional sources of industrial advantage, such as engineering specialisation, export orientation, extensive integration into global value chains, and reliance on dynamic foreign markets, have become channels of exposure amid the recent intensification of geo-economic rivalry, China's rise in the electric vehicle sector, the resurgence of U.S. industrial policy, and the reconfiguration of global technology chains. Drawing on evidence related to gross value added, employment, foreign trade, vehicle production, and the shift towards electromobility, the paper highlights the progressive weakening of the long-standing pattern of German automotive performance. The analysis concludes that the German automotive industry is not merely undergoing a phase of sectoral adjustment, but has entered a broader process of strategic recalibration, whose outcome will shape Germany's ability to preserve its position as a major manufacturing power in an increasingly fragmented world economic order.

Keywords: German automotive industry; geo-economic rivalry; structural vulnerability; electromobility; global value chains; industrial policy; strategic recalibration
JEL Classification: L62; L52; O33; F14

1. Introduction

In the early years following the Second World War, the automotive industry established itself as one of the emblems of the broad process of reconstruction and economic reconfiguration initiated in West Germany, becoming a genuine anchor of the country's renewed identity and of the later achievement of the "economic miracle" (Koehler, 2010). The sector underwent rapid development, fuelled by sustained technological modernisation, the consolidation of industrial capacities and the refinement of a productive ecosystem grounded in engineering excellence, quality and rigour. These factors decisively positioned Germany as a benchmark of European and international manufacturing competitiveness at the time. In the subsequent decades, German-made automobiles came to be regarded as symbols of technical reliability and industrial performance, while the automotive sector evolved into one of the primary drivers of export-oriented growth, thereby consolidating the German economy as a major actor in the architecture of global trade (Tolliday, 1995).

This historical position was not, however, the result of a simple accumulation of productive capacity, but rather the expression of a complex industrial model, founded on technological specialisation, integration into increasingly extensive value chains and the consolidation of competitive advantages associated with high value-added segments. Thus, beginning in the 1980s[1] and, especially, following German reunification, the automotive industry entered a phase of progressive internationalisation, marked, in a first stage, by the externalisation of

[1] In the 1980s, the expansion of West German automotive industrial networks was directed primarily towards Southern Europe, especially Spain and Portugal, following their accession to the European Economic Community (EEC). At the same time, the previously established partnership with Italy was consolidated during this period, particularly in the automotive components segment.

certain production segments and the regionalisation of industrial chains within Europe (Spatz & Nunnenkamp, 2004). Thereafter, as German producers expanded their presence in the dynamic markets of the global economy, productive activities were gradually integrated into more complex transnational networks, while the technological core and strategic command functions were maintained in Germany. In this way, Germany assumed a pivotal role in orchestrating continental value chains within the automotive sector (Sturgeon, Van Biesebroeck, & Gereffi, 2008).

However, in recent years, this historically consolidated architecture has entered a phase of structural vulnerability. The technological transformations associated with electromobility and digitalisation, China's rise as a major automotive competitor, the revival of U.S. industrial policy and the reconfiguration of global value chains have modified the conditions that had sustained the performance of the German automotive industry for decades. In an economic order marked by mounting geo-economic rivalry, global interdependence no longer functions exclusively as a source of efficiency and expansion; rather, it is becoming a source of systemic vulnerability. Under the impact of these shifts, engineering specialisation, export orientation, deep integration into international production networks and dependence on dynamic foreign markets, which were previously the cornerstones of sectoral strength, have gradually turned into vectors of fragility.

Against this backdrop, the present article analyses the causes that have led to the transformation of the traditional advantages of the German automotive industry into structural vulnerabilities, based on the hypothesis that the sector's current difficulties cannot be interpreted as a cyclical downturn or as a simple delay in the transition towards electromobility and digitalisation. Instead, they signify a more profound transformation of the German manufacturing paradigm, in which the long-standing mechanisms of industrial performance require recalibration in relation to the new conditions of global competition. From this standpoint, the automotive industry no longer represents merely a strategic sector of the federal economy, but a critical test of Germany's capacity to reconfigure its productive base, preserve its technological advantages and maintain its position as a major manufacturing power in an increasingly fragmented international economic order.

The analysis is based on the examination of several indicators relevant for capturing the recent transformations of the sector: the evolution of gross value added (GVA), employment dynamics, foreign trade performance, vehicle production and the transition towards electromobility. This approach allows for a simultaneous assessment of the continuities and ruptures that define the current stage of transformation of the German automotive industry. The article is structured around two main directions: first, the assessment of the contemporary economic relevance of the German automotive industry and of the structural vulnerabilities that have come to the fore in recent years; second, the analysis of the mechanisms through which its traditional advantages have become channels of exposure, thereby imposing the need for a broad strategic recalibration.

2. Literature review

The existing literature on the German automotive industry has traditionally emphasised its pivotal role in the consolidation of Germany's post-war industrial model, export-oriented growth and manufacturing competitiveness. Historical and business-history analyses show that the sector's rise was not merely the result of accumulated productive capacity, but reflected a broader industrial architecture based on engineering excellence, technological specialisation, quality and close coordination between firms, suppliers and international markets (Tolliday, 1995; Koehler, 2010). At the same time, studies on global value chains have highlighted the internationalisation of German automotive production and the capacity of German manufacturers to coordinate transnational production networks while maintaining high-value strategic functions within Germany (Spatz & Nunnenkamp, 2004; Sturgeon, Van Biesebroeck, & Gereffi, 2008). More recent contributions, however, point to the growing fragility of this model under conditions of geo-economic rivalry, technological disruption and the transition towards electromobility. Openness, export dependence and deep integration into global value chains, formerly regarded as sources of efficiency and expansion, increasingly appear as channels of exposure and vulnerability (Krpata, 2021; RSM Ebner Stolz, 2025; Puls, 2024). This diagnosis is also supported by recent institutional analyses, which show that German automotive production and exports have fallen in volume terms, while higher prices, better-equipped vehicles and the shift towards high-value activities have only partially compensated for weaker sales volumes and declining domestic production (Heymann, 2026). At the same time, research on the "dual transformation" of the automotive industry emphasises the redistribution of value added towards batteries, electronics, software, data services and connected mobility systems, as well as the consequences for employment, skills and industrial policy (Brown et al., 2021; Boewe & Schulten, 2023; Krzywdzinski, Lechowski, Ferdinand, & Schneiß, 2022; Expert Group Transformation of the Automotive

Industry, 2024; Nettekoven, 2023). Building on these contributions, the present article develops an interpretative framework that understands the current difficulties of the German automotive industry not as a cyclical downturn, but as part of a broader process in which historical competitive advantages are being transformed into structural vulnerabilities.

3. Methodology

The article employs a qualitative and data-driven analytical approach, integrating structural interpretation with the examination of sectoral indicators relevant to the transformation of the German automotive industry. The empirical analysis is supported by a range of official statistical and institutional sources, including Eurostat, the Federal Statistical Office of Germany (Destatis), the German Association of the Automotive Industry (VDA), the International Organization of Motor Vehicle Manufacturers (OICA), the European Automobile Manufacturers' Association (ACEA), the International Energy Agency (IEA) and specialised policy reports. The period under review extends from 2010 to 2025, depending on data availability. The selected indicators capture several dimensions of sectoral performance and vulnerability, including gross value added, employment dynamics, foreign trade performance, domestic and international vehicle production, and the transition towards electromobility. Rather than treating these variables as isolated statistical series, the analysis interprets them as interconnected expressions of a broader transformation of the German productive model. This approach makes it possible to identify both continuities, such as the persistent economic relevance and export strength of the sector, and ruptures, such as the weakening of the domestic production base, the restructuring of employment, the trans-nationalisation of value creation and the growing dependence on software, digital infrastructures and electric mobility ecosystems.

4. The German automotive industry: strategic relevance and structural vulnerability

Although the automotive industry still retains its multifaceted strategic relevance within Germany's productive system, having been regarded for decades as a true "backbone" of national industrialism (Puls & Fritsch, Eine Branche unter Druck: Die Bedeutung der Autoindustrie für Deutschland, 2020), precisely this density of competences and interdependencies has rendered it an epicentre of systemic vulnerabilities. The recent erosion of globalisation, the reconfiguration of world demand in the premium segment[2] and the shift in performance criteria towards technology, efficiency, digitalisation and speed of innovation have profoundly altered the traditional coordinates of German automotive competitiveness (Puls, 2024).

Consequently, although the automotive sector maintains its position as a defining component of the federal economy and as a reference point of German industrial identity, the technological and geo-economic transformations of the last decade have significantly changed its relationship with the overall economy. Beyond its historical role in generating value added, employment and exports, the automotive value chain is currently undergoing a broad process of structural transformation, in which performance no longer derives exclusively from high-end engineering quality and integration into global production chains, but increasingly from the capacity to adapt to the new paradigms of mobility, digitalisation and sustainability. This transition does not entail a quantitative decline in the economic importance of the automotive industry, but rather a qualitative transformation of the internal balance of the German productive model. The primary factors driving this transformation are the increasingly complex European regulatory agenda, combining objectives of decarbonisation, digitalisation and industrial standardisation, and the intensification of global competition for technological dominance. Taken together, these developments have reshaped the sector's value-added equation, both internally and externally.

A close examination of developments over the 2010–2024 period reveals the complexity of the evolving role of the automotive industry within the German economy. Beyond cyclical fluctuations and conjunctural

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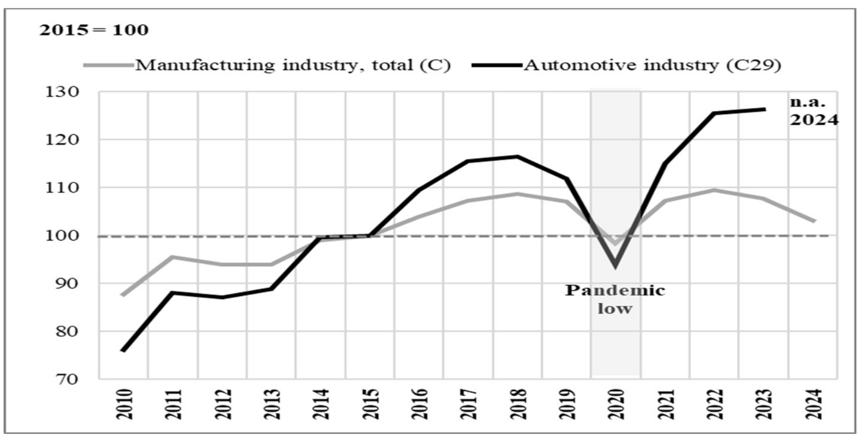
[2] In the automotive industry, the premium segment refers to vehicles with high embedded value added, advanced technological content, superior quality and strong brand positioning (Krzywdzinski, Lechowski, Ferdinand, & Schneiß, 2022; Puls, 2024). While this segment has long supported the competitive strength of German car manufacturers, its sustainability is increasingly challenged by electric mobility, software integration, faster innovation cycles and the rise of Chinese manufacturers (RSM Ebner Stolz, 2025).

tensions, the sector remains one of the key pillars of the federal productive architecture, exerting, through an extensive network of producers and suppliers, a strong spillover effect on value added, employment and exports. However, recent dynamics point to increasingly visible signs of fragility in the traditional performance model, reflected in the decline of domestic production from the late 2010s, the gradual relocation of manufacturing capacities to China, and the deepening dependence on this market. It is precisely at this intersection between continuity and vulnerability that the meaning and direction of the strategic recalibration of the German automotive industry are ultimately defined.

To assess the scale and nature of these transformations, the analysis focuses on three core dimensions of the automotive industry: its contribution to GVA, employment dynamics and foreign trade performance. This methodological approach facilitates the identification of the qualitative changes that have occurred within the structure of the German industrial model, whilst also providing the empirical basis required to evaluate the sector's contemporary strategic significance.

The examination of gross value added, a relevant indicator of the automotive industry's real contribution to domestic production and to the consolidation of the national industrial base, reaffirms its central role in Germany's economic dynamics. From 2010 to 2023 (the latest year for which C29[3] data are available), the GVA trajectory reveals not a linear decline, but an alternation of expansion, shock-induced contraction and subsequent recovery, reflecting both the regenerative capacity and the degree of vulnerability of the German productive model (see Figure 1).

Figure 1: Real gross value added in the automotive industry and total manufacturing industry in Germany, 2010–2024[1),2)]



Source: Author's representation based on Eurostat data (2026), code: *nama_10_a64 – Gross value added and income by detailed industry (NACE Rev. 2)*;
Notes: [1)] Chain-linked volumes, 2015 = 100; [2)] Data for the German automotive industry (C29) are not available for 2024, the latest available observation refers to 2023.

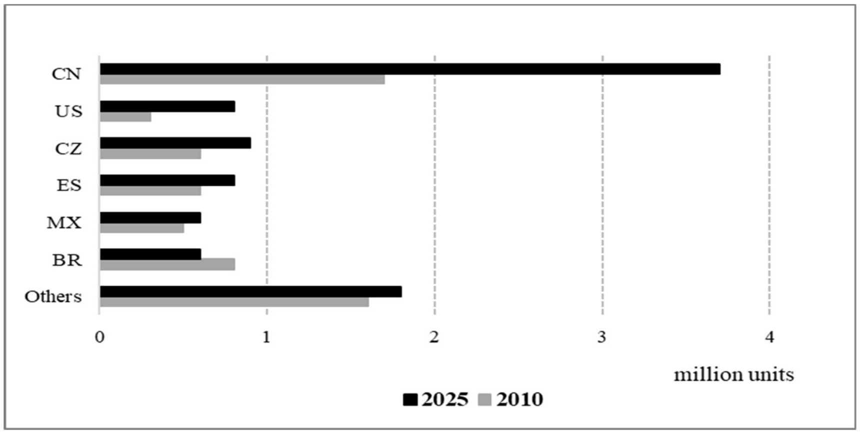
In the early years of the period under review, the automotive industry remained below the performance of total manufacturing[4], a development that may be associated with the lingering effects of the sovereign debt crisis, which affected European demand for motor vehicles and delayed the recovery of exports. As the euro area gradually stabilised after 2013, the automotive industry closed the earlier gap, reaching the 2015 benchmark, after which it entered a phase of pronounced expansion and emerged as a major vector of industrial growth, thus reaffirming its role as a pivotal sector of the German economy.

The pronounced expansion recorded between 2015 and 2018, fuelled by external demand and the development of high value-added segments, confirmed, in value-added terms, the prominent position of the automotive industry within the national industrial architecture. However, this period also marked a subtle but decisive change in the paradigm of industrial performance. The focus shifted from volume and manufacturing integration to the structural refinement of production through technological upgrading, innovation and the consolidation of export-

[3] C29 refers to the NACE Rev. 2 division "Manufacture of motor vehicles, trailers and semi-trailers", used here as the statistical approximation of the automotive industry.
[4] The faster recovery of total manufacturing was supported by other industrial branches, especially those serving the domestic market and/or segments with more stable demand, such as chemicals and electrical equipment.

oriented premium segments (Falck, Ebnet, Koenen, & Dieler, 2017; Krzywdzinski, Lechowski, Ferdinand, & Schneiß, 2022). At the same time, the redirection of investment towards Asian markets, notably China, initiated a new form of external dependence, whereby the source of expansion gradually shifted from the domestic base towards foreign production networks. This shift is reflected in the fact that passenger car production abroad by German manufacturers has more than doubled in China since 2010, making it by far their most important foreign production location by 2025 (Heymann, 2026) [See Figure 2].

Figure 2: Passenger car production abroad by German manufacturers, 2010 and 2025 (million units)



Source: Author's representation based on data published by German Association of the Automotive Industry (VDA, 2026); International Organization of Motor Vehicle Manufacturer (OICA, 2026); CEIC Database (2026).

This externalisation of production does not contradict the strong GVA performance observed in Germany during the pre-pandemic expansion phase (2015–2018), but rather, it points to the increasingly transnational configuration through which German automotive value creation was sustained.

The economic downturn in 2020, triggered by the pandemic, resulted in a substantial decline in GVA. This contraction also exposed the automotive industry's strong interdependence with the Chinese market, which had deepened during the pre-pandemic expansion phase of German carmakers, particularly in the second half of the 2010s. Nevertheless, the post-pandemic recovery recorded between 2021 and 2023, supported by the rebound in exports and the acceleration of the transition towards electromobility, confirmed the sector's structural resilience and strategic role. Even in a context of compressed profitability and heightened dependence on global supply chains, the automotive industry continued to act as an essential pillar of Germany's industrial economy.

Following the examination of the trajectory of real gross value added a complementary perspective is provided by the relative weight of the automotive industry within total manufacturing and GDP. These indicators make it possible to assess not only the sector's own dynamics, but also its degree of concentration within the German economic structure, thereby showing the extent to which automotive performance continues to shape the national manufacturing base and the wider economic structure (Box 1).

Box 1: The German automotive industry's weight in manufacturing and GDP, 2010–2024[1), 2)] (%)

Figure 3: Automotive GVA as share of total manufacturing GVA, 2010–2024 (%)

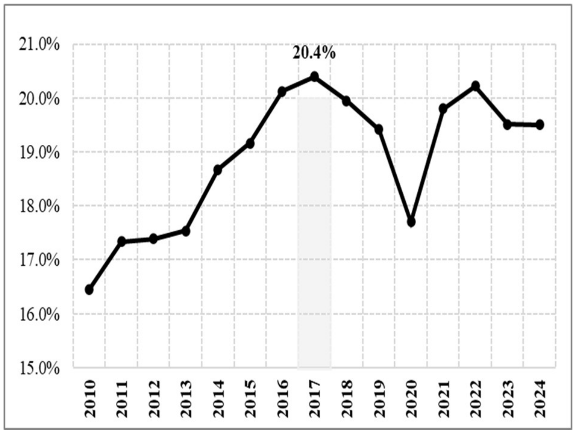
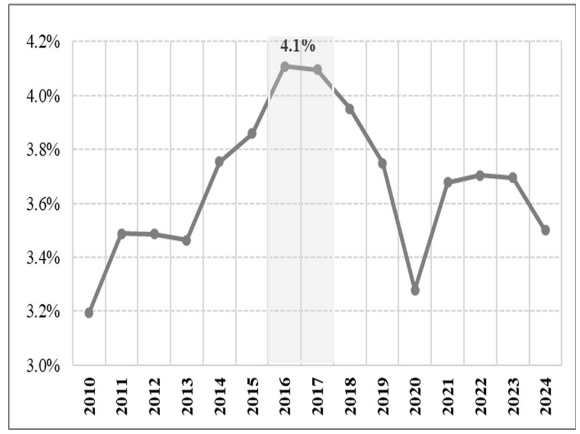


Figure 4: Automotive GVA as a share of GDP, 2010–2024 (%)



Source: Author's calculations and representation based on Eurostat data (2026), codes: *nama_10_a64 – Gross value added and income by detailed industry (NACE Rev. 2)* and *nama_10_gdp – Gross domestic product (GDP) and main components*;
Notes:[1)] Shares are calculated as the gross value added of the automotive industry relative to total manufacturing gross value added and to GDP, respectively; [2)] Latest available data at the time of writing, 2026.

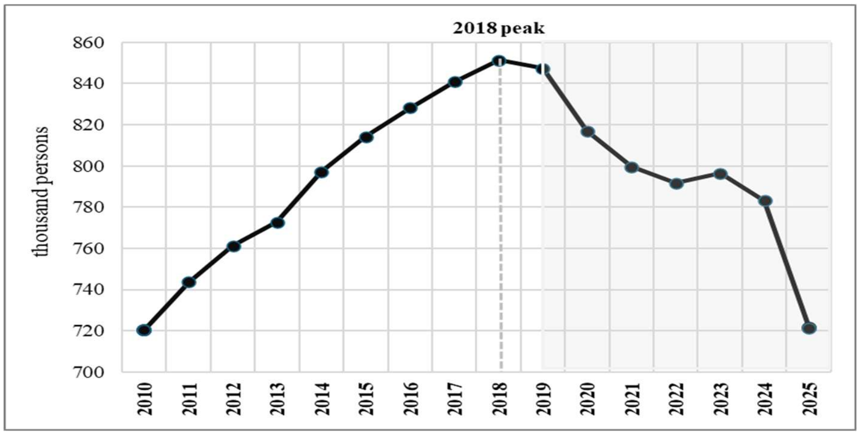
The developments summarised in Box 1 show that, despite significant fluctuations, the automotive industry has preserved substantial structural importance in the German economy. Its share in total manufacturing GVA increased from 16.5% in 2010 to more than 20% in 2017, while its contribution to GDP rose from 3.2% to 4.1% over the same period. These values illustrate not only the sector's role as a key pillar of the German productive architecture, but also the systemic risk associated with such a high degree of concentration, since any sectoral decline can rapidly propagate across the national economy.

However, the post-2017 decline points to the gradual weakening of this traditional configuration. Under the combined impact of high energy costs, productivity stagnation, the accelerated transition towards electromobility, the relocation of production capacities and China's growing competitive pressure, the German automotive industry has entered a phase of profound structural transformation (Boewe & Schulten, 2023; Krzywdzinski, Lechowski, Ferdinand, & Schneiß, 2022). Thus, the relative weight of the sector confirms both the persistence of its economic significance and the fragility generated by its concentration within the German growth model.

At the same time, China's rise in the automotive and electric mobility sectors, Sino-American trade tensions and the successive shocks generated by the pandemic and the energy crisis associated with the war in Ukraine have intensified competitive pressures and further exposed the fragility of the German industrial model. Although the sector recovered relatively swiftly after the pandemic-induced contraction, its share in GDP did not return to the peak levels recorded in 2016–2017. Nevertheless, the automotive industry remains a key reference point of German industrial performance, capable of concentrating resources, innovation and skilled labour, even in a context marked by volatility and structural adjustment.

Recent developments in employment provide insight into the profound changes that have reshaped the German automotive industry, revealing not only the intensity of technological change, but also the reconfiguration of the relationship between industry, labour and competitiveness. Following a period of sustained growth, typical of the peak years of exports and brand-oriented production, the sector entered a phase of structural adjustment driven by the "dual transformation", namely the simultaneous acceleration of decarbonisation and digitalisation processes, as well as by the relocation of a significant share of production capacities to Central, Eastern and South-Eastern European (CESEE) countries and Asia, especially China (Krzywdzinski, Lechowski, Ferdinand, & Schneiß, 2022) [see Figure 5].

Figure 5: Employment in the German automotive industry, 2010–2025 (thousand persons)



Source: Author's representation based on Destatis data (2026), cod: 42271-0002 – *Persons employed and turnover of local units in manufacturing* [WZ2008].

A close examination of the employment data reveals a change in trend, structured into three distinct phases. The number of employees increased steadily between 2010 and 2018, in line with the expansion of production and exports, reaching a peak of more than 850 thousand persons in 2018. After this point, a marked inflection in the trend became evident, associated with a prolonged phase of structural adjustment. Between 2019 and 2025, the decline in labour demand became persistent, accentuated by the effects of the pandemic, supply chain disruptions and growing pressures on production costs. By 2025, employment in the German automotive industry had returned close to its 2010 level, suggesting not merely a cyclical correction, but the substantial erosion of the employment base accumulated during the expansionary phase.

Beyond the simple arithmetic of job losses, this reorientation of employment dynamics does not simply reflect a cyclical contraction, but rather a deeper redefinition of labour demand. This transition is characterised by the gradual replacement of conventional roles in assembly and mechanical production with positions requiring more advanced digital and technological skills, particularly in electrical engineering, electronics and industrial software. The decline in employment therefore corresponds to a qualitative restructuring of the workforce, partly offset by demographic decline and by the expansion of related fields, such as battery production, charging networks and digital mobility services (Expert Group Transformation of the Automotive Industry (ETA), 2024). Overall, the employment trend indicates a transition from extensive growth to a skills- and innovation-driven pattern, in which sectoral competitiveness increasingly depends on human capital and innovative capacity.

After examining the automotive industry's contribution to value added and employment dynamics at the domestic level, particular relevance is attached to the external dimension of industrial performance, which reflects the sector's capacity to transform national productive potential into a durable trade advantage. The evolution of foreign trade reveals not only the strength of the German automotive industry's integration into international exchange, but also its role as a linking mechanism between the internal dynamics of growth and the outward projection of the national economy.

The automotive industry continued to play a structurally significant role in the external performance of the German economy, as reflected in the persistently high share of automotive exports in total exports throughout the 2010–2025 period (see Box2 / Figure 6). Following a gradual increase in the initial phase of the period under review, the share of automotive exports in Germany's total exports reached its peak in 2016, pointing to the consolidation of the industry's international specialisation in high value-added segments (German Association of the Automotive Industry (VDA), 2025).

Box 2: Foreign trade performance of the German automotive industry, 2010–2025 [1), 2), 3)]

Figure 6: Share of automotive exports and imports in Germany's total exports and imports (%)

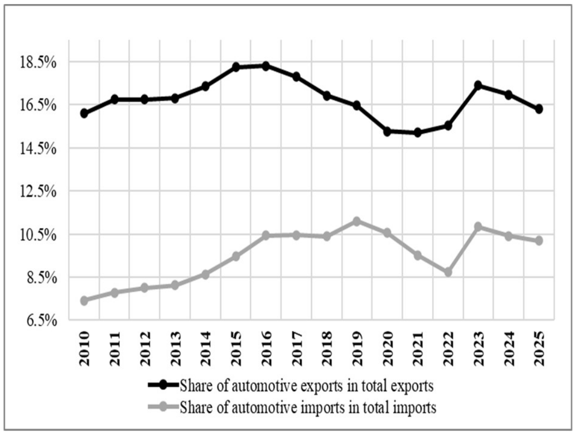
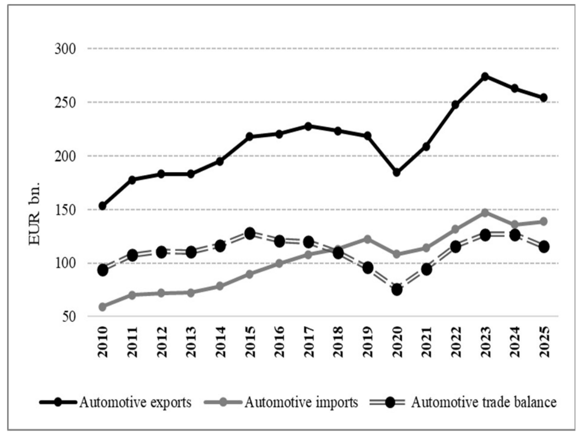


Figure 7: Automotive exports, imports and trade balance (EUR bn)



Source: Author's calculations and representations based on data published by Destatis (2026), codes *51000-0001 and 51000-0005*: Exports and imports (foreign trade): Germany, years; Exports and imports (foreign trade); Germany, years, classifications of trading goods, Foreign Trade Statistics, 2-digit code, WA87 – Vehicles other than railway or tramway rolling stock;

Notes: [1)] Shares are calculated as the value of automotive exports and imports relative to Germany's total exports and imports, respectively; [2)] Values are expressed in current prices; [3)] Data for 2025 are provisional.

The subsequent decline, particularly between 2019 and 2022, reflected the cumulative impact of major exogenous factors, such as the deterioration of U.S.-China trade relations, the acceleration of technological transition, the pandemic shock and the outbreak of the war in Ukraine. Nevertheless, the visible recovery recorded in 2023 brought the indicator back towards its historical average, confirming the structural resilience and adaptive capacity of German manufacturers, even though the values recorded in 2024–2025 suggest a stabilisation below the peak levels of the 2015–2017 period (Puls, 2024).

In parallel, the share of automotive imports in Germany's total imports followed a long-term upward trajectory, reaching a peak of approximately 11% in 2019 and returning to elevated levels after the decline recorded in 2022. This development signals, on the one hand, the sector's deeper integration into international production chains, reflected in a stronger dependence on imports of components, subassemblies and vehicles originating from external networks, and, on the other hand, the intensification of competition on the domestic market, driven by the increase in imports of finished vehicles. Consequently, the external performance of the German automotive industry remains robust, but it is supported by an increasingly trans-nationalised production architecture, in which the export advantage coexists with greater exposure to value-chain fragmentation and international competition.

Data on exports, imports and the trade balance confirm the same structural ambivalence (See Box 2 / Figure 7). Automotive exports remained high in nominal terms, while the industry's trade surplus stayed substantial throughout the period under review, exceeding EUR 120 billion in 2023 and 2024, before declining to approximately EUR 116 billion in 2025. This evolution confirms the sector's role in supporting the external position of the German economy. Nevertheless, the increase in imports and the volatility of the trade balance after 2019 show that external performance can no longer be interpreted exclusively as the expression of uncontested industrial superiority, but rather as the outcome of a complex insertion into a global production system increasingly exposed to technological reconfiguration, trade fragmentation and geo-economic competition.

The synthesis of developments observed across the three defining pillars – gross value added, employment dynamics and external performance – provides a complex picture of the German automotive industry, marked by an increasingly pronounced structural dissonance. Although the indicators continue to confirm its central role within the national industrial architecture, post-2018 trends reveal a gradual weakening of the traditional performance model. The apparent resilience of the sector conceals a deeper reconfiguration of the growth paradigm, driven by technological disruption, recurrent economic shocks and mounting geopolitical pressures, which have transformed the sector's historical competitive advantage into a source of systemic vulnerability. Consequently, to capture the broader implications of this transformation, the following section examines the causal mechanisms and structural effects that define the fracturing of the German export-oriented growth model.

5. From competitive advantage to systemic vulnerability

Viewed against the backdrop of the processes examined above, the evolution of the German automotive industry reveals a fundamental paradox of industrial modernity. The very mechanisms that, for decades, underpinned its performance, stability and rise, namely technological specialisation, global integration and a pronounced export orientation, are gradually transforming into sources of systemic vulnerability. Behind the apparent balance between value added, employment and external performance, a dynamic of structural tension is taking shape, driven simultaneously by the intensification of external pressures, the erosion of the domestic production base and the acceleration of technological transformation.

This metamorphosis of competitive advantage does not point to a cyclical crisis, but to the progressive fracturing of the industrial paradigm that established Germany as the leader of European automotive production. The relocation of production centres, the decline of domestic volumes and the reconfiguration of value chains under the impact of electromobility and digitalisation indicate the end of a historical cycle. In place of the old expansion model, which was based on volume, engineering excellence and manufacturing integration, an economy of adaptation is taking shape. In this new economy, performance increasingly depends on the capacity for strategic reconstruction.

5.1. From global integration to geo-economic exposure

A first manifestation of the structural vulnerability of the German automotive industry lies in the erosion of the global architecture that served, for several decades, as both its frame of reference and a driver of performance. The German export model, built on the principles of economic liberalisation, the optimisation of value chains, the reduction of trade barriers and the maximisation of productive efficiency, is currently facing a profound reversal of the very logic that ensured its success. Liberalisation, once a guarantee of expansion, has become a source of exposure, while global interdependence, formerly an advantage, has turned into a systemic risk.

This structural shift marks the transition from the open economy of classical liberalism to the strategic economy of geo-economics, "in which economic development worldwide is not driven by market liberalisation and the globalisation of supply chains, but rather by the pursuit of economic superiority and political dominance" (RSM Ebner Stolz, 2025, p. 3). In the context of contemporary geopolitical dynamics, in which states increasingly use economic instruments to achieve geopolitical objectives, the German export model, founded on openness, interdependence and access to dynamic markets, has become increasingly vulnerable. As Krpata (2021) observed, its traditional role as a driver of European industrial hegemony is transformed into the "Achilles' heel of the national economy".

This change in the global economic regime has concrete effects on the material base of the automotive industry. The decline in production volumes within Germany (see Table 1 and Figure 8) signals a shift in the centre of gravity from manufacturing production towards design, coordination and R&D functions. This reorientation is driven on the one hand by the deterioration of structural competitiveness factors, the rise of global protectionism, high energy costs and excessive domestic bureaucracy, and on the other by the imperative of proximity to dynamic markets and easier access to resources (Expert Group Transformation of the Automotive Industry (ETA), 2024; Puls, 2024).

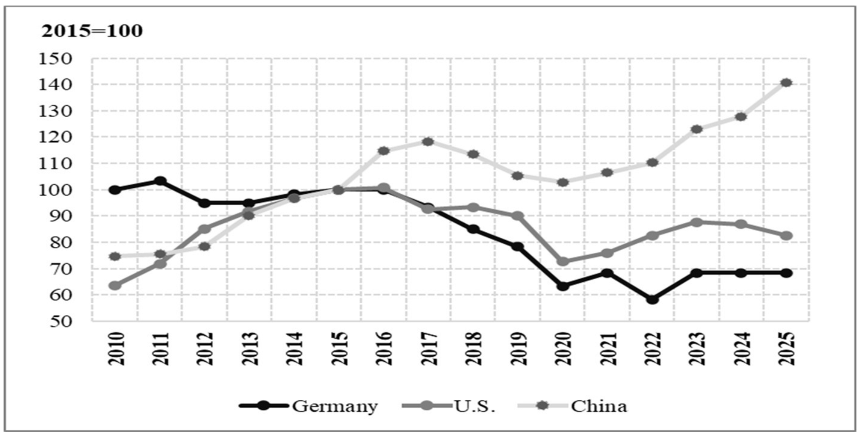
Table 1: Domestic motor vehicle production in Germany, the United States and China, 2010–2025[1), 2)]
(million units)

	Germany	United States	China
2010	6.0	7.7	18.3
2011	6.2	8.7	18.5
2012	5.7	10.3	19.2

	Germany	United States	China
2013	5.7	11.1	22.1
2014	5.9	11.7	23.7
2015	6.0	12.1	24.5
2016	6.0	12.2	28.1
2017	5.6	11.2	29.0
2018	5.1	11.3	27.8
2019	4.7	10.9	25.8
2020	3.8	8.8	25.2
2021	4.1	9.2	26.1
2022	3.5	10.0	27.0
2023	4.1	10.6	30.1
2024	4.1	10.5	31.3
2025	4.1	10.0	34.5

Source: Author's compilation based on data published by the International Organization of Motor Vehicle Manufacturers (OICA, 2026), the European Automobile Manufacturers' Association (ACEA, 2026) and the German Association of the Automotive Industry (VDA, 2026);
Notes: [1)] Values refer to domestic motor vehicle production (including passenger cars and commercial vehicles), expressed in million units; [2)] Figures are rounded to one decimal place.

Figure 8: Diverging trajectories of motor vehicle production in Germany, the United States and China, 2010–2025 (2015 = 100)[1)]



Source: Author's representation and calculation based on data published by the International Organization of Motor Vehicle Manufacturers (OICA, 2026), the European Automobile Manufacturers' Association (ACEA, 2026) and the German Association of the Automotive Industry (VDA, 2026);
Note: [1)] Values are volume indices (2015 = 100), calculated based on domestic motor vehicle production, including passenger cars and commercial vehicles, expressed in million units.

The available data on motor vehicle production confirm the gradual weakening of Germany's role within the global production architecture. Following a period of relative stability between 2010 and 2017, the German automotive industry entered a phase of persistent contraction, followed by only a partial recovery after the pandemic shock. The stabilisation of production on a plateau below the pre-2018 level suggests that this break in trend cannot be interpreted as a simple cyclical fluctuation, but rather as an erosion of the domestic production base, associated with rising energy costs, shortages of highly skilled labour and the relocation of facilities to other production centres (Puls, 2024).

In contrast, China has continued a process of large-scale industrial expansion, demonstrating its systemic capacity for the vertical integration of value chains, control over intermediate production and the internalisation of segments with high embedded technological content (Germany Trade & Invest (GTAI), 2025). This evolution marked the shift of the centre of gravity of the global automotive industry towards Asia, where volume growth has been combined with direct political support and strategic control over critical resources, particularly in batteries and critical raw materials. The United States followed a different trajectory, seeking to mitigate the limits of its production capacity by directing investment towards high-value-added sectors, including microelectronics, software and electric mobility.

Taken together, these developments describe a profoundly reconfigured industrial world: Germany, once synonymous with engineering excellence, is increasingly moving towards an economy of coordination and design; the United States increasingly resembles an economy of selection and specialisation; while China has evolved into an economy of scale and integration. Consequently, the production indicator reflects a structural reconfiguration of the global competitiveness model, in which manufacturing strength no longer derives solely from efficiency, but from strategic control over the entire productive ecosystem (RSM Ebner Stolz, 2025).

5.2. From mechanical excellence to electric and digital mobility

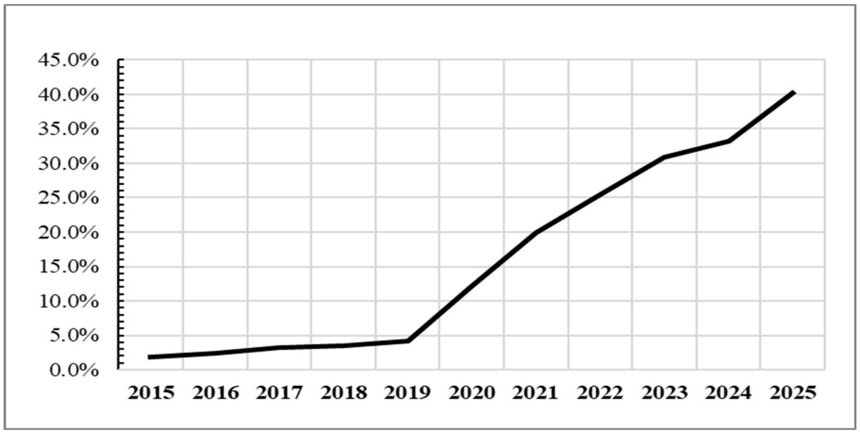
The second dimension of the weakening of the German model is internal and results from the profound transformation of the structure of value added. Over the last decade, the centre of gravity of industrial performance has shifted from traditional mechanical engineering towards integrated electronic systems, software and data management technologies, generating a structural mutation in the business model of automotive manufacturers (Boewe & Schulten, 2023).

This change does not represent merely a transitional stage of modernisation, but a fundamental reconstruction of the automotive product itself. For decades, Germany's competitiveness rested on the engineering excellence of the internal combustion engine and on the superiority of manufacturing processes. In the contemporary technological landscape, however, value added is increasingly generated in the domains of software, integrated electronics, connectivity and digital services, progressively reducing the relevance of conventional mechanical components.

This shift of value towards the digital domain modifies the balance of power within the global value chain. The expansion of connected vehicles and automated driving systems is transferring a growing share of control over innovation processes and data flows towards global technology actors, particularly those based in the United States and China. The absence of a sufficiently developed European and German information technology sector accentuates the structural dependence of automotive manufacturers on extra-EU suppliers, which already hold dominant positions in software infrastructure, digital mapping, data analytics, battery production and electronic components.

Germany's transition towards electromobility accelerated significantly after 2020, following a prolonged period of stagnation between 2015 and 2019 (see Figure 9). However, this increase, although remarkable as a share of total passenger car production, reveals a structural lag when measured against the pace of transformation imposed by the global market and by intense competition from Asia. The scale of this asymmetry becomes particularly visible when Germany is placed against the global production landscape: in 2024, China produced 12.4 million electric cars, compared with approximately 1.4 million in Germany, and accounted for more than 70% of global electric car production, confirming its position as the main manufacturing hub of electric mobility (International Energy Agency (IEA), 2025). Against this background, Germany's progress remains insufficient to compensate for the decline in traditional production and to secure a superior competitive position in a context in which China and the United States have already consolidated industrial ecosystems dedicated to electric mobility.

Figure 9: Share of electric vehicles in total passenger car production in Germany, 2015–2025 [1), 2)] (%)



Source: Author's representation and calculations based on monthly data published by the German Association of the Automotive Industry (VDA, 2026);
Notes: [1)] For the years prior to 2015, electric vehicle production was statistically insignificant, accounting for less than 1% of total passenger car production; [2)] The category "electric vehicles" (EVs) includes battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs).

This structural discrepancy highlights the difficulty of aligning the German automotive hub with the dynamics of global transformation, turning the transition effort from a potential source of competitive advantage into an additional factor of short-term vulnerability. In this sense, the digitalisation of the automotive industry is not merely a technological test per se, but also an institutional one, which will determine whether the transition can be converted into a new competitive advantage or whether, on the contrary, it will deepen existing structural dependencies (Brown, et al., 2021).

However, the efforts to develop domestic software capabilities are constrained by a structural shortage of qualified human resources, as the share of the workforce with advanced digital skills remains below the EU average. This incongruity between the industry's strategic objective of closing gaps "in all key areas of value creation" and the effective capacity to develop human capital accentuates the digital capability gap and limits the speed of industrial adaptation (Expert Group Transformation of the Automotive Industry, 2024, p. 10).

Overall, the internal reconfiguration of industrial performance marks the transition from a mechanically driven production model to a digital-systemic one, in which competitiveness depends on the capacity to integrate hardware, software and data-based services into a unified, scalable and updatable product. This transition is not merely a technological process, but rather a shift in the economic paradigm through which the German automotive industry is redefining its position within the global value chain. In the absence of strategic coordination between public policy, industrial strategies and vocational training programmes, Germany risks preserving its engineering performance while losing control over the core of value added in the automotive industry.

6. Strategic reconstruction and the imperatives of industrial resilience

In the contemporary context, the German automotive industry is confronted with a triad of challenges: the erosion of the domestic manufacturing base, the intensification of global competitive pressures and the acceleration of technological transition. In such circumstances, the strategic imperative can no longer be framed in terms of preserving the old performance model, but rather in terms of its recalibration. The transformations examined above, namely the decline in domestic production volumes, the weakening of engineering-based advantages, the widening gap in digital skills and the shift of value added towards software, electronics and data services, all point to the same conclusion: industrial resilience can no longer derive from the inertia of historical competitiveness, but from the capacity for structural reorganisation, the re-anchoring of value added and the redefinition of the relationship between industrial policy, innovation and the material foundations of production. In this new context, the automotive industry becomes the arena in which the limits of the established paradigm are tested, and the premises of a new industrial model begin to take shape. The previous model can no longer be sustained through successive adjustments or through the mere prolongation of historical advantages. Instead, it requires the consolidation of technological autonomy, securing critical segments of the value chain and reconstructing endogenous innovation capacity. Without a strategic repositioning of key industries, Germany risks not only an episodic weakening of its industrial position, but also the loss of control over the core of value added. This risk becomes particularly acute at a time when geo-economic competition is transforming the automotive industry into a strategic domain of economic power (IPE Institut für Politikevaluation GmbH, Institut für Kraftfahrzeuge, RWTH Aachen University & Roland Berger GmbH, 2020; RSM Ebner Stolz, 2025).

The reconstruction agenda must be built around two interdependent components. The first concerns the restoration of the internal capacity for value creation, through the recovery of control over the decisive technological segments that define the vehicle of the future: microelectronics, advanced electronics, software, digital infrastructures and energy systems associated with electromobility. In these areas, dependence on extra-European actors, high imports of specialised components and the concentration of key capacities in Asia have reduced Germany's ability to retain full control over the technological core of the automobile of the future. The reconstruction of this pillar requires not only investment in research, prototyping and testing, but also the formation of a coherent ecosystem in which European and federal initiatives, competence centres, suppliers, universities and automotive manufacturers operate within a common architecture of innovation (Nettekoven, 2023; Boewe & Schulten, 2023; Puls, 2024).

The second component concerns the institutional, financial and organisational stabilisation of the new industrial model. Technological reconstruction, however necessary, remains incomplete without an institutional framework capable of sustaining the pace, coherence and depth of transformation. This requires mechanisms of strategic financing, the simplification of administrative procedures, a fiscal framework more favourable to productive investment, targeted support for suppliers undergoing technological conversion and the modernisation of digital, energy and logistics infrastructures. In the absence of these conditions, the German automotive industry risks remaining trapped between insufficient investment, administrative bottlenecks and the vertical fragmentation of the supplier ecosystem.

A third pivotal element of this reconstruction is human capital. The digital and electric transformation of the automotive industry requires new skills in software engineering, data analytics, electronic control systems, artificial intelligence and advanced production technologies. Without a coherent reform of vocational training, technical education and university partnerships, industrial reconfiguration remains incomplete, while the gap between the strategic objective of recovering technological value and the effective capacity to develop human resources may become a long-term structural constraint.

Overall, the industrial reconstruction of the German automotive sector cannot be reduced to a simple process of technological adaptation. It implies a systemic recalibration of the productive model, in which competitive advantage must be rebuilt through technological control, institutional coordination and the re-anchoring of value added within the national and European industrial ecosystem. Germany is not condemned to industrial decline, but neither can it preserve its position through the inertia of engineering excellence alone. The future of the German automotive industry will depend on its capacity to transform current pressures into a new competitive advantage, built on software, digital infrastructures, technological autonomy, human capital and institutional resilience.

7. Conclusion

Reconstructing the trajectory of the German automotive industry over the last decade and a half reveals a profound transformation of one of the core components of the federal industrial model. The historical competitive advantage, built on engineering excellence, manufacturing integration, specialisation in high value-added segments and export performance, is being reshaped in a context marked by intensifying global competition, the fragmentation of value chains, China's rise in electric mobility and the simultaneous pressure of digitalisation and the green transition. The weakening of Germany's position in global production, the progressive relocation of productive capacities, the compression of the employment base and the transfer of value towards software, electronics and data-based services do not point to a linear decline of the German automotive industry, but to the structural mutation of an economic model compelled to redefine the foundations of its competitiveness.

The analysis of gross value added, employment and foreign trade performance shows that the automotive industry continues to retain major structural relevance within the German economy. However, this position no longer functions exclusively as a source of strength, but also as a mechanism of systemic exposure. Although the sector remains a benchmark of industrial performance, and the automotive trade surplus continues to support Germany's external position, post-2018 developments reveal the gradual weakening of the traditional performance model, through the contraction of domestic production, the intensification of dependence on external networks, the rise in imports and the widening technological gaps relative to new global competitors.

In this context, industrial resilience can no longer derive from the inertia of historical competitiveness, but from the capacity for institutional reorganisation, technological reconstruction and the re-anchoring of value added within the national and European industrial ecosystem. German industrial policy is therefore becoming an increasingly important instrument of strategic survival, aimed at rebuilding the link between innovation, financing, productive autonomy and human capital. The success of this recalibration depends on the synchronisation of the technological, institutional and social dimensions of transformation: the capacity to generate domestic technologies, to stabilise mechanisms of financing and coordination, to support suppliers and to ensure a sustainable transition for the workforce.

Consequently, the German automotive industry is not simply approaching the end of a cycle, but the reconfiguration of a new industrial paradigm, in which performance will no longer be assessed exclusively through volume, exports or mechanical excellence, but through the degree of control over the core of value added and the ability to transform technological transition into systemic advantage. The revalidation of this sector as a pivot of European competitiveness will depend on Germany's capacity to convert its current fragility into a new form of economic power, based on technological autonomy, strategic digitalisation, human capital and industrial cohesion.

References:

[1] Boewe, J., & Schulten, J. (2023). Resilient or vulnerable? The double transformation of the German automotive industry and the consequences for employment. Are European automotive jobs resilient in the global electromobility race? (pp. 1-40). Brussels: European Trade Union Institute (ETUI). Retrieved from https://www.etui.org/sites/default/files/2024-03/06%20Germany-Automotive-Employment-trends.pdf.

[2] Brown, D., Flickenschild, M., Mazzi, C., Gasparotti, A., Panagiotidou, Z., Dingemanse, J., & Bratzel, S. (2021). The Future of the EU Automotive Sector. Luxembourg: European Parliament - Policy Department for Economic, Scientific and Quality of Life Policies. Retrieved from https://www.europarl.europa.eu/RegData/etudes/STUD/2021/695457/IPOL_STU(2021)695457_EN.pdf.

[3] CEIC Database/ISI Markets. (2026). Germany Motor Vehicle Production: Passenger Car. Retrieved from CEIC Data: https://isimarkets.com/ceic/.

[4] European Automobile Manufacturers' Association (ACEA). (2026, April). Economic and Market Report: Global and EU auto industry – Full year 2025. Retrieved from ACEA: https://www.acea.auto/publication/economic-and-market-report-global-and-eu-auto-industry-full-year-2025/.

[5] Eurostat. (2026). European Commission Database. Retrieved from https://ec.europa.eu/eurostat/databrowser/explore/all/all_themes?lang=en&display=list&sort=category.

[6] Expert Group Transformation of the Automotive Industry (ETA). (2024). Future of automotive value creation in Germany. Berlin: Federal Ministry of Economic Affairs and Climate Action (BMWK). doi:https://expertenkreis-automobilwirtschaft.de/media/pages/home/veroeffentlichungen/cee68931b4-1738665517/20250123_eta-wertschopfung-a4_engl_final.pdf.

[7] Falck, O., Ebnet, M., Koenen, J., & Dieler, J. (2017). Auswirkungen eines Zulassungsverbots für Personenkraftwagen und leichte Nutzfahrzeuge mit Verbrennungsmotor. München: ifo Institut. Retrieved from https://www.ifo.de/DocDL/ifo_Forschungsberichte_87_2017_Falck_etal_Verbrennungsmotoren.pdf.

[8] Federal Statistical Office of Germany (Destatis). (2026). The database of Federal Statistical Office. Retrieved from GENESIS - ONLINE: https://www-genesis.destatis.de/datenbank/online/.

[9] German Association of the Automotive Industry (VDA). (2025). Blickpunkt Automobilindustrie. Facts and Figures 2024/2025. Berlin: Verband der Automobilindustrie e.V. Retrieved from https://www.vda.de/dam/jcr:f536fa15-1470-4791-80ab-1bf97f436d1f/VDA%20Jahresbericht%202024.pdf?mode=view.

[10] German Association of the Automotive Industry (VDA). (2026). German Association of the Automotive Industry/Verband der Automobilindustrie e.V. Retrieved from Annual figures: https://www.vda.de/en.

[11] Germany Trade & Invest (GTAI). (2025). The Automotive Industry in Germany 2025. Bonn: Germany Trade & Invest (GTAI). Retrieved from https://www.gtai.de/en/invest/service/publications/the-automotive-industry-in-germany-64580.

[12] Heymann, E. (2026). Germany's Automotive Transition: A Chartbook. Frankfurt am Main: Deutsche Bank Research. Retrieved from https://www.dbresearch.com/PROD/IE-PROD/PDFVIEWER.calias?pdfViewerPdfUrl=PROD0000000000624590&rwnode=REPORT.

[13] International Energy Agency (IEA). (2025). Global EV Outlook 2025: Trends in the electric car industry. Paris: IEA. Retrieved from https://www.iea.org/reports/global-ev-outlook-2025/trends-in-the-electric-car-industry-3.

[14] International Organization of Motor Vehicle Manufacturers (OICA). (2026). OICA. Retrieved from OICA Statistics: https://oica.net/about/.

[15] IPE Institut für Politikevaluation GmbH; fka GmbH; Institut für Kraftfahrzeuge, RWTH Aachen University; Roland Berger GmbH. (2020). Automobile Wertschöpfung 2030/2050, Study on behalf of the Federal Ministry for Economic Affairs and Energy. Berlin: IPE Institut für Politikevaluation GmbH, fka GmbH and Roland Berger GmbH. Retrieved from https://www.publikationen-bundesregierung.de/pp-de/publikationssuche/automobile-wertschoepfung-2030-2050-1725526.

[16] Koehler, I. (2010). Overcoming Stagnation: Product Policy and Marketing in the German Automobile Industry of the 1970s. The Business History Review, 84(1), 53-78. Retrieved from http://www.jstor.org/stable/20743867.

[17] Krpata, M. (2021). The Automotive Industry: The Achilles' Heel of German Economy. Paris: French Institute of International Relations (Ifri) & Study Committee on Franco-German. Retrieved from https://www.ifri.org/sites/default/files/migrated_files/documents/atoms/files/krpata_automotive_industry_germany_2021.pdf.

[18] Krzywdzinski, M., Lechowski, G., Ferdinand, J., & Schneiß, D. (2022). The future of the European automobile industry The German path to electric mobility and its impacts on automotive production and employment, Brussels: European Climate Foundation (ECF) & European Trade Union Institute (ETUI). Retrieved from https://www.etui.org/events/are-european-automotive-jobs-resilient-global-electromobility-race.

[19] Nettekoven, Z. (2023). Automotive industry transformation and industrial policy in the EU and Germany: A critical perspective. Berlin: Institute for International Political Economy (IPE). Retrieved from https://www.ipe-berlin.org/fileadmin/institut-ipe/Dokumente/Working_Papers/ipe_working_paper_208.pdf.

[20] Puls, T. (2024). Die Automobilindustrie im Jahr 2024. Köln: Institut der deutschen Wirtschaft Köln (IW), IW Report No. 38. Retrieved from https://www.iwkoeln.de/fileadmin/user_upload/Studien/Report/PDF/2024/IW-Report_2024-Automobilindustrie.pdf.

[21] Puls, T., & Fritsch, M. (2020). Eine Branche unter Druck: Die Bedeutung der Autoindustrie für Deutschland. Köln: Institut der deutschen Wirtschaft Köln (IW), Report. No. 43. Retrieved from https://www.iwkoeln.de/studien/thomas-puls-manuel-fritsch-die-bedeutung-der-autoindustrie-fuer-deutschland.html.

[22] RSM Ebner Stolz. (2025). The future of Germany as an automotive manufacturing hub in times of de-globalization. Retrieved from RSM Ebner Stolz Automotive Study 2025: https://www.ebnerstolz.de/en/about-rsm-ebner-stolz/publications/rsm-ebner-stolz-automotive-study-2025-92496.html.

[23] Spatz, J., & Nunnenkamp, P. (2004). Globalization of the automobile industry: traditional locations under pressure? In M. Faust, European industrial restructuring in a global economy: fragmentation and relocation of value chains (pp. 105-129). Göttingen: Soziologisches Forschungsinst. an der Georg-August-Univ. (SOFI). Retrieved from https://www.econstor.eu/bitstream/10419/3248/1/Nu_Globalization_Automobile.pdf.

[24] Sturgeon, T., Van Biesebroeck, J., & Gereffi, G. (2008). Value chains, networks and clusters: reframing the global automotive industry. Journal of Economic Geography, 8(3), 297-321. doi:https://doi.org/10.1093/jeg/lbn007.

[25] Tolliday, S. (1995). Enterprise and State in the West German Wirtschaftswunder: Volkswagen and the Automobile Industry, 1939-1962. The Business History Review, 69(3), 273-350. Retrieved from https://www.jstor.org/stable/3117336.

The Role of Renewable Energy in the Efforts to Combat Climate Change in the CEE-4 Countries

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Abstract: The European Union's strategic objective is to augment the proportion of renewable energy sources within its energy mix. This initiative is primarily driven by the need to address the pressing issue of climate change, with a secondary objective of maintaining its position as a global leader in high-performance technologies. As members of the European Union, the CEE-4 countries (Czech Republic, Hungary, Poland, Romania) attach considerable importance to the development of this type of energy, setting ambitious targets and allocating substantial investment to this sector. The present article aims to analyse the latest trends in the renewable energy sector in the CEE-4 countries. In the initial section of the article, an extensive review of the pertinent literature was conducted. This entailed the examination of significant articles and studies within the field, with the objective of identifying existing gap in the available research. In the second part of the paper, a quantitative analysis was conducted that included four indicators related to renewable energy. The primary findings indicate that the CEE-4 countries demonstrate a commendable performance in terms of the proportion of renewable energy sources utilised, in comparison to the European Union average. This is particularly noteworthy when considering these countries' communist past and their relatively recent accession to the European Union. Furthermore, Romania is the CEE-4 country that ranks highest on three of the four indicators. Nevertheless, the full potential of renewable energy sources has yet to be realised. To address this issue, several measures must be taken. These include the improvement of support schemes for renewable energy sources, the construction of new facilities, particularly those dedicated to solar and wind power, and the modernisation of existing cogeneration plants.

Key words: renewable energy, climate change, CEE-4 countries, policies
JEL Classification: Q42, Q48, Q49, Q54

1. Introduction

The transition to renewable energy signifies a considerable structural shift in energy supply and consumption within an energy system. The transition to sustainable energy represents a contemporary phenomenon that is being implemented with the aim of mitigating the effects of climate change. Most of the sustainable energy is of a renewable nature. The current transition aims to reduce greenhouse gas emissions rapidly and sustainably from the energy sector, primarily by phasing out fossil fuels and shifting as many processes as possible to low-carbon electricity (Saleh et al., 2024).

The European Union's most significant challenge is to become the first climate-neutral continent by 2050. In pursuit of this objective, the European Commission unveiled the European Green Deal on 11 December 2019.

This initiative constitutes the most ambitious plan to date to assist European citizens and businesses in benefitting from the sustainable green transition (Sustelo et al, 2023). The measures that have been implemented include an initial roadmap for key policies. The measures adopted include actions such as reducing emissions, investing in research and innovation, and protecting the environment in the EU (Rayner et al., 2023). Of particular significance is the fact that the European Green Deal establishes a equitable trajectory for the transition. The objective of the programme is to ensure that no person or region is left behind as future changes take effect (Ottomano et al., 2025).

The European Green Deal will contribute to the Clean Industrial Deal. It is part of the Commission's strategy to implement the United Nations 2030 Agenda and its sustainable development goals. It will also boost competitiveness and innovation in the EU. These are just some of the priorities announced in the current Commission's political guidelines. It has developed several plans to make the economy safer, more sustainable, with lower emissions (Costadone et al., 2023). In addition to efforts to combat climate change by reducing greenhouse gas emissions, the use of renewable energy sources is likely to create a more secure and diversified energy supply, reduce air pollution, and create jobs in the environmental and renewable energy sectors (Batra, 2023).

Considering the European Union's target of achieving a 20% share of renewable energy by the year 2020, the Union adopted Directive 2018/2001/EU on the 11th of December 2018, with the aim of promoting the utilisation of energy from renewable sources. The most recent amendment to this directive (Directive (EU) 2023/2413) incorporates a binding renewable energy target for the EU of 42.5% for 2030, with the objective of achieving 45%.

On 18 May 2022, the Commission published the REPowerEU plan. The strategy outlined in this plan involves the implementation of a series of measures designed to swiftly reduce reliance on fossil fuels from the Russian Federation. The objective is to accomplish this objective prior to 2030 by expediting the transition to clean energy. The REPowerEU plan is comprised of three distinct components. The first section of the report focuses on energy savings, the second section focuses on clean energy production, and the third section focuses on the diversification of energy sources within the European Union.

The primary objective of our paper endeavour is to undertake a comprehensive analysis of the renewable energy sector within the CEE-4 countries (Czech Republic, Hungary, Poland, Romania). Consequently, a quantitative analysis of the primary indicators associated with renewable energy will be conducted, with the objective of evaluating and comparing the levels of development of the CEE-4 countries in this regard, considering their communist past and their relatively late accession to the European Union.

2. Literature review

The European Union has identified the promotion of renewable energy as a key priority for the 21st century. The public has become increasingly concerned about climate change, greenhouse gas emissions, environmental damage, and energy security (Ruiz et al., 2023; Gajdzik et al., 2024). This has prompted European institutions to advocate for the transition from fossil fuels to cleaner and more sustainable energy systems. Renewable energy sources, including solar, wind, hydroelectric, geothermal, and biomass, are currently regarded as pivotal in achieving climate neutrality and long-term economic sustainability (Saeed et al., 2024; Gayen et al., 2024).

As demonstrated in the relevant literature (Escribano et al. 2023; Algarni et al., 2023; Xiao et al., 2025), the development of renewable energy sources has been shown to be advantageous in terms of environmental impact, in addition to generating economic, technological, and geopolitical benefits. Researchers (Hanna et al., 2024; Tamasiga et al., 2026) believe that the transition towards a low-carbon economy is significant for industrial development, the labour market, innovation, and the way different regions of Europe collaborate.

A significant aspect within the existing literature pertains to the evolution of the European Union's renewable energy policy over time. The Renewable Energy Directive establishes common objectives for Member States and establishes a uniform framework for the promotion of renewable energy sources. Previous EU policies sought to achieve the "20-20-20" targets. These objectives aimed to reduce greenhouse gas emissions by 20%, enhance energy efficiency by 20%, and augment the share of renewable energy consumption by 20%, all by the year 2020. Recent initiatives, including the European Green Deal and the "Fit for 55" package, have set forth more ambitious objectives, such as achieving climate neutrality in the European Union by 2050.

Experts (Raikar et al., 2024; Arzo et al., 2024; Sun et al., 2025) theorise that if governments maintain consistent policies and do not frequently amend legislation, investments in renewable energy projects will be significantly more straightforward. This phenomenon can be attributed to the divergent operational practices of institutions, the varying levels of economic development, and the distinct political priorities of each region. Consequently, there are discrepancies in the utilisation of renewable energy across various regions of the European Union (Dogan et al., 2023).

Another salient topic that has been the subject of discussion in the academic literature pertains to the integration of renewable energy sources into the EU's energy systems. Renewable energy sources, such as wind and solar power, are contingent on meteorological conditions. Researchers (Sahoo et al., 2023; Obakhume et al, 2025) have expressed the view that there is a necessity to modernise power grids, to build interconnections between countries, and to develop energy storage technologies. In the realm of energy systems, there is an increasing emphasis on the significance of smart grids and battery systems, particularly in scenarios where a substantial share of energy is derived from renewable sources (Al-Shetwi et al., 2025).

Several studies (Wang et al., 2023; Thellufsen et al., 2023; Pastore et al., 2025) have been conducted about sector coupling, a concept defined as the integration of electricity generation with the transportation, heating, and industrial sectors. It is the opinion of experts in the field (Prina et al., 2023; Son et al., 2023) that sector coupling has the potential to enhance the system's flexibility and contribute to a reduction in the overall costs associated with carbon emission reduction. Researchers (Amini et al., 2024) also highlight the growing significance of digital technologies, artificial intelligence, and data-driven energy management systems in optimising the distribution and consumption of renewable energy.

The extant literature further underscores the economic and social dimensions of the transition to renewable energy sources within the European Union. Investment in the field of renewable energy has been demonstrated to have a positive correlation with employment opportunities, particularly within sectors such as manufacturing, construction, maintenance, and the development of new technologies. The extant research in this field indicates that the renewable energy industry has a beneficial effect on regional economies, enhancing their growth and increasing business competitiveness (Vîrjan et al., 2023). However, researchers (Georgescu et al., 2025) also identify challenges related to unequal economic capacities among Member States.

Developed countries have greater financial resources with which to invest in renewable energy projects, while less developed countries encounter difficulties in identifying funding sources. Another significant issue that has been highlighted by researchers (Esiri et al., 2023) is that of public acceptance. Residents have been known to attempt to impede the development of renewable energy projects, including wind farms, power lines, and solar farms. Consequently, experts (Ryder et al., 2023) advocate for public involvement to ensure transparent decision-making processes and to empower communities to play an active role.

The existing literature has addressed issues related to energy communities and citizens involved in renewable energy systems. Energy communities are defined as groups of individuals, local authorities, and businesses that collaborate to produce, utilise, and oversee renewable electricity (Ahmed et al., 2024). Researchers (Abdulkareem et al., 2024) hypothesise that projects involving the local community can facilitate citizen participation in decision-making processes and promote familiarity with renewable energy technologies. These initiatives have the potential to reduce household energy costs and address the issue of energy access for vulnerable populations.

Research in this field demonstrates that solar photovoltaic systems are frequently utilised in energy communities due to their relative cost-effectiveness and the ability to be deployed expeditiously. Nevertheless, several challenges have the potential to impede the development of community projects. The challenges experienced by these entrepreneurs include the bureaucratic processes involved in setting up a business and the difficulty in securing funding. Research in this area suggests that simpler legal frameworks and greater financial support for citizen-led renewable energy initiatives are recommended (Schwanitz et al., 2024).

Even though renewable energy is intended to be environmentally sustainable, researchers have also focused on how it can have a negative impact on the environment. Large-scale renewable energy infrastructure, including wind turbines and solar farms, has the potential to exert a detrimental effect on biodiversity, ecosystems, and land use if not meticulously designed (Apoorva et al., 2025). The construction of wind farms has been demonstrated to exert an effect on bird populations, whilst hydropower projects have been shown to exert a detrimental effect on aquatic ecosystems. Solar farms require substantial land areas, in some cases.

Renewable energy technologies are dependent on critical minerals and rare earth elements that are utilised in the manufacture of batteries, solar panels, and wind turbines. Researchers (Antony Jose et al., 2024) have posited that it is imperative to employ mining practices that do not compromise environmental integrity, to establish recycling systems, and to cultivate a circular economy.

A comprehensive review of extant literature indicates that the European Union has made significant progress in the use of renewable energy over the past two decades. At present, wind and solar power account for a significant share of the electricity produced in Europe, and many countries continue to expand their use of renewable energy (Dolge et al., 2023). However, researchers (Singh et al., 2024) concur that there are still significant challenges to address, including the integration of the technology into the power grid, the amount of electricity it can store, policy coordination, funding inequalities, and how to gain public acceptance.

Future research will address these issues, with a particular focus on ways to do so, the use of computers and technology, hydrogen-based technologies, and ensuring access to energy for all. Most experts concur that achieving climate neutrality by 2050 will necessitate enhanced cooperation between regions, the implementation of long-term investment plans, and governance approaches that integrate the environment, technology, the economy, and society.

The research gap identified in the relevant literature pertains to the lack of studies examining the status of renewable energy in the CEE-4 countries. In consideration of the distinctive historical trajectory of these countries – encompassing their transition from communism to accession and integration into the European Union – and within the framework of the region's geopolitical environment, renewable energy, an indispensable component of the energy sector, necessitates more focused analytical scrutiny.

3. Methodology

The methodological design of this paper is mixed, based on an analysis of the key indicators reflecting the state of renewable energy in the CEE-4 countries (Romania, the Czech Republic, Hungary, and Poland), using the latest Eurostat data, and on a qualitative review of the relevant literature in the field.

The quantitative analysis is based on Eurostat data to illustrate the level of development of the CEE-4 countries in terms of renewable energy use. The present analysis was conducted utilising four pertinent indicators, namely: the share of renewable energy sources in final energy consumption, the share of renewable energy sources in electricity consumption, renewable energy in the heating and cooling sector, and renewable energy used in the transport sector.

The present article provides an analysis of the challenges and opportunities inherent in the development of renewable energy. In addition, it offers a comparative analysis of the CEE-4 countries.

The primary limitation of this study is the absence of European Union statistics for the year 2025; consequently, it is imperative to extend the research in subsequent studies once these data are available.

4. The development of the renewable energy sector in the CEE-4 countries

The implementation of renewable energy sources can offer numerous advantages, including the mitigation of greenhouse gas emissions, the diversification of energy supplies, and the reduction of reliance on fossil fuels. The European Union is set to generate a significant number of employment opportunities in the domain of novel "green" technologies, as it endeavours to enhance the share of renewable energy. This constitutes a fundamental component of the Energy Union and the Clean Industrial Deal.

This section of the article presents statistical data on the proportion of energy from renewable sources in the total energy consumption of the CEE-4 countries, broken down by the three main consumption sectors (electricity, heating and cooling, and transport). The data is based on the latest figures from Eurostat. These renewable energy sources include wind, solar (thermal and photovoltaic), hydropower, wave energy, geothermal energy, heat extracted by heat pumps, biofuels, and the renewable fraction of waste.

4.1. Energy from renewable sources in gross final energy consumption

The Renewable Energy Directive 2009/28/EC (RED I) stipulates that final energy consumption pertains to the energy supplied to industry, transport, households, services (including public services), agriculture, forestry, and fisheries for energy purposes. This encompasses the consumption of electricity and heat by the energy sector for the purpose of electricity and heat generation, in addition to losses of electricity and heat that occur during distribution and transmission.

In 2024, the EU accounted for 25.2% of the global energy consumption from renewable sources. This indicates an increase of 0.7 percentage points compared to the 2023 figures, and a figure that is more than three times the 2004 percentage (9.6%). A recent EU directive (2023/2413) has led to an increase in the EU's target for the utilisation of energy from renewable sources. The target has been increased from 32% to 42.5%, with a goal of reaching 45%. Consequently, it is incumbent upon EU countries to collaborate in order to achieve the 2030 target. The objective is to increase the market share by more than 17% over the next six years.

Figure 1: Share of energy from renewable sources in final energy consumption in 2024 (CEE-4, %)

Source: Authors based on Eurostat data, 2025

As demonstrated in Figure 1, the most recent data available concerning the proportion of renewable energy in final energy consumption within the CEE-4 countries is illustrated. Romania had the highest share, at 25.4%, followed by the Czech Republic at 19.2%, Hungary at 18.3%, and Poland at 17.8%.

4.2. Renewable energy in the electricity sector

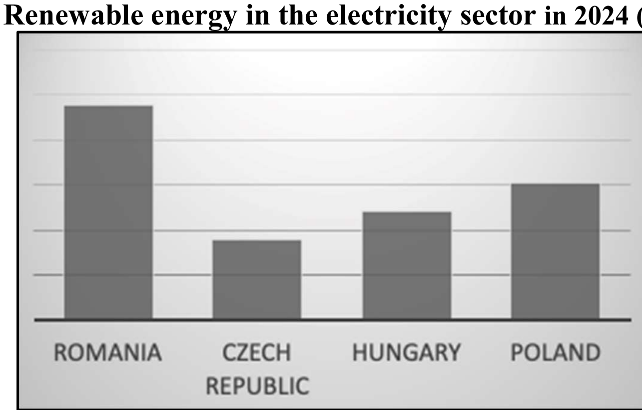
The share of electricity produced from renewable sources is defined as the ratio of electricity produced from such sources to the total electricity consumed within a given country. According to the Renewable Energy Directive, the term 'final consumption of electricity from renewable sources' refers to electricity produced from renewable energy sources. This encompasses hydroelectric power plants (excluding electricity derived from pumped-storage plants that utilise water already pumped upstream), as well as electricity generated from solid biofuels/waste, wind, solar, or geothermal installations. The Directive also stipulates that electricity produced using water and wind should be treated in the same way.

The provisions of EU Directive 2018/2001 stipulate that electricity generated from hydro and wind sources must be standardized to account for year-to-year variations in weather conditions. The present section is concerned with the presentation of results that have been obtained with these provisions in mind.

The increase in renewable energy in electricity consumption between 2014 and 2024 is indicative of the growth of solar and wind energy in the EU. In 2024, the share of electricity in the EU derived from renewable sources accounted for more than 50% of the total consumption (47.5%), marking an increase of approximately 2 percentage points compared to the preceding year (45.4% in 2023).

At the EU level, wind and hydro power together accounted for nearly two-thirds of the electricity generated from renewable sources (38% and 26.4%, respectively). The residual electricity was derived from solar sources (23.4%), solid biofuels (5.8%), and alternative renewable sources (6.1%). Solar energy is expanding at an accelerated rate. In 2008, the share of the market was 1%. This indicates that electricity from solar sources has increased significantly, from 7.4 TWh in 2008 to 304 TWh in 2024.

Figure 2: Renewable energy in the electricity sector in 2024 (CEE-4, %)



Authors based on Eurostat data, 2025

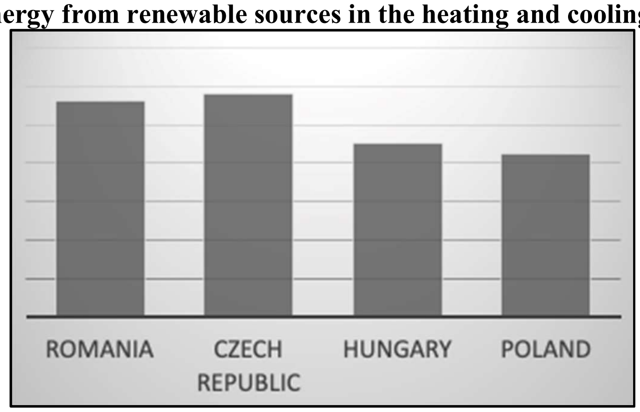
Figure 2 illustrates the proportion of renewable energy in electricity consumption within the CEE-4. As is evident, Romania is leading the field with 47.6% of its electricity being produced from renewable sources, followed at a considerable distance by Poland (30.4%), Hungary (24.1%), and the Czech Republic (17.9%).

4.3. Renewable energy in heating and cooling

To calculate the amount of energy from renewable sources utilised for heating and cooling purposes, the analysis encompasses the evaluation of energy consumption in industry, households, services, agriculture, forestry, and fisheries for heating and cooling, in addition to district heating produced from renewable sources. The term 'final consumption for heating and cooling' is used to denote the final consumption of all energy products, except for electricity, for purposes other than transportation. It also incorporates heat consumption for own use at power and heating plants, as well as heat losses from networks.

In 2024, the share of energy from renewable sources in the total energy used for heating and cooling across the EU was 26.7%. This represents a substantial increase of 11.7% since 2004. The observed rise can be attributed to advancements in industry, services, and households. Additionally, heat pumps have the capacity to capture energy from the ambient air, thereby enabling the provision of heating and cooling for buildings.

Figure 3: Share of energy from renewable sources in the heating and cooling in 2024 (CEE-4, %)



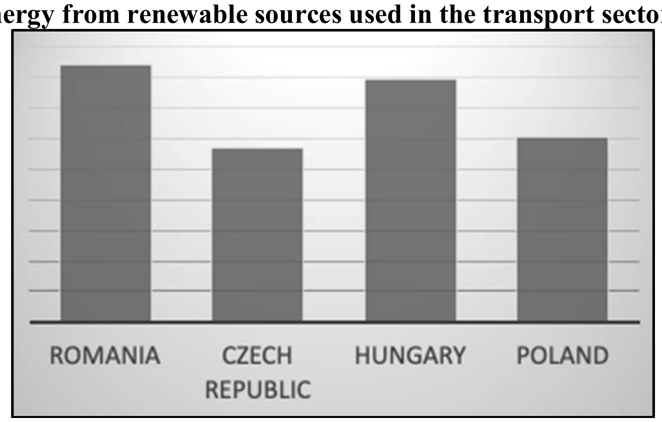
Source: Authors based on Eurostat data, 2025

Figure 3 illustrates the share of renewable energy utilised for heating and cooling purposes in the CEE-4 countries. As is evident, the Czech Republic occupies the first position with 29.1%, closely followed by Romania with 28.1%. Hungary (22.8%) and Poland (21.3%) demonstrate a significant disparity in their performance.

4.4. Renewable energy in the transport sector

The EU has formally adopted a mandate to establish a unified target of 29% for the incorporation of renewable energy sources (including liquid biofuels, hydrogen, biomethane, "green" electricity, and analogous fuels) in the domain of transportation by the year 2030. In contrast to the initial target of a 29% reduction, countries may opt for a more ambitious approach, aiming to reduce the greenhouse gas intensity of transport fuels by a minimum of 14.5% by the year 2030. The share of energy from renewable sources such as wind and solar power in transportation has increased from 1.4% in 2004 to 11.2% in 2024.

Figure 4: Share of energy from renewable sources used in the transport sector in 2024 (CEE-4, %)



Source: Authors based on Eurostat data, 2025

Figure 4 illustrates the share of energy from renewable sources in the transport sector in the CEE-4. As is apparent from the data, Romania occupies the first position with 8.4%, closely followed by Hungary with 7.9%. The findings of this study indicate that Poland and the Czech Republic demonstrated substandard outcomes in relation to the specified indicator, with figures standing at 6% and 5.7%, respectively, in the case of Poland and the Czech Republic.

6. Conclusion

Renewable energy is a pivotal component in the ongoing efforts to combat climate change, and the European Union accords significant importance to the objective of achieving carbon neutrality. Considering this, the EU has established ambitious targets for renewable energy.

The first conclusion of our research is that, despite these countries' communist past and the specific challenges stemming from it – namely, their late accession to the European Union, economic transition, and heavy bureaucracy – all four CEE-4 countries are performing well in terms of renewable energy use.

The second conclusion relates to the fact that progress in renewable energy in the CEE-4 countries has been steady since these countries joined the European Union. This is evidenced by the figures reported by these countries regarding the four indicators analysed (the share of renewable energy sources in final energy consumption, the share of renewable energy sources in electricity consumption, renewable energy in the heating and cooling sector, and renewable energy used in the transport sector) relative to the EU average, according to the latest Eurostat data.

The third conclusion of this article concerns Romania, which ranks first among the CEE-4 countries on three of the four indicators analysed. Despite being the most recent of these countries to accede to the European Union, Romania has achieved considerable progress in terms of increasing the share of renewable energy sources. This rapid progress can be attributed to two key factors: firstly, the implementation of generous support schemes from 2016 onwards, and secondly, a collective understanding of the long-term objectives among all stakeholders. In terms of the subsequent measures to be implemented by Romania in this domain, it is imperative to augment the renewable energy generation capacity (predominantly wind and solar), expand the clean energy capacity derived from nuclear sources, modernise existing cogeneration facilities, and construct new ones.

The primary limitation of this study is the absence of European Union statistics for the year 2025; consequently, it is imperative to extend the scope of the research in subsequent studies once these data are available.

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References:

[1] Abdulkareem, A. K. (2024). Examining the role of community engagement and capacity building in the acceptance of renewable energy projects: The mediating role of trust. *Public Administration & Regional Studies,* 17(1), 22-48.

[2] Ahmed, S., Ali, A., & D'angola, A. (2024). A review of renewable energy communities: concepts, scope, progress, challenges, and recommendations. Sustainability, 16(5), 1749.

[3] Al-Shetwi, A. Q., Hannan, M. A., Al-Masri, H. M., & Sujod, M. Z. (2025). Latest advancements in smart grid technologies and their transformative role in shaping the power systems of tomorrow: An overview. *Progress in Energy*, 7(1), 012004.

[4] Algarni, S., Tirth, V., Alqahtani, T., Alshehery, S., & Kshirsagar, P. (2023). Contribution of renewable energy sources to the environmental impacts and economic benefits for sustainable development. *Sustainable energy technologies and assessments*, 56, 103098.

[5] Amini, M., & Baradaran Rohani, M. (2024). The role of machine learning and artificial intelligence in enhancing renewable energy through data science. *World Journal of Technology and Scientific Research*, 12(07), 2341-2365.

[6] Antony Jose, S., Calhoun, J., Renteria, O. B., Mercado, P., Nakajima, S., Hope, C. N., ... & Menezes, P. L. (2024). Promoting a circular economy in mining practices. *Sustainability, 16*(24), 11016.

[7] Apoorva, M. S., Nayak, S. H., & Dinesh, S. (2025). Environmental impacts of renewable energy systems and strategies for mitigation.

[8] Arzo, S., & Hong, M. (2024). Resilient green infrastructure: Navigating environmental resistance for sustainable development, social mobility in climate change policy. *Heliyon,* 10(13).
[9] Batra, G. (2023). Renewable energy economics: achieving harmony between environmental protection and economic goals. *Social science chronicle,* 2(2), 1-32.
[10] Costadone, L., & Vierikko, K. (2023). Are traditional urban greening actions compliant with the European Greening Plans guidance?. *Urban Forestry & Urban Greening*, 90, 128131.
[11] Dogan, E., Hodžić, S., & Šikić, T. F. (2023). Do energy and environmental taxes stimulate or inhibit renewable energy deployment in the European Union?. *Renewable Energy*, 202, 1138-1145.
[12] Dolge, K., & Blumberga, D. (2023). Transitioning to Clean Energy: A Comprehensive Analysis of Renewable Electricity Generation in the EU-27. *Energies,* 16(18), 6415.
[13] European Commission. (2019). Communication From the Commission To The European Parliament, The European Council, The Council, The European Economic And Social Committee And The Committee Of The Regions. *The European Green Deal*
[14] European Commission. (2022). *Communication From The Commission To The European Parliament, The European Council, The Council, The European Economic And Social Committee And The Committee Of The Regions. REPowerEU Plan.*
[15] European Commission. (2020). *Commission Implementing Regulation (EU) 2020/1294 of 15 September 2020 on the Union renewable energy financing mechanism (Text with EEA relevance)*
[16] European Parliament. (2009). *Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC (Text with EEA relevance)*
[17] European Parliament. (2018). *Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources (recast) (Text with EEA relevance.)*
[18] Escribano, G., & Lázaro-Touza, L. (2023). The economic benefits of renewable energies: a geopolitical perspective. In Handbook on the Economics of Renewable Energy (pp. 251-283). *Edward Elgar Publishing.*
[19] Gayen, D., Chatterjee, R., & Roy, S. (2024). A review on environmental impacts of renewable energy for sustainable development. *International Journal of Environmental Science and Technology*, 21(5), 5285-5310.
[20] Gajdzik, B., Nagaj, R., Wolniak, R., Bałaga, D., Žuromskaitė, B., & Grebski, W. W. (2024). Renewable energy share in European industry: Analysis and extrapolation of trends in EU countries. *Energies,* 17(11), 2476.
[21] Georgescu, L. P., Fortea, C., Antohi, V. M., Balsalobre-Lorente, D., Zlati, M. L., & Barbuta–Misu, N. (2025). Economic, technological and environmental drivers of the circular economy in the European Union: a panel data analysis. *Environmental Sciences Europe*, 37(1), 76.
[22] Esiri, A. E., Kwakye, J. M., Ekechukwu, D. E., & Benjamin, O. (2023). Public perception and policy development in the transition to renewable energy. *Magna Scientia Advanced Research and Reviews*, 8(2), 228-237.
[23] Hanna, R., Heptonstall, P., & Gross, R. (2024). Job creation in a low carbon transition to renewables and energy efficiency: a review of international evidence. *Sustainability Science*, 19(1), 125-150.
[24] Obakhume, K. A., & Opatola, F. F. (2025). Enhancing renewable energy integration through energy storage and smart grid innovations: *A systematic review. Journal of Emerging Science and Engineering*, 3(2), e38-e38.
[25] Ottomano Palmisano, G., Rocchi, L., Negri, L., & Piscitelli, L. (2025). Evaluating the progress of the EU countries towards implementation of the European Green Deal: *A multiple criteria approach. Land,* 14(1), 141.
[26] Pastore, L. M. (2026). Sector Coupling and Flexibility Measures in Distributed Renewable Energy Systems: A Comprehensive Review. *Sustainability,* 18(1), 437.
[27] Prina, M. G., Feijoo, F., Mimica, M., & Duić, N. (2023). Advances in energy system modeling, sector coupling, and emission reduction strategies. e-Prime-Advances in Electrical Engineering, Electronics and Energy, 6, 100316.
[28] Raikar, S., & Adamson, S. (2024). Renewable energy finance: Theory and practice. *Elsevier.*
[29] Rayner, T., Szulecki, K., Jordan, A. J., & Oberthür, S. (2023). The global importance of EU climate policy: an introduction. In Handbook on European Union climate change policy and politics (pp. 1-21). *Edward Elgar Publishing.*
[30] Ryder, S., Walker, C., Batel, S., Devine-Wright, H., Devine-Wright, P., & Sherry-Brennan, F. (2023). Do the ends justify the means? Problematizing social acceptance and instrumentally-driven community engagement in proposed energy projects. *Socio-Ecological Practice Research,* 5(2), 189-204.
[31] Ruiz, A. Z., Martín, J. M. M., & Prados-Castillo, J. F. (2023). The European Union facing climate change: a window of opportunity for technological development and entrepreneurship. *Sustainable Technology and Entrepreneurship*, 2(2), 100035.
[32] Saeed, S., & Siraj, T. (2024). Global renewable energy infrastructure:: pathways to carbon neutrality and sustainability. *Solar energy and sustainable development journal*, 13(2), 183-203.
[33] Sahoo, S., & Timmann, P. (2023). Energy storage technologies for modern power systems: A detailed analysis of functionalities, potentials, and impacts. *IEEe Access*, 11, 49689-49729.
[34] Saleh, H. M., & Hassan, A. I. (2024). The challenges of sustainable energy transition: A focus on renewable energy. *Applied Chemical Engineering*, 7(2), 2084.

[35] Singh, S., & Singh, S. (2024). Advancements and challenges in integrating renewable energy sources into distribution grid systems: A comprehensive review. *Journal of energy resources technology,* 146(9), 090801.
[36] Son, M., Kim, M., & Kim, H. (2023). Sector coupling and migration towards carbon-neutral power systems. Energies, 16(4), 1897.
[37] Sun, F., Qu, Z., Wu, B., & Bold, S. (2025). Comparative analysis of international environmental policies and supply chain sustainability. *Journal of Environmental Management,* 390, 126324.
[38] Sustelo, M. L. M. G. (2023). Examining the Feasibility of Attaining Carbon Neutrality by 2050 and Ensuring a Just Transition: *The European Green Deal in the Context of EU Law*. Universidade NOVA de Lisboa (Portugal).
[39] Schwanitz, V. J., Paudler, H. A., & Wierling, A. (2024). The contribution of European citizen-led energy initiatives to sustainable development goals. *Sustainable Development*, 32(4), 3313-3328.

State Aid as a Driver of the EU Green Transition: A Comparative Analysis of Member States in the Post-Pandemic Era

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Abstract: State aid policy is often perceived as a restrictive component of the European Union (EU) competition law. However, recent crises, such as the COVID-19 pandemic and the economic disruptions generated by the war in Ukraine, have demonstrated its capacity to function as an effective policy instrument enabling Member States to mitigate economic difficulties and strengthen economic resilience. At its core, EU state aid policy prioritizes horizontal aid aimed at addressing market failures, particularly in areas such as environmental protection, research, development and innovation (RDI), and other objectives of common European interest. Against the backdrop of persistent economic challenges and the European Union's continued commitment to the green transition, this research examines the extent to which state aid granted by Member States in recent years has contributed to advancing sustainability objectives. The methodology relies on a comparative analysis of state aid measures implemented between 2019 and 2024, based on data provided by the State Aid Scoreboard, complemented by a case study focusing on Romania. The paper aims to assess both the evolution of environmentally oriented state aid and the role of national policy choices in supporting the EU's green transition agenda.

Key-Words: State Aid, European Union, green transition, environmental state aid, Romania
JEL Classification: *H23, H25, O38, Q57, Q58*

1 Introduction

In the aftermath of the COVID-19 pandemic, a substantial share of public financial support within the European Union was directed towards economic recovery and crisis mitigation through the Temporary Framework adopted in response to the COVID-19 pandemic (European Commission, 2020) and the Temporary Crisis and Transition Framework introduced following the war in Ukraine (European Commission, 2023). These exceptional instruments considerably expanded the possibilities for Member States to intervene in the economy through state aid measures aimed at preserving economic stability, supporting undertakings and strengthening economic resilience.

Despite persistent economic and geopolitical pressures, the European Union continued to pursue the objectives associated with the green transition, understood as the gradual transformation towards a climate-neutral, resource-efficient and sustainable economy. Environmental protection and energy-related objectives therefore remained an important component of state aid expenditure, with Member States continuing to support investments in renewable energy, decarbonisation, energy efficiency and other sustainability-oriented initiatives.

The most recent data published in the 2025 edition of the State Aid Scoreboard, covering the period up to 2024, indicate that support for the green transition through state aid instruments has remained significant even during a period characterized by overlapping crises and increasing fiscal constraints. Although crisis-related support dominated the broader economic response at EU level, environmentally oriented aid continued to play an important role within national support schemes.

Against this background, the present research seeks to answer the main question of whether green transition objectives have remained a priority within EU state aid policy during the post-pandemic period. A secondary research question concerns the reasons why environmentally oriented state aid continues to be regarded not only as a sustainability objective, but also as an essential instrument for economic recovery, competitiveness and long-term resilience.

2 Literature review

State aid policies play an increasingly important role in shaping the decarbonisation trajectory of European industries, particularly in Central and Eastern European (CEE) countries, where energy transitions continue to be influenced by legacy energy systems, economic constraints, and institutional capacity limitations (Nagaj et al., 2024; Brodny et al., 2025; Czarnecka et al., 2022). Within the broader framework established by the European Green Deal and related EU legal instruments, Member States are expected to contribute to the Union's climate neutrality objectives while ensuring economic competitiveness and social cohesion. Nevertheless, the implementation of decarbonisation policies and the use of state aid instruments vary considerably across the European Union (Sobczyk et al., 2026; Vuletic, 2020; Manowska et al., 2024).

Romania represents a particularly relevant case within this regional context. Although the country has made progress in aligning with EU climate and energy objectives, significant structural, regulatory, and administrative challenges continue to affect the pace and effectiveness of the green transition (Brodny et al., 2025; Nichifor et al., 2025). The literature increasingly emphasizes that industrial decarbonisation in CEE countries cannot be understood solely through environmental indicators, but must also be examined through the interaction between legal frameworks, state aid policies, fiscal instruments, and governance capacities.

A substantial body of literature highlights the importance of state aid and public funding mechanisms in supporting industrial decarbonisation and renewable energy investments across the European Union. Grants, subsidies, tax incentives, and other forms of public financial support are frequently identified as essential tools for facilitating investments in renewable energy, energy efficiency, and low-carbon industrial transformation (Czarnecka et al., 2022; Nagaj et al., 2024; Nichifor et al., 2025).

Several studies argue that state aid policies are most effective when integrated into broader fiscal and environmental governance frameworks. Environmental taxation, green budgeting mechanisms, and targeted public investment strategies have been associated with reductions in greenhouse gas emissions and increased renewable energy deployment (Lobont et al., 2025; Degirmenci & Unsal, 2026). At the same time, the literature points to significant disparities between Western European and CEE Member States regarding both the volume and effectiveness of environmentally oriented state aid (Brodny et al., 2025; Jorge-Vazquez et al., 2024).

The existing research also suggests that local and decentralized funding instruments may produce more effective decarbonisation outcomes than highly centralized schemes, particularly in regions facing distinct socio-economic and industrial constraints (Czarnecka et al., 2022). However, unequal administrative capacities and divergent national policy priorities continue to contribute to uneven implementation patterns across the European Union.

The evolution of the EU legal framework governing state aid and renewable energy promotion has generated significant academic debate. Existing studies emphasize that EU state aid rules have gradually evolved from a primarily competition-oriented approach toward a more flexible framework capable of accommodating climate and sustainability objectives (Chen & Vandendriessche, 2023; Vuletic, 2020).

Nevertheless, important tensions remain between market liberalization principles and the increasing reliance on public intervention to support decarbonisation processes. This tension is particularly visible in CEE countries, where regulatory fragmentation, administrative limitations, and political considerations frequently affect the implementation of EU environmental and energy policies (Raudla et al., 2025; Bernaciak, 2025).

The literature further demonstrates that legal harmonization at EU level does not automatically translate into uniform implementation at national level. Variations in institutional quality, governance structures, and political commitment significantly influence the effectiveness of decarbonisation policies and the absorption of EU financial support mechanisms (Vuletic, 2020; Chen & Vandendriessche, 2023).

Comparative assessments consistently indicate that Romania, together with other CEE countries such as Bulgaria, Hungary, and Poland, remains among the weakest performers in terms of energy transition and industrial decarbonisation indicators within the EU-27 (Brodny et al., 2025; Manowska et al., 2024). Although public expenditures for environmental protection and renewable investments contribute positively to sustainable development objectives, the overall effectiveness of the transition process remains constrained by structural inefficiencies and regulatory obstacles (Degirmenci & Unsal, 2026).

Research also indicates that excessive or poorly coordinated environmental spending may generate diminishing returns once investment levels exceed certain efficiency thresholds, highlighting the importance of strategic allocation and institutional coordination (Nichifor et al., 2025). Additional barriers identified in the literature include dependence on fossil fuels and coal-based energy systems, limited administrative capacity, and the politicization of energy transition policies (Bernaciak, 2025; Sobczyk et al., 2026).

At the same time, several enabling factors have been identified as potentially accelerating decarbonisation in the region. These include funding provided through the EU Recovery and Resilience Facility, cross-border policy coordination, innovative financing mechanisms such as green bonds and crowdfunding, and increased private-sector participation in sustainable infrastructure projects (Raudla et al., 2025; Zywiolek et al., 2026; Hribernik et al., 2025).

Despite the growing body of literature addressing decarbonisation and state aid policies in the European Union, several important research gaps remain.

First, while Romania is frequently included in comparative regional analyses, relatively few studies provide in-depth country-specific examinations of the interaction between state aid policies, legal frameworks, and industrial decarbonisation outcomes (Degirmenci & Unsal, 2026; Brodny et al., 2025). Existing research often prioritizes aggregate indicators while offering limited analysis of the institutional and regulatory mechanisms shaping national implementation.

Second, comparative studies focusing on CEE countries frequently identify disparities in performance but provide insufficient explanation regarding why certain Member States are more successful than others in leveraging state aid for green transition objectives. Political, administrative, and governance-related factors remain underexplored in comparative perspective (Raudla et al., 2025; Nichifor et al., 2025).

Third, there is limited research examining the implementation gap between EU-level legal frameworks and national regulatory practices. More specifically, insufficient attention has been paid to the extent to which legislative reforms and state aid flexibility measures effectively translate into measurable decarbonisation outcomes within CEE economies (Chen & Vandendriessche, 2023; Vuletic, 2020).

Finally, relatively few longitudinal studies assess the long-term impact of different forms of state aid—including grants, tax exemptions, guarantees, and decentralized support mechanisms—on industrial decarbonisation trajectories in Romania and neighbouring CEE states (Czarnecka et al., 2022; Nagaj et al., 2024).

The present research seeks to address part of these gaps by examining whether the alignment between EU legal frameworks and national regulatory implementation is weaker in Romania and other CEE countries than in Western European Member States, thereby affecting progress toward decarbonisation objectives. The paper also explores whether increasing levels of environmental public spending necessarily generate proportionate decarbonisation outcomes or whether diminishing returns emerge beyond certain investment thresholds.

Through a comparative analysis of environmentally oriented state aid measures and a focused case study on Romania, the research aims to contribute to a more nuanced understanding of the relationship between state aid policy, legal implementation, and the green transition within the European Union.

3 Methodology

The research is based on a comparative analysis of state aid granted by EU Member States during the 2019–2024 period, using data published in the 2025 edition of the State Aid Scoreboard. The analysis focuses on the relative share of environmentally oriented aid as well as on the principal financial instruments used to support the green transition, including guarantees, loans, tax exemptions and other forms of public support. In addition to the comparative dimension, the paper includes a more detailed case study on Romania, selected due to the significant challenges it continues to face in achieving green transition objectives and in effectively mobilising state aid instruments for sustainability purposes.

The methodological approach combines quantitative and qualitative elements. On the one hand, the research examines the evolution and distribution of environmental aid measures across Member States; on the other hand, it evaluates the policy relevance of these measures within the broader framework of economic recovery and resilience.

Several limitations of the research should nevertheless be acknowledged. First, the most recent data currently available through the State Aid Scoreboard cover the period up to 2024, meaning that developments occurring during 2025 are not yet reflected in the analysis. Second, state aid cases that remain under examination by the European Commission are excluded, as their final assessment and compatibility status have not yet been established.

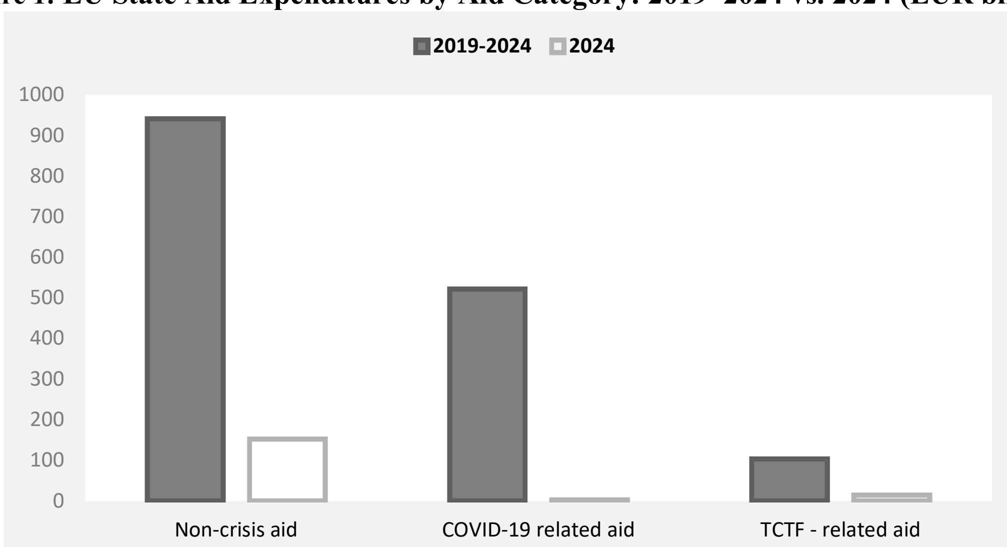
Furthermore, the research does not cover general economic measures that do not favour specific undertakings or sectors, nor public subsidies that do not affect trade or distort competition within the internal market, since such measures fall outside the scope of the European Commission's investigative powers under EU state aid rules. The analysis also excludes support granted under the de minimis regime. De minimis aid refers to limited amounts of public support considered too small to affect competition and trade between Member States and therefore exempted from the notification requirements applicable to state aid under Article 107(1) TFEU. Since de minimis support is governed by a separate regulatory framework and is not systematically reflected in the State Aid Scoreboard data used in this research, its inclusion would reduce the comparability and consistency of the analysis. The originality of the paper lies in combining a comparative EU-level assessment of environmentally oriented state aid with a focused analysis of Romania's evolving policy priorities during the post-pandemic period.

Future research may provide a more comprehensive assessment once data for 2025 become available through subsequent editions of the State Aid Scoreboard. Such analysis could offer additional insights into the evolution of environmentally oriented aid following the recent adoption of the Clean Industrial Deal State Aid Framework by the European Commission (European Commission, 2025). The new framework is expected to further facilitate public support for industrial decarbonisation, clean technologies and sustainability-related investments, potentially reshaping the role of state aid within the EU's green transition strategy.

4 State Aid in the European Union: General Trends and Post-Crisis Developments

Based on the most recent data available in the State Aid Scoreboard, the importance of crisis-related aid significantly declined in 2024 compared to previous years (Figure 1).

Figure 1: EU State Aid Expenditures by Aid Category: 2019–2024 vs. 2024 (EUR billion)



Note: The 2019–2024 values represent cumulative expenditures for the entire reference period, while the 2024 data reflect annual expenditure levels for the most recent year available in the State Aid Scoreboard.
Source: Author, based on State Aid Scoreboard data (https://competition-policy.ec.europa.eu/state-aid/scoreboard/scoreboard-state-aid-data_en)

Figure 1 illustrates the evolution of total EU state aid expenditures by distinguishing between non-crisis aid, COVID-19 related aid, and aid granted under the Temporary Crisis and Transition Framework (TCTF). The data indicate a substantial reduction in crisis-related support measures by 2024 compared to the cumulative levels recorded during the 2019–2024 period.

COVID-19 related aid decreased dramatically from EUR 521.8 billion during the overall reference period to only EUR 2.27 billion in 2024, reflecting the gradual withdrawal of exceptional pandemic-related support measures. Similarly, aid granted under the Temporary Crisis and Transition Framework declined from EUR 103.18 billion to EUR 14.06 billion in 2024. Nevertheless, the persistence of TCTF-related aid demonstrates that certain crisis-response mechanisms continued to play a role in addressing the economic consequences of geopolitical instability and energy market disruptions.

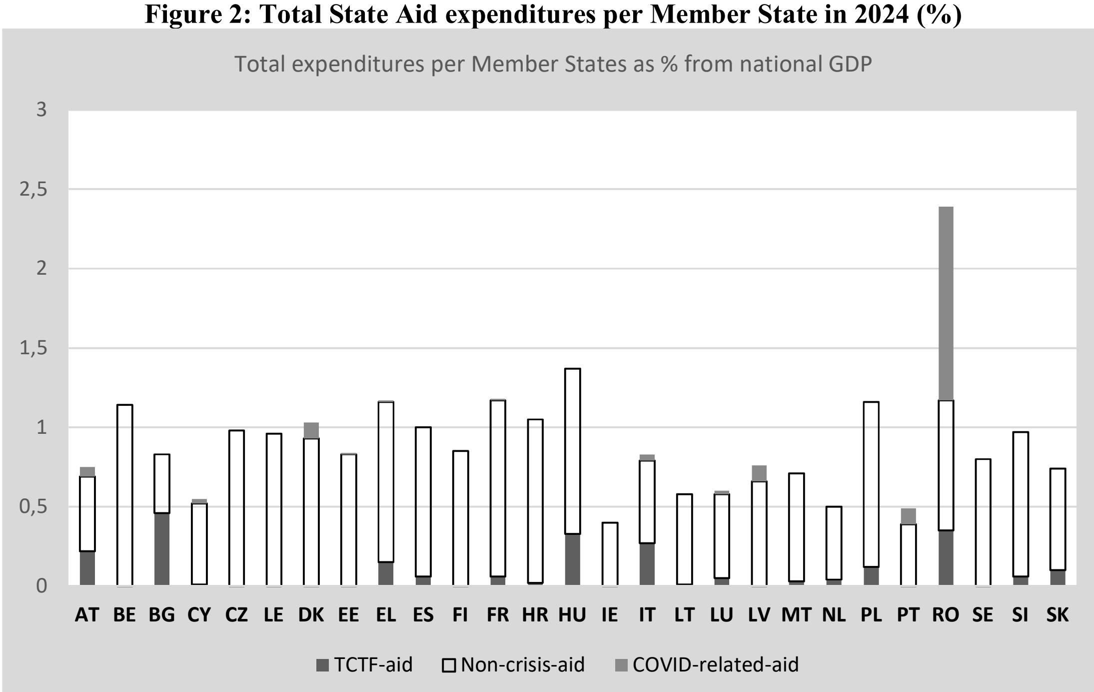
At the same time, non-crisis aid remained dominant, accounting for EUR 151.9 billion in 2024. This suggests that, although emergency interventions became less prominent, Member States continued to rely extensively on state aid instruments to support broader economic and strategic objectives, including environmental protection, energy transition, industrial competitiveness, and economic resilience.

Overall, the data support the conclusion that crisis-related state aid measures played an important role in stabilising the European economy during periods of overlapping crises. Their gradual reduction after 2022 may indicate a transition from emergency economic intervention toward longer-term policy objectives centred on resilience, competitiveness, and the green transition.

If we look at data for 2024, one may see that the majority of Member States directed their state aid expenses as percent of national GDP toward non-crisis aid, while Romania is still depended on crisis related aid.

Figure 2 presents total state aid expenditures by Member State in 2024 as a percentage of national GDP, offering a more accurate perspective on the relative scale of public intervention than absolute expenditure values alone. Expressing aid intensity relative to GDP allows for a better assessment of the actual fiscal effort undertaken by Member States and facilitates comparisons between economies of different sizes

Figure 2: Total State Aid expenditures per Member State in 2024 (%)



Source: Author, based on State Aid Scoreboard data (https://competition-policy.ec.europa.eu/state-aid/scoreboard/scoreboard-state-aid-data_en)

The data reveal that COVID-19 related aid had almost entirely disappeared by 2024 across the European Union, confirming the gradual withdrawal of exceptional pandemic-related support measures. In most Member States, non-crisis aid represented the dominant category of state aid expenditure, suggesting a broader transition from emergency economic intervention toward structural and strategic policy objectives.

At the same time, important differences remain visible among Member States. Several countries continued to allocate a relatively significant share of aid under the Temporary Crisis and Transition Framework (TCTF), reflecting the persistence of economic pressures associated with the energy crisis and geopolitical instability. Romania appears to represent a notable exception compared to many other Member States, as crisis-related aid continued to account for a comparatively larger share of total aid expenditure in relation to GDP.

These differences may reflect varying fiscal capacities, levels of economic vulnerability, energy market structures, and national policy priorities. The data therefore support the argument that the transition from crisis-response aid toward long-term strategic aid has occurred unevenly across the European Union.

An additional aspect revealed by Figure 2 concerns the relative intensity of total state aid expenditure in Romania. Measured as a percentage of national GDP, Romania recorded one of the highest levels of state aid expenditure among EU Member States in 2024, exceeding many larger Western European economies. This finding suggests that Romania relied extensively on public intervention mechanisms during the post-crisis period.

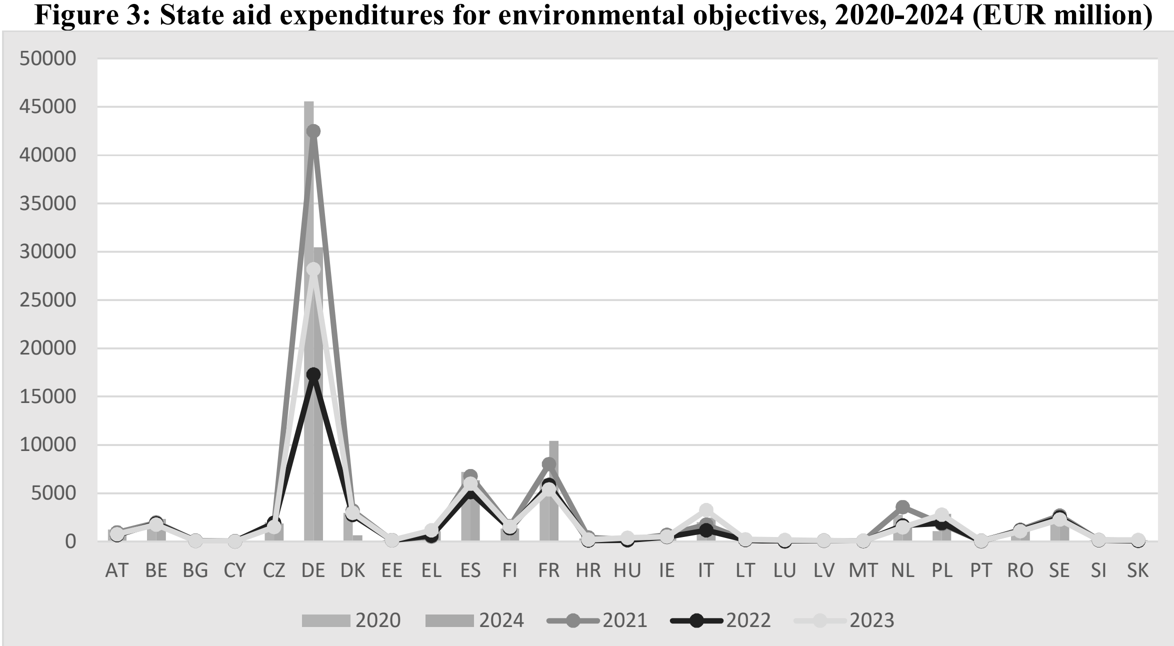
However, the composition of aid expenditure differs significantly from the pattern observed in many other Member States. While most countries concentrated their support primarily on non-crisis aid measures, Romania continued to allocate a comparatively important share of aid under the Temporary Crisis and Transition Framework (TCTF). This may reflect the persistence of structural vulnerabilities within the Romanian economy, including energy market pressures, lower economic resilience, and the continued need for state intervention to mitigate adjustment costs associated with the green transition.

At the same time, the data indicate that high levels of state aid expenditure do not necessarily imply a more advanced stage of decarbonisation or green transformation. Rather, they may also signal deeper structural dependencies and greater exposure to economic and energy-related shocks. Consequently, the Romanian case highlights the importance not only of the volume of aid granted, but also of the allocation structure and strategic orientation of public support measures.

5 Environmental State Aid and the Green Transition: The Case of Romania in a Comparative EU Perspective

Figure 3 illustrates the evolution of state aid expenditures for environmental objectives across EU Member States between 2020 and 2024. Overall, the data indicate that environmentally oriented aid remained an important component of EU state aid policy throughout the post-pandemic period. For many Member States, environmental aid expenditures in 2024 exceeded the levels recorded in 2020, suggesting that support for the green transition continued despite the fiscal pressures generated by successive economic and geopolitical crises.

Figure 3: State aid expenditures for environmental objectives, 2020-2024 (EUR million)

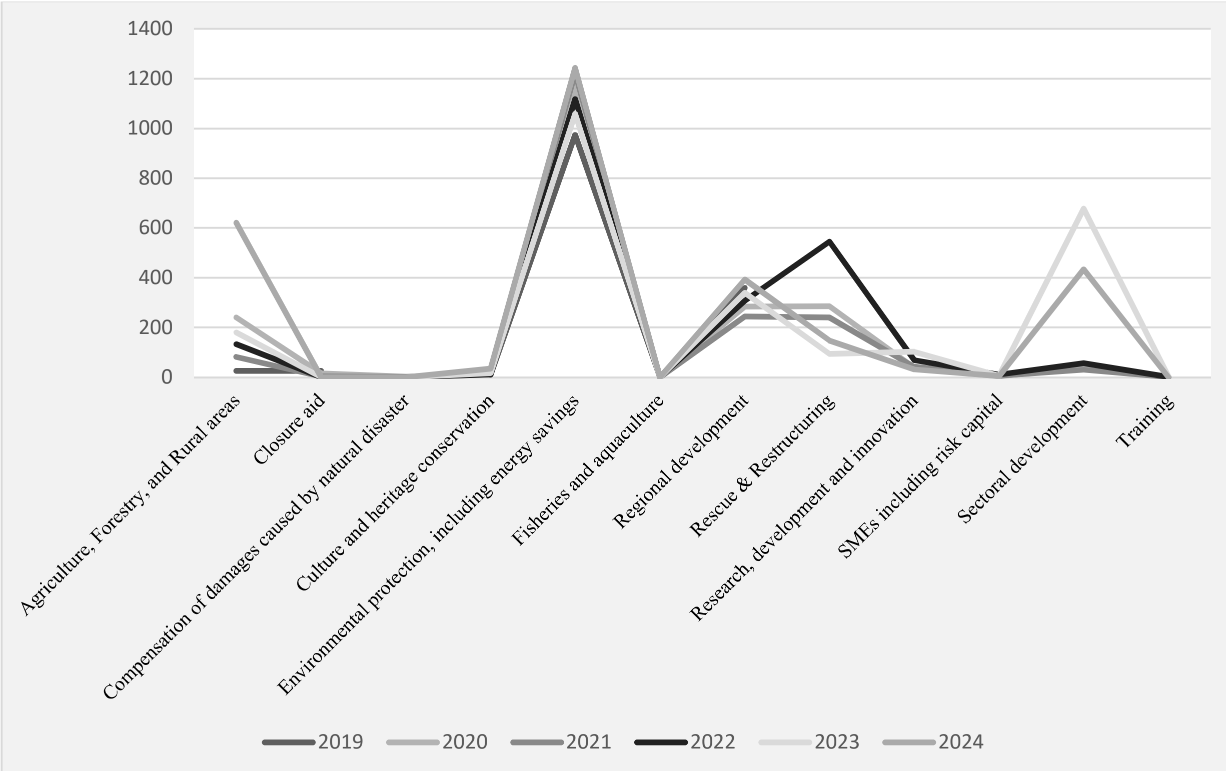


Source: Author, based on State Aid Scoreboard data (https://competition-policy.ec.europa.eu/state-aid/scoreboard/scoreboard-state-aid-data_en)

At the same time, Figure 3 highlights that the distribution of environmental aid remains highly uneven across the European Union. Larger economies such as Germany and France continue to dominate in absolute expenditure levels, reflecting both greater fiscal capacity and more extensive industrial transformation programs. Nevertheless, several smaller and medium-sized Member States also registered significant increases in environmental aid during the analysed period.

The Romanian case presents a particularly interesting dynamic within the broader European context. Although Romania has often been identified in the literature as lagging behind in terms of energy transition performance and decarbonisation indicators, the data show a gradual increase in environmentally oriented state aid between 2020 and 2024 (Figure 3). This suggests a growing policy commitment toward sustainability objectives and alignment with EU green transition priorities.

Figure 4 shows that, for Romania, during 2019-2024, among all aid categories, environmental protection and energy-saving objectives registered the most substantial increase during the analysed period. Environmental aid became one of the dominant components of Romanian state aid expenditure, particularly after the pandemic period, suggesting a stronger alignment with the broader objectives of the EU green transition strategy.



Source: Author, based on State Aid Scoreboard data (https://competition-policy.ec.europa.eu/state-aid/scoreboard/scoreboard-state-aid-data_en)

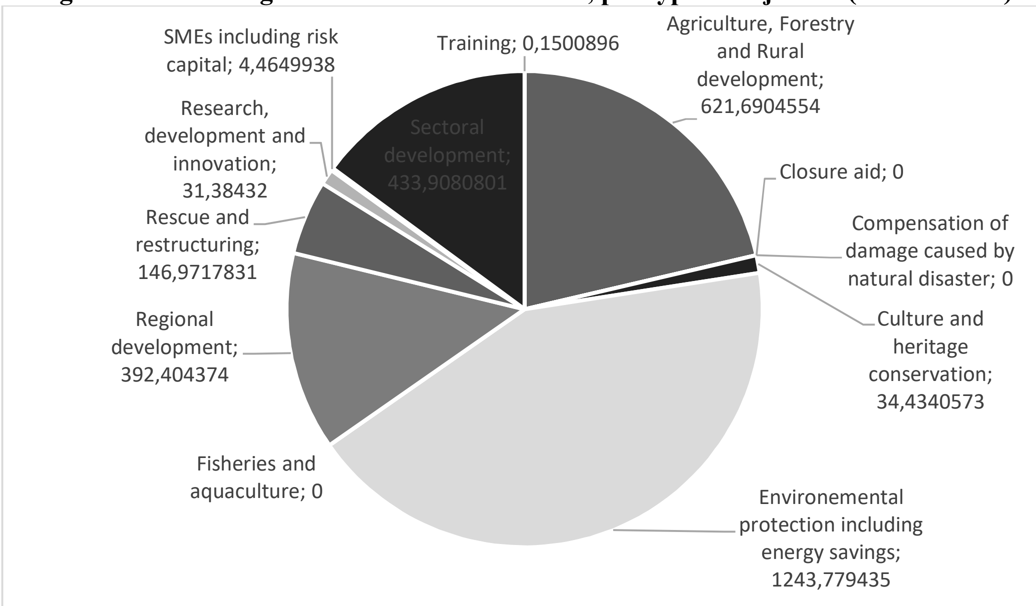
The Figure 4 also indicates that Romania gradually shifted from emergency-oriented support measures toward more structural and long-term policy objectives. While regional development and rescue and restructuring measures continued to play an important role, environmentally oriented aid experienced the most visible and sustained expansion between 2019 and 2024. This trend is particularly significant considering Romania's relatively modest position within the broader European hierarchy of environmental state aid expenditures. Although the country remains below larger Western European economies in absolute expenditure levels, the evolution recorded during the analysed period suggests increasing institutional and policy commitment toward sustainability and decarbonisation objectives.

Another important aspect concerns the post-pandemic adjustment of state aid priorities. Unlike the exceptional support measures associated with the COVID-19 crisis, environmental aid appears to have evolved into a more stable and strategic category of public intervention. This may indicate that Romania increasingly perceives the green transition not only as a regulatory obligation arising from EU membership, but also as a component of long-term economic modernisation and resilience.

Overall, the Romanian case demonstrates that environmentally oriented state aid has gained increasing relevance even in Member States facing important structural and fiscal constraints. The findings therefore support the broader argument that the green transition has remained an important policy priority within the European Union despite overlapping economic and geopolitical crises.

Figure 5 illustrates the distribution of state aid granted in Romania in 2024 according to policy objectives. The data reveal a clear hierarchy of priorities, with environmental protection and energy-saving measures representing the largest category of state aid expenditure.

Figure 5: State aid granted in Romania in 2024, per type of objective (EUR million)



Source: Author, based on State Aid Scoreboard data (https://competition-policy.ec.europa.eu/state-aid/scoreboard/scoreboard-state-aid-data_en)

Environmental aid accounted for the highest share of total aid granted in Romania in 2024, significantly exceeding other policy objectives such as regional development, agriculture and rural development, or rescue and restructuring measures. This finding suggests that environmental and energy-related objectives have become increasingly central within the Romanian state aid framework.

Agriculture, forestry and rural development also represented an important share of total expenditure, reflecting the continued structural importance of these sectors within the Romanian economy. At the same time, regional development and sectoral development measures maintained substantial relevance, indicating that cohesion and structural adjustment objectives continue to coexist alongside green transition priorities.

By contrast, aid allocated to research, development and innovation (RDI), SMEs, training, culture, and other horizontal objectives remained comparatively limited. This may suggest that Romania's state aid strategy continues to focus more strongly on immediate structural and sectoral support than on innovation-driven transformation mechanisms.

Expressed as a proportion of total aid expenditure, the dominance of environmental objectives further supports the argument that Romania has increasingly aligned its state aid priorities with the broader sustainability and decarbonisation agenda promoted at EU level. Although Romania remains below several Western European economies in terms of total environmental aid expenditure, the internal composition of aid granted in 2024 indicates a significant strategic shift toward green transition objectives.

Beyond the distribution of aid objectives, the composition of financial instruments used to support environmental aid also deserves attention.

A broader perspective covering the 2019–2024 period indicates that Member States gradually diversified the financial instruments used to support environmental objectives. While direct grants remained the dominant form of aid throughout the analysed period, an increasing use of loans, guarantees, tax measures, and other repayable instruments can also be observed, particularly after the pandemic period and during the implementation of the Temporary Crisis and Transition Framework. This evolution suggests a gradual shift from emergency support mechanisms toward more complex and strategically oriented financing structures intended to facilitate long-term green investments and industrial transformation. In Romania, the evolution of aid instruments between 2019 and 2024 reflects a similar tendency toward diversification, although direct forms of public support continued to dominate. The growing use of loans and other financial instruments in recent years may indicate an increasing effort to align national support schemes with broader EU approaches promoting sustainable investment and economic resilience. Nevertheless, compared to several Western European Member States, Romania still appears to rely more heavily on direct intervention mechanisms and less on fiscal incentives or market-based instruments.

The analysis of aid instruments further confirms that Member States rely on different mechanisms to support environmental objectives. At EU level, environmental aid in 2024 was mainly channelled through direct grants, tax measures, loans or repayable instruments, and other forms of support. This reflects a diversified policy mix, combining direct public expenditure with fiscal incentives and financial instruments aimed at stimulating green investments.

Romania presents a somewhat different profile. In 2024, more than half of its environmental aid was granted through instruments classified as "other", while direct grants and loans or repayable instruments also played an important role. By contrast, tax-based instruments represented a relatively limited share of Romanian environmental aid. This differs from the pattern observed in several other Member States, where tax exemptions or tax advantages constitute a more substantial component of environmental support.

These findings suggest that Romania's environmental state aid remains more dependent on direct or administratively defined support mechanisms than on broad fiscal incentives. This may reflect the country's institutional capacity, the structure of national support schemes, and the need to provide targeted financing for green investments. At the same time, the relatively important role of loans and repayable instruments may indicate a gradual movement toward more diversified forms of public support.

6 Conclusion

The analysis conducted in this paper demonstrates that the commitment to environmental objectives remained significant across all EU Member States during the 2019–2024 period, despite the overlapping economic and geopolitical crises affecting the European economy. Although crisis-related aid expanded substantially during the pandemic and the energy crisis generated by the war in Ukraine, environmentally oriented state aid continued to represent an important component of overall public intervention. This finding suggests that the green transition has remained a central priority of EU public policies rather than a secondary objective postponed in times of economic uncertainty.

The gradual reduction of COVID-19 related aid and the decreasing importance of emergency support mechanisms after 2022 further indicate a broader transition from short-term economic stabilisation measures toward longer-term strategic objectives linked to sustainability, industrial transformation, competitiveness, and economic resilience. Environmental state aid increasingly appears to function not only as a climate policy instrument, but also as a mechanism supporting economic modernisation and structural adaptation within the European Union.

The Romanian case reveals a more nuanced dynamic. Although Romania cannot yet be considered a top performer within the European hierarchy of environmental state aid expenditure, the data indicate a strong and visible commitment toward environmental objectives between 2019 and 2024. Environmental protection and energy-saving measures recorded the most substantial increase among all aid categories and became the dominant objective of Romanian state aid expenditure in 2024. This evolution reflects a gradual alignment with the broader objectives of the EU green transition agenda.

At the same time, the structure of aid instruments used by Romania differs from the patterns observed in several Western European Member States. Romanian environmental aid remains largely dependent on direct grants and loans or repayable financial instruments, whereas tax-based measures and fiscal incentives play a comparatively more important role in other Member States. This difference may reflect variations in fiscal capacity, institutional development, administrative practices, and the sophistication of national support schemes.

The findings of the research also suggest that the effectiveness of environmental state aid depends not only on the volume of financial support granted, but also on the strategic allocation of resources, institutional quality, policy coordination, and the capacity to mobilise private investment. Consequently, increasing expenditure alone does not automatically guarantee stronger decarbonisation outcomes or a more efficient green transition.

Several policy recommendations emerge from the analysis. First, Romanian authorities should continue strengthening support for environmentally oriented investments while gradually diversifying the financial instruments used to support the green transition. Greater use of fiscal incentives, guarantees, and market-based financing mechanisms could improve the long-term sustainability and leverage effect of public support. Second, improving administrative capacity and policy coordination remains essential for ensuring the effective implementation of environmental aid schemes and the absorption of EU funding opportunities. Finally, future policy strategies should increasingly integrate environmental objectives with broader industrial, innovation, and competitiveness policies in order to support a resilient and sustainable economic transformation.

Overall, the paper supports the conclusion that state aid has evolved beyond its traditional crisis-management function and has become an increasingly important strategic instrument for supporting the EU green transition. The recent evolution of EU state aid policy, including the adoption of the Clean Industrial Deal State Aid Framework, further suggests that environmentally oriented aid will continue to play a major role in shaping the future trajectory of European economic development.

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References:

[1] Bernaciak, M. (2025). The politics of Bulgaria's uneven energy transition. Energy Research & Social Science.

[2] Brodny, J., Tutak, M., & Grebski, W. W. (2025). Empirical evaluation of the energy transition efficiency in the EU-27 countries over a decade—A non-obvious perspective. Energies.

[3] Chen, T., & Vandendriessche, F. (2023). Evolution of the EU legal framework for promoting RES-E: A market compatible paradigm shift? Utilities Policy.

[4] Czarnecka, M., Chudy-Laskowska, K., & Budka, B. (2022). Grants and funding for the processes of decarbonization in the scope of sustainability development—The case from Poland. Energies.

[5] Degirmenci, T., & Unsal, Y. (2026). Achieving sustainable development through the green budget in the European Union: The role of renewable energy, energy productivity, and environmental policy. Sustainable Development.

[6] European Commission. (2020). Communication from the Commission—Temporary Framework for State aid measures to support the economy in the current COVID-19 outbreak (2020/C 91 I/01). Official Journal of the European Union, C 91I, 1–9.

[7] European Commission. (2023). Communication from the Commission—Temporary Crisis and Transition Framework for State aid measures to support the economy following the aggression against Ukraine by Russia (2023/C 101/03). Official Journal of the European Union, C 101, 3–16.

[8] European Commission. (2025). Communication from the Commission—Framework for State Aid measures to support the Clean Industrial Deal (Clean Industrial Deal State Aid Framework) (C/2025/3602). Official Journal of the European Union, C/2025/3602.

[9] Grafstrom, J., Soderholm, P., & Strunz, S. (2023). Government support to renewable energy R&D: Drivers and strategic interactions among EU Member States. Economics of Innovation and New Technology.

[10] Hribernik, W., Landwehr-Zloch, S. S., & Kienberger, T. (2025). Accelerating European HVDC interconnector deployment: Innovative financing mechanisms and regulatory pathways. Elektrotechnik Und Informationstechnik.

[11] Jorge-Vazquez, J., Kaczmarek, J. L., & Szymla, W. (2024). Energy transition in Poland and Spain against changes in the EU energy and climate policy. Journal of Cleaner Production.

[12] Khalique, A., Wang, Y. C., & Ahmed, K. (2025). Europe's environmental dichotomy: The impact of regulations, climate investments, and renewable energy on carbon mitigation in the EU-22. Energy Policy.

[13] Kordela, D., Mankowska, M., & Pettersen-Sobczyk, M. (2026). Crowdfunding in transport innovation and sustainability: A literature review and future directions. Sustainability.

[14] Landwehr-Zloch, S., & Hehn, M. (2026). Policy note: Mobilising private capital for European grids. Utilities Policy.

[15] Lobont, O. R., Barbulescu, M. A., & Moldovan, N. C. (2025). Paying the price to power the future: Environmental taxation, energy transition, and Europe's Green Deal. Energies.

[16] Madsen, T., Kountouris, I., & Keles, D. (2025). European or national-level emission reduction policy? Effectiveness and energy system implications. Applied Energy.

[17] Manowska, A., Bluszcz, A., & Wowra, R. (2024). Towards energy transformation: A case study of EU countries. Energies.

[18] Myskiv, G., & Ivanytskyi, R. (2024). Decarbonization as a key to sustainable development: Challenges and prospects of the EU and Ukraine. Financial and Credit Activity—Problems of Theory and Practice.

[19] Nagaj, R., Gajdzik, B., & Grebski, W. W. (2024). The impact of deep decarbonization policy on the level of greenhouse gas emissions in the European Union. Energies.

[20] Nichifor, B., Zait, L., & Turcu, O. (2025). Renewable investments, environmental spending, and emissions in Eastern Europe: A spatial-economic analysis of management and policy decisions efficiency. Sustainability.
[21] Raudla, R., Spendzharova, A., & Veskioja, K. (2025). How policy capacities shape the green transition: Explaining the use of EU sustainable finance in the EU's Central and Eastern European member states. Journal of European Public Policy.
[22] Sala, D., Liashenko, O., & Chornyi, R. (2025). The energy footprint in the EU: How CO2 emission reductions drive sustainable development. Energies.
[23] Sobczyk, E. J., Sobczyk, W., & Ciepiela, M. (2026). Assessing the pace of decarbonization in EU countries using multi-criteria decision analysis. Energies.
[24] Taylor, M., Mcdonnell, N., & Trueck, S. (2025). Scaling agrivoltaics: Planning, legal, and market pathways to readiness. Sustainability Science.
[25] Tutak, M., Brodny, J., & Grebski, W. W. (2026). Dynamic and balanced monitoring of the path to carbon neutrality among European Union countries: The DETA framework for energy transition assessment. Energies.
[26] Vuletic, D. (2020). The interaction between the EU's climate change objectives and its state aid regulation in the area of renewable energy. Croatian Yearbook of European Law & Policy.
[27] Wojtaszek, H. (2025). Renewable energy in policy frameworks: A comparative analysis of EU and global strategies for sustainable development. Sustainability.
[28] Zywiolek, J., Wolniak, R., & Abedin, M. Z. (2026). Public perceptions of crowdfunding as a tool for financing renewable energy in Europe. Energy Policy.

Researchers in R&D and Patent Applications by Residents: A Cross-Country Econometric Analysis

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Abstract: A patent application is a relevant indicator of the outcomes of research and development activities and also represents an incentive for firms and countries to invest in such activities for the economic and strategic value of the resulting goods or processes, protected for a certain period of time. In the current geopolitical and economic context, marked by fierce competition, inventions can make the difference between winners and losers on the world stage. This paper investigates the relationship between the number of researchers in R&D and patent applications by residents. It aims to determine the impact of research on innovation in Bulgaria, China, France, Germany, Hungary, Romania, Russia, Turkey, Ukraine, the United Kingdom and the US, using quantitative and econometric analyses (log-log, OLS, lag structures and non-linear specifications). The results indicate heterogeneities among the analysed countries, indicating that a high number of researchers in R&D is not enough to boost innovation. China exhibits a statistically significant, linear relationship with the highest positive elasticity between R&D and innovation, indicating an efficient conversion of researchers' activity into patent applications. France, Germany and the US showed non-linear relationships, whereas Romania, Bulgaria and Hungary registered weaker elasticities and lower research efficiency.

Keywords: R&D, researchers, patent application, innovation, econometrics
JEL Classification: O31, O32, O34, C23, O57

1 Introduction

Innovation is the main driver of progress since the beginning of recorded history. Civilisations rose and fell, led by new technologies or their absence. Particularly in the context of a knowledge-based economy, R&D and innovation are drivers of economic competitiveness and sustainable development. Against this background, the number of researchers working in R&D and the number of patent applications are relevant indicators for assessing the national innovation systems and generating and capitalising technological change.

According to the World Bank Group (2026a), researchers in Research & Development (RR&D) are "professionals who conduct research and improve or develop concepts, theories, models, techniques, instrumentation, software of operational methods, covering basic research, applied research, and experimental development."

Patent applications are "worldwide patent applications filed through the Patent Cooperation Treaty procedure or with a national patent office for exclusive rights for an invention--a product or process that provides a new way of doing something or offers a new technical solution to a problem. A patent provides protection for the invention to the owner of the patent for a limited period, generally 20 years" (World Bank Group, 2026b).

The EU aims to adopt the European Innovation Act in 2026, to create cross-sectoral legal framework conditions that remove barriers to bringing innovative ideas to market across all sectors, because it has an impressive amount of research and innovation that is not sufficiently capitalised as manufactured products or processes (European Commission, 2026).

This paper aims to compare the relationship between the number of researchers in R&D and patent applications by residents in a selection of countries across three continents, to identify whether the number of researchers alone matters, or whether other factors interfere in the innovation process.

2 Literature review

In general, the literature regards patents as an indicator of innovation in research and development activities. According to Carlino & Kerr (2014), a patent provides a legal right to exclusively make, use, or sell the invention or process for a specified period. It offers the economic motivation for inventors to pursue new opportunities by granting a temporary monopoly to successful efforts. Therefore, patent applications represent not only innovation but also an incentive to invest in R&D.

Several studies suggest there is a significant relationship between R&D personnel (human capital) and patent production. Hong & Jung (2012) identified a significant effect of the number and quality of R&D staff involved in corporate technology innovation on patent production. Their findings also emphasise that younger and larger companies tend to produce more patents, because they have more resources to support innovation, and pursue new technologies and innovative activities than older firms. Varas and de la Mata (2023) also found a strong correlation between patenting and R&D personnel, supporting the importance of specialised staff for innovation.

The role of skilled human capital in promoting innovation is also emphasised by Jin et al. (2020), who identified an extremely significant positive correlation between the number of patents and the human capital index at the company and significant positive correlations with the education level of personnel, and the proportion of engineering professionals. Thus, human capital plays an important role in innovation. Psachoulias (2021) makes the analogy to the production of physical goods when analysing how innovative output is determined by R&D activity and human capital.

There is research focused on the relationship between innovation and economic growth; for example, Beltrán-Morales et al. (2021) demonstrated that the Mexican states with the highest inventiveness activity and the greatest number of members of the National System of Researchers, on average, realised higher rates of economic growth. However, Shan (2018) argued that over 25 years, the Chinese labour force grew more slowly than R&D personnel (17% and 480%, respectively) and questioned whether such remarkable growth in R&D personnel and technological innovation capacity could continue to sustain China's economic development. The researcher believes that China’s economy and market share limit its ability to benefit from having more R&D personnel. Raghupathi & Raghupathi (2019) explored how innovation focus changes as economy develops, underline that as a nation develops, government expenditure on R&D decreases, and businesses increase local innovation. Related to that, when measuring innovation by the number of patents, Que & Zhang (2018) found that companies financed by foreign venture capital proved to be less innovative than those backed by domestic venture capital.

Castellacci & Natera (2013) found that the dynamics of national systems of innovation are driven by innovative input, scientific output and technological output, on the one hand, and infrastructures, international trade and human capital, on the other. This result varies and takes specific patterns in national systems characterised by different levels of development.

Overall, the literature suggests that R&D personnel is a central driver of innovation and patent applications, but heterogeneity exists due to institutional, economic and financial conditions.

However, despite the growing literature regarding the relationship between the researchers in R&D and patent applications by residents, there were no identified studies analysing specifically this relationship for the selected countries in this paper.

3 Methodology

This research is centred on World Bank data on researchers in R&D and patent applications by residents (PAR), covering the period 1996 to 2021. The analysis focuses on Romania and its neighbours, Bulgaria, Hungary and Ukraine, France and Germany, as the relevant countries for the EU, and the US and China as the leaders regarding the selected indicators worldwide.

In the quantitative analysis, we examined the dynamics of the selected indicators to better understand the econometric analysis results by observing their trends.

In the econometric analysis, to assess the relationship between researchers in RR&D and PAR, log-linear regression models (Ordinary least squares) are estimated, with PAR as the dependent variable and RR&D as the independent variable, to compare the relationships based on elasticities.

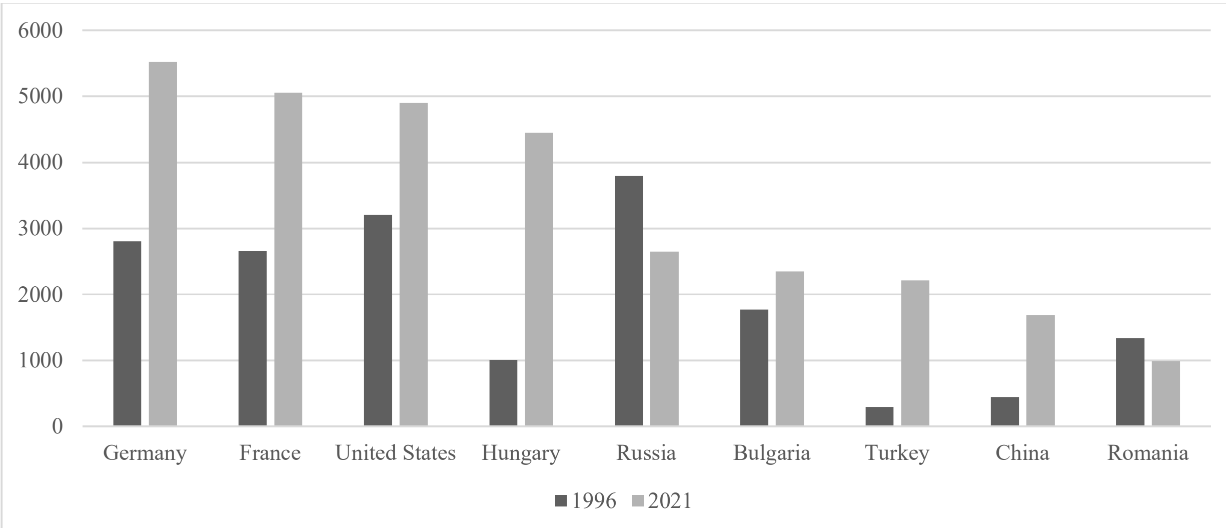
Because the effects of increasing research personnel in R&D may take time to generate relevant outcomes, several lag structures (1 to 11 years) were tested, and the models with the best explanatory power were selected.

Quadratic terms are introduced to capture potential non-linear relationships. Diagnostic tests (linearity, heteroskedasticity, autocorrelation, and normality of residuals) are conducted to assess the validity of models.

4 Quantitative analyses

In 2021, Germany registered the highest number of researchers in R&D per million inhabitants (Figure 1), at 5521, followed by France (5058) and the US (4901). Among the Eastern Bloc, Hungary leads with 4452, followed by Bulgaria (2347), with Romania ranking last in the selection (989). Among the non-Western countries, Russia ranks first with 2647 researchers in R&D activities, followed by Turkey (2210) and China (1686).

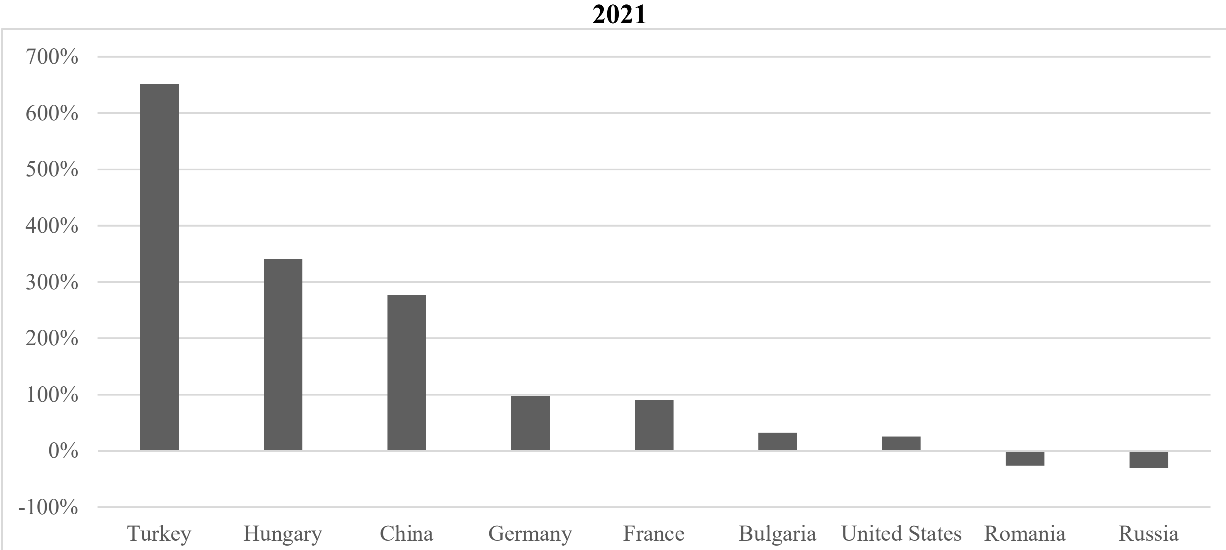
Figure 1. The number of researchers in Research & Development (R&D), expressed per million inhabitants



Source: Author’s representation based on World Bank Group (2026a).

Between 1996 and 2021, Turkey recorded the highest increase in the number of researchers in R&D activities (651%), followed by Hungary (341%) and China (277%). Germany and France increased their numbers by 97% and 90%, respectively, while Bulgaria (32%) and the US (25%) rounded out the group of selected countries with increases. Romania and Russia recorded decreases in RR&D numbers (Figure 2)

Figure 2. The number of researchers in Research & Development, Percentage change between 1996 and 2021

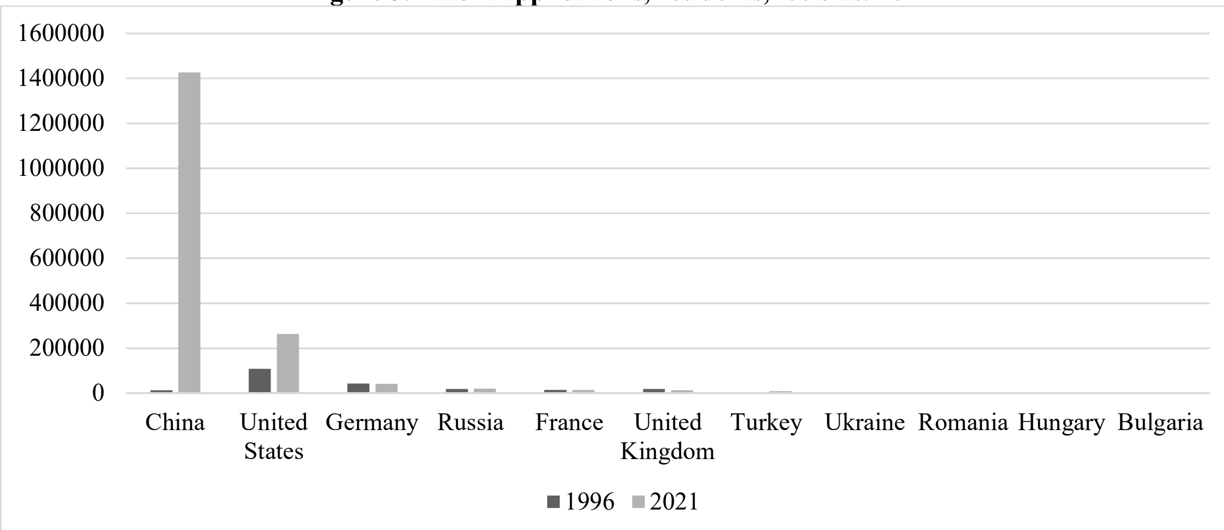


Source: Author’s representation based on World Bank Group (2026a).

Regarding patent applications by residents, in 2021, China stands out at 1.4 million, followed by the US with 262 thousand, and Germany (40 thousand). There is a group of countries with a PAR between 10,000 and 20,000, including the United Kingdom, France and Russia. Ukraine and Turkey follow at 1,302 and 8,234, respectively.

Romania and its neighbours, Hungary and Bulgaria, are at the bottom of the ranking with 772, 433 and 165 PAR, respectively (Figure 3).

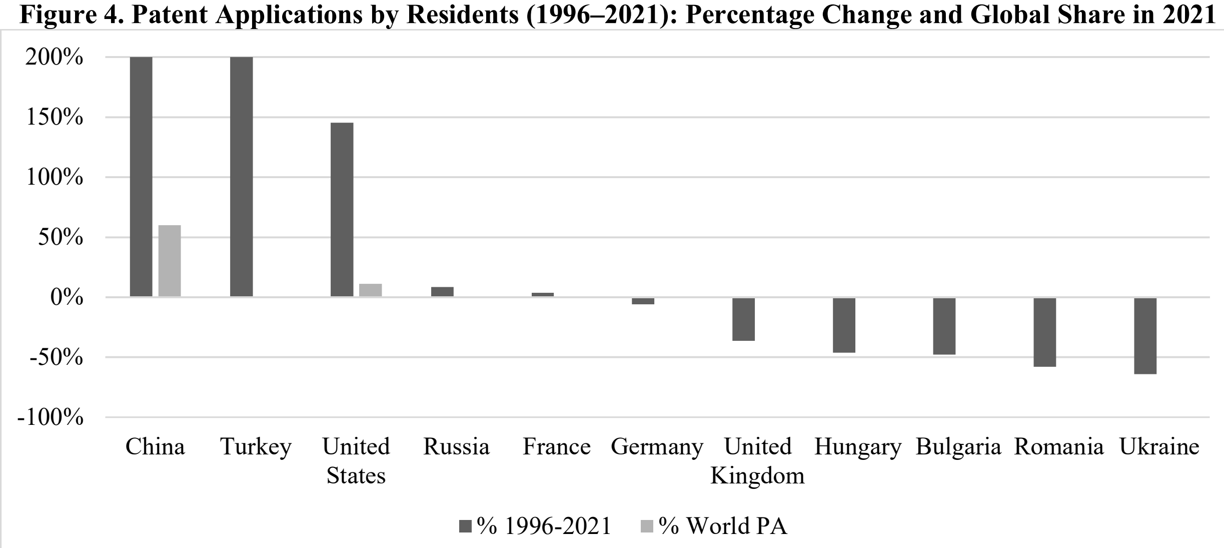
Figure 3. Patent applications, residents, 1996 vs. 2021



Source: Author's representation based on World Bank Group (2026b).

Between 1996 and 2021, China experienced a remarkable 12,169% increase in PAR (Figure 4), which accounted for almost 60% of the world's PAR in 2021. Turkey followed with a 4.256% increase, and the US ranked third with 145%. However, the US accounted for only 11% of the world's PAR, far behind China. In the positive range were Russia (9% increase in PAR) and France (4% increase in PAR).

Figure 4. Patent Applications by Residents (1996–2021): Percentage Change and Global Share in 2021



Source: Author's representation based on World Bank Group (2026b).

The rest of the selected countries recorded decreases in patent applications by residents: Germany (-6%), the UK (-36%), Hungary (46%), Bulgaria (-48%), Romania (-58%), and Ukraine (-64%).

5 Econometric analyses

To exemplify the methodology (log-log/lag), China, which had the highest elasticity among the analysed countries, was selected. The dependent variable was $lnPAR_{t,}$ and the regressor was lnRR&D, lagged by six years. The linear relationship was tested at the 95% confidence level to assess its statistical significance. The null hypothesis (H_0: $\rho = 0$) implied there was no statistically significant linear relationship between lnPARt and

$\ln RR\&D_{t-6}$ in China. The alternative hypothesis (H_a: $\rho \neq 0$) supported a statistically significant linear relationship between the two variables. The regression statistics are displayed in Table 1. The models allowed us to estimate elasticity directly: a 1% change in $\ln RR\&D_{t-6}$ leads to a ß% change in $\ln PAR_t$.

Table 1. OLS, using observations 2002-2021 (T = 20). Dependent variable: l_PAR

	Coefficient	*Std. Error*	*t-ratio*	*p-value*
const	−7.96888	1.87835	−4.243	0.0005
l_RR&D_6	3.13579	0.286987	10.93	<0.0001

Mean dependent var	12.81561	S.D. dependent var	1.208120
Sum squared resid	2.740023	S.E. of regression	0.390158
R-squared	0.901195	Adjusted R-squared	0.895706
F(1, 15)	119.3907	P-value(F)	2.25e-09
Log-likelihood	−8.501110	Akaike criterion	21.00222
Schwarz criterion	22.99369	Hannan-Quinn	21.39098
rho	0.445685	Durbin-Watson	0.987375

Since the P-value = 0.0001, smaller than the significance level: $\alpha = 0.05$, the null hypothesis (H_0) is rejected (Table 1).

Therefore, we are 95% confident that a statistically significant linear relationship exists between $\ln PAR_t$ and $\ln RR\&D_{t-6}$ in China.

Table 2. The results of tests to verify the assumptions

Lagrange Multiplier (LM) test for non-Linearity (squared terms), Null hypothesis: relationship is linear, $\alpha = 0.05$	Test statistic: LM = 0.0915696 with p-value = P(Chi-square(1) > 0.0915696) = 0.762191 P-value> α, we fail to reject the null hypothesis Relationship is linear
White's test for heteroskedasticity, Null hypothesis: heteroskedasticity not present, $\alpha = 0.05$	Test statistic: LM = 1.79654 with p-value = P(Chi-square(2) > 1.79654) = 0.407274 P-value> α, we fail to reject the null hypothesis Homoskedasticity
Test for normality of residuals, Null hypothesis: error is normally distributed, $\alpha = 0.05$	Test statistic: Chi-square(2) = 0.309956 with p-value = 0.856434, P-value> α, we fail to reject the null hypothesis Error is normally distributed
Breusch-Godfrey test for autocorrelation up to order 3, Null hypothesis: no autocorrelation, $\alpha = 0.05$	Test statistic: LMF = 2.13312 with p-value = P(F(3, 15) > 2.13312) = 0.1388, P-value> α, we fail to reject the null hypothesis No autocorrelation
Estimated Equation of the regression line	$\ln(PAR_t) = -7.97 + 3.14\ln(RR\&D_{t-6})$

According to the model, in China, a 1% increase in the number of researchers in R&D in year *t-6* is associated with a 3.14% increase in PAR in year *t*. The high elasticity ($\beta = 3.14$) indicates a very good efficiency of R&D researchers in producing patentable innovations. The six-year lag reflects the time it takes for the research to be converted into patents.

The model is statistically significant at the 95% confidence level ($\alpha = 0.0001 < 0.05$). R-squared = 0.9012, suggesting that over 90% of the variation in PAR is explained by the relationship between the two selected variables. The diagnostic tests confirm the validity of the economic model (Table 2).

The same methodology, with various procedures, was applied to the EU, as well as to Bulgaria, Hungary, Romania, Ukraine, the United Kingdom and the USA, as shown in Table 3.

Table 3. Summary table of linear regression statistical data and associated tests

Country	Model Equation	Lag	β	p-value	R^2	T	LM	WT	NR	BGA
Bulgaria	$\ln(PAR_t) = 8.87 - 0.461\ln(RR\&D_{t-2})$	t-2	-0.461	<0.0001	0.443	24	0.127	0.115	0.804	0.877
Hungary	$\ln(PAR_t) = 10.84 - 0.585\ln(RR\&D_{t-3})$	t-3	-0.585	<0.0001	0.782	23	0.190	0.581	0.318	0.133
Romania	$\ln(PAR_t) = 3.396 + 0.511\ln(RR\&D_{t-5})$	t-5	0.511	0.0282	0.139	21	0.763	0.810	0.423	0.354
Russia	$\ln(PAR_t) = 1.22 + 1.10\ln(R\ RR\&D_{t-10})$	t-10	1.103	0.0110	0.858	16	0.118	0.518	0.360	0.734
Ukraine	$\ln(PAR_t) = -6.79 + 2.02\ln(R\ RR\&D_{t-7})$	t-7	2.02	<0.0001	0.858	9	0.763	0.334	0.465	0.572
United Kingdom	$\ln(PAR_t) = 14.15 – 0.55\ln(R\ RR\&D_{t-7})$	t-7	-0.55	<0.0001	0.871	15	0.125	0.144	0.602	0.115
USA	$\ln(PAR_t) = 1.81 + 1.305\ln(RR\&D_{t-11})$	t-11	1.305	0.0007	0.51	15	0.899	0.694	0.566	0.228

The model for Turkey includes a quadratic term (sq_l_RR&D) that captures the non-linear effects of RR&D on PAR (Table 4).

Table 4. Model: OLS, using observations 1997-2021 (T = 25)
Dependent variable: l_PAR
HAC standard errors, bandwidth 2, Bartlett kernel

	Coefficient	*Std. Error*	*t-ratio*	*p-value*
const	−13.8429	3.78367	−3.659	0.0015
sq_l_RR&D	−0.287976	0.0699808	−4.115	0.0005
l_RR&D	4.34211	1.15952	3.745	0.0012
l_PAR_1	0.722524	0.114509	6.310	<0.0001

Mean dependent var	7.482840	S.D. dependent var	1.323140
Sum squared resid	0.247722	S.E. of regression	0.108611
R-squared	0.994104	Adjusted R-squared	0.993262
F(3, 21)	6314.213	P-value(F)	3.49e-31
Log-likelihood	22.20558	Akaike criterion	−36.41117
Schwarz criterion	−31.53566	Hannan-Quinn	−35.05891
rho	−0.400934	Durbin's h	−2.445100

Table 5. Diagnostic tests

Lagrange Multiplier (LM) test for non-Linearity (squared terms), Null hypothesis: relationship is linear, α = 0.05	Test statistic: LM = 3.47467 with p-value = P(Chi-square(2) > 3.47467) = 0.175989, P-value> α, we fail to reject the null hypothesis Relationship is linear
White's test for heteroskedasticity, Null hypothesis: heteroskedasticity not present, α = 0.05	Test statistic: LM = 6.73591 with p-value = P(Chi-square(8) > 6.73591) = 0.565375, P-value> α, we fail to reject the null hypothesis Homoskedasticity
Test for normality of residuals, Null hypothesis: error is normally distributed, α = 0.05	Test statistic: Chi-square(2) = 0.578559 with p-value = 0.748803, P-value> α, we fail to reject the null hypothesis Error is normally distributed
Breusch-Godfrey test for autocorrelation up to order 3, Null hypothesis: no autocorrelation, α = 0.05	Test statistic: LMF = 2.00687 with p-value = P(F(3, 18) > 2.00687) = 0.149084, P-value> α, we fail to reject the null hypothesis No autocorrelation

Estimated Equation of the regression line	*$ln(PAR_t) = -13.84 + 4.34ln(RR\&D_t) - 0.288[ln(RR\&D_t)]^2 + 0.723ln(PAR_{t-1})$*

Although the null hypothesis of linearity cannot be rejected (p = 0.176), both the linear and quadratic coefficients are statistically significant at a 95% confidence level and display the expected signs for an inverted U-shaped relationship. (Table 6). For an inverted U relationship, the EKC-type relationship applied to innovation, the conditions are: $\beta 1 > 0$, $\beta 2 < 0$

Table 6. Results

Coefficient	Sign	p-value
β1 = 4.34211	positive	0.0005
β2 = −0.28796	negative	0.0012

Thus, even if the linear relationship cannot be rejected, the quadratic model is considered because it provides additional insights into the nature of the relationship by identifying the turning point and showing why the positive effect of increasing the number of researchers in R&D weakens beyond that level.

To find the turning point for $\ln(PAR_t) = -13.84 + 4.34\ln(RR\&D_t) - 0.288[\ln(RR\&D_t)]^2 + 0.723\ln(PAR_{t-1})$

The standard formula for a quadratic function is used:

$$\ln(RR\&D)^* = -\frac{\beta 1}{2\beta 2}$$

$$\ln(RR\&D)^* = -\frac{4.34211}{2x(-0.28796)} = \frac{4.34211}{0.57592} \approx 7.54$$

$\ln(RR\&D)^* \approx 7.54$

$RR\&D^* = e^{7.54} \approx 1880$, where e ≈ 2.71828 (the base of the natural logarithm).

The results indicate that in Turkey, below 1880 researchers in R&D, an increase in RR&D leads to an increase in PAR. Beyond that level, the marginal contribution to PAR begins to decrease.

For France, the same model was used, but the residuals deviate from normality. For Germany, the relationship is not statistically significant at the 95% confidence level. The results are presented in Table 6.

Table 7. Summary table of non-linear relationships

Country	Model Equation	Lag	β	p-value	R²	T	LM	WT	NR	BGA
France*	$\ln(PAR_t) = -34.46 + 10.03\ln(RR\&D_t) - 0.610[\ln(RR\&D_t)]^2 + 0.293\ln(PAR_{t-1})$	t, t-1	10.033 / -0.610	0.0182 / 0.0185	0.669	25	0.058	0.087	**0.0002**	0.636
Germany**	$\ln(PAR_t) = -40.03 + 12.44\ln(RR\&D_t) - 0.761[\ln(RR\&D_t)]^2$	t	12.441 / −0.761	**0.0808 / 0.0755**	0.687	25				
Turkey*	$\ln(PAR_t) = -13.84 + 4.34\ln(RR\&D_t) - 0.288[\ln(RR\&D_t)]^2 + 0.723\ln(PAR_{t-1})$	t, t-1	4.342 / -0.288	0.0012 / 0.0005	0.994	25	0.176	0.565	0.749	0.149

* Model: OLS, using observations 1997-2021 (T = 25) Dependent variable: l_PAR, HAC standard errors, bandwidth 2, Bartlett kernel

** Cochrane-Orcutt, using observations 1997-2021 (T = 25), Dependent variable: l_PAR

6 Conclusions

Both quantitative and econometric analyses revealed heterogeneity among the selected countries.

China stands out with the strongest linear and statistically significant relationship at the 95% confidence level. The elasticity coefficient indicates that for a 1% increase in RR&D, patent applications by residents increase more than 3% after six years, reflecting a high productivity of research investment. The model's explanatory power is very high, with over 90% of the variation in patents being explained by the relationship between the two variables. The quantitative analysis supports these dynamics, showing an increase of more than 12,000% between 1996 and 2021. The results confirm why China alone accounts for almost 60% of the world's patent applications in 2021.

The United States and Russia have smaller elasticities (1.3 and 1.1, respectively) and lags of 11 and 10 years, indicating that a longer time is required to convert research into patentable innovation than in China.

Romania displays an elasticity below 1% and a lower model explanatory power (R^2=0.139). That indicates that other factors may influence the number of patentable innovations. Romania and Russia are the only countries in the selection where the number of researchers in R&D decreased between 1996 and 2021.

Despite the increase in the number of researchers in R&D during the analysed period, Bulgaria and Hungary recorded negative elasticities. That suggests inefficiencies in the innovation system. A 1% increase in RR&D leads to a decrease in PAR by 0.46% in Bulgaria and 0.59% in Hungary.

From the countries with a non-linear relationship between RR&D and PAR, Turkey provides the best model, with an inverted-U-shaped relationship between the variables and a turning point of 1,880 researchers, meaning that beyond that level, the marginal contribution of additional researchers to patent applications by residents diminishes.

France and Germany also displayed potential non-linear relationships. However, the model for France did not pass the diagnostic test regarding the residual normality, and the model for Germany was not statistically significant at the 95% confidence level.

Overall, the results suggest that the number of researchers in R&D alone is insufficient to increase patent applications. Therefore, further research should focus on other factors that might improve innovation output, such as R&D spending, the quality of education, patent quality metrics, and industrial structure. In this context, policymakers should adopt tailored strategies that not only aim to increase the number of researchers involved in R&D but also improve the quality of institutions, commercialisation capacity and cooperation between research and industry.

References:

[1] Beltrán-Morales, L. F., Almendarez-Hernández, M. A., Avilés-Polanco, G., & Jefferson, D. J. (2021). *Effects of the utilization of intellectual property by scientific researchers on economic growth in Mexico*. Plos one, 16(10), e0258131.

[2] Carlino, G., & Kerr, W. R. (2015). *Agglomeration and innovation*. Handbook of regional and urban economics, 5, 349-404.

[3] Castellacci, F., & Natera, J. M. (2013). *The dynamics of national innovation systems: A panel cointegration analysis of the coevolution between innovative capability and absorptive capacity*. Research Policy, 42(3), 579-594.

[4] European Commission. (2026). *European Innovation Act.* Available at: https://research-and-innovation.ec.europa.eu/strategy/support-policy-making/shaping-eu-research-and-innovation-policy/european-innovation-act_en#latest

[5] Hong, C. S., & Jung, J. H. (2012). *Technology innovation in Korean manufacturing firms: intra-firm knowledge diffusion and market strategy in patent production*. Asian Journal of Innovation and Policy, 1(1), 50-70.

[6] Jin, X., Zheng, P., Zhong, Z., & Cao, Y. (2020). *The effect of venture capital on enterprise benefit according to the heterogeneity of human capital of entrepreneur*. Frontiers in psychology, 11, 1558.

[7] Que, J., & Zhang, X. (2020). *The role of foreign and domestic venture capital in innovation: Evidence from China*. Accounting & Finance, 60, 1077-1110.

[8] Raghupathi, V., & Raghupathi, W. (2019). *Exploring science-and-technology-led innovation: a cross-country study.* Journal of Innovation and Entrepreneurship, 8(1), 5.

[9] Shan, Y. (2018, September). The impact of technological innovation on China's economic level. In 2018 International Symposium on Humanities and Social Sciences, Management and Education Engineering (HSSMEE 2018) (pp. 307-316). Atlantis Press.

[10] Pincheira Varas, A., & Mata, A. A. D. L. (2023). Innovation in Latin America and the Caribbean from advanced human capital: contribution to the development of patents in emerging countries. Journal of technology management & innovation, 18(4), 72-85.

[11] Psachoulias, G. (2021). *Human capital, trade flows and technology balance*. Available at: https://dione.lib.unipi.gr/xmlui/bitstream/handle/unipi/13840/Psachoulias_YDO1501.pdf?sequence=1

[12] World Bank Group. (2026a). *The number of researchers engaged in Research & Development (R&D), expressed as per million*. Available at: https://api.worldbank.org/v2/en/indicator/SP.POP.SCIE.RD.P6?downloadformat=excel

[13] World Bank Group. (2026b). *Patent applications, residents*. Available at: https://api.worldbank.org/v2/en/indicator/IP.PAT.RESD?downloadformat=excel

Annexe 1. Researchers in R&D (1996-2021)

Year	China	France	Germany	Hungary	Bulgaria	Romania	Russia	Ukraine	UK	USA	Turkey
1996	447.10	2656.27	2801.62	1009.15	1771.85	1340.55	3792.64	N/A	2485.75	3206.68	294.09
1997	476.21	2646.35	2862.83	1083.88	1450.78	1264.79	3598.52	N/A	2495.08	3310.88	302.98
1998	389.63	2654.59	2884.31	1142.66	1464.18	1230.48	3333.55	N/A	2694.03	3472.49	298.98
1999	422.98	2723.93	3120.90	1228.77	1306.20	1056.12	3368.96	N/A	2853.24	3547.13	312.68
2000	549.57	2902.95	3154.48	1412.00	1179.70	926.24	3446.17	N/A	2893.38	3556.39	355.05
2001	582.79	2971.39	3230.27	1440.86	1157.05	897.21	3452.79	N/A	3078.41	3598.59	344.81
2002	631.73	3100.95	3240.75	1473.70	1168.80	928.25	3375.24	N/A	3335.63	3645.75	360.00
2003	667.93	3184.64	3275.19	1499.68	1224.20	966.75	3335.95	N/A	3631.26	3851.47	484.24
2004	713.43	3320.67	3290.96	1476.27	1263.77	988.66	3283.70	N/A	3818.24	3710.15	496.59
2005	856.66	3297.85	3315.76	1575.85	1301.71	1077.56	3206.19	N/A	4117.75	3635.29	567.50
2006	931.20	3405.18	3411.79	1745.00	1348.09	900.57	3218.09	1451.92	4176.44	3674.19	612.17
2007	1076.74	3563.57	3573.67	1731.43	1471.48	897.74	3259.50	1430.03	4122.71	3624.05	705.52
2008	1197.59	3636.48	3726.67	1846.00	1505.75	932.80	3137.58	1404.84	4077.29	3751.46	742.75
2009	861.25	3723.00	3916.78	2004.50	1593.43	933.39	3075.23	1324.32	4113.42	3877.89	801.95
2010	898.86	3849.59	4056.42	2135.63	1470.69	964.53	3071.56	1306.70	4089.21	3643.93	882.50
2011	972.02	3920.66	4191.52	2309.99	1606.21	789.88	3109.37	1237.48	3973.02	3754.88	977.26
2012	1028.98	4052.17	4355.57	2400.89	1537.41	891.60	3075.21	1210.05	4017.98	3734.66	1100.19
2013	1079.64	4133.56	4380.39	2527.85	1685.20	923.70	3050.28	1139.62	4171.81	3815.21	1175.90
2014	1101.80	4210.04	4336.02	2654.80	1822.03	904.76	3072.94	1002.51	4280.80	3915.03	1163.54
2015	1162.71	4310.71	4755.30	2569.67	1976.76	876.41	3096.03	1006.00	4389.56	3949.66	1136.18
2016	1208.86	4392.05	4839.85	2625.94	2236.86	910.45	2947.00	1037.24	4434.66	3897.11	1263.79
2017	1235.85	4546.76	5058.40	2902.24	2125.46	887.75	2811.97	994.08	4472.69	4020.59	1420.60
2018	1317.49	4670.53	5209.21	3846.49	2343.49	876.17	2772.64	988.08	N/A	4322.79	1585.08
2019	1483.86	4773.97	5398.63	4021.15	2420.09	887.47	2734.69	880.55	N/A	4367.21	1737.58
2020	1600.31	4883.22	5390.05	4309.62	2401.17	942.32	2710.16	846.25	N/A	4567.79	1964.66
2021	1685.98	5058.05	5520.58	4452.49	2346.70	988.68	2647.79	774.07	N/A	4900.77	2209.70

Source: World Bank (2026a).

Annexe 2. Patent applications, residents (1996-2021)

Year	China	France	Germany	Hungary	Bulgaria	Romania	Russia	Ukraine	UK	USA	Turkey
1996	11628	12916	42322	803	316	1831	18014	3636	18184	106892	189
1997	12672	13252	44438	737	394	1708	15106	4688	17938	119214	203
1998	13751	13251	46523	690	274	1299	16454	5319	19530	134733	207
1999	15626	13592	50029	729	282	1061	19900	5401	21333	149251	276
2000	25346	13870	51736	810	231	1003	23377	5620	22050	164795	277
2001	30038	13499	49989	919	283	1128	24777	7208	21423	177513	337
2002	39806	13519	47598	842	289	1478	23712	1601	20624	184245	414
2003	56769	13511	47818	756	278	881	24969	1635	20426	188941	489
2004	65786	14230	48448	748	263	937	22985	4090	19178	189536	682
2005	93485	14327	48367	705	261	916	23644	3538	17833	207867	928
2006	122318	14529	48012	718	243	814	27884	3474	17484	221784	1072
2007	153060	14722	47853	689	211	827	27505	3440	17375	241347	1810
2008	194579	14658	49240	683	249	995	27712	2825	16523	231588	2221
2009	229096	14100	47859	757	242	1054	25598	2434	15985	224912	2555
2010	293066	14748	47047	649	243	1382	28722	2556	15490	241977	3180
2011	415829	14655	46986	662	262	1424	26495	2649	15343	247750	3885
2012	535313	14540	46620	692	245	1022	28701	2491	15370	268782	4434
2013	704936	14690	47353	642	282	993	28765	2856	14972	287831	4392
2014	801135	14500	48154	546	218	952	24072	2457	15196	285096	4766
2015	968252	14306	47384	569	280	975	29269	2271	14867	288335	5352
2016	1204981	14206	48480	616	230	1005	26795	2233	13876	295327	6230
2017	1245709	14415	47785	496	202	1098	22777	2283	13301	293904	8175
2018	1393815	14303	46617	407	180	1100	24926	2107	12865	285095	7156
2019	1243568	14103	46632	427	186	881	23337	2097	12061	285113	7871
2020	1344817	12771	42260	428	239	817	23759	1361	11990	269586	7920
2021	1426644	13386	39822	433	165	772	19569	1302	11592	262244	8234

Source: World Bank (2026b).

A Closer Look at the New IFRS Accounting Standard IFRS 18 „Presentation And Disclosure In Financial Statements” and his Impact on Company Reporting in the Future

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Abstract: In April 2024, the International Accounting Standards Board (IASB) has published a new accounting standard to be used by IFRS reporters from 2027, IFRS 18 ”Presentation and Disclosure in Financial Statements”. The new standard will transform the look of the income statement and aims to improve comparability and transparency of financial reporting. Who will the changes impact?All entities reporting under IFRS Accounting Standards will be required to adopt IFRS 18 which will replace IAS 1 ”Presentation of Financial Statements”. The main objective of the article is to present the main changes in the presentation of financial statements resulting from IFRS 18 that will affect financial reporting for periods beginning from 2027. The changes in the structure and content of financial statements are considered from the perspective of the needs of potential investors as well as other stakeholders. The paper shows that changes in the structure of IFRS's financial statements are focused on the increasing value for investors and that they improve financial performance reporting. IFRS 18 has introduced an obligation to disclose more subtotals in the income statement as well as information about management-defined performance measures. On the other hand, this accounting standard may still have a positive impact on transparency of financial statements reducing additional disclosures alongside with the presumed improvement in the quality of the financial result presented in the income statement. The considerations may constitute an impact for the preparers of financial statements under IFRS to improve the informative value of the financial statements.

Keywords: Accounting Standards, Financial Statements, Comparability, Stakeholders

1.Introduction

The objective of financial statements is to provide financial information about Companies to different stakeholders. The information should be useful for them in making decisions about e.g., buying and selling or holding equity, providing loans etc., (IFRS Foundation, 2018). One might say that financial statement is the primary means of communication with stakeholders. That is why a structure and content of financial statements are an important focus of accounting regulations. In the light of International Financial Reporting Standards the rules of preparing and presenting financial statements are covered by IAS 1 Presentation of Financial Statements (IFRS Foundation, 2024) that was first issued in 1997 (it replaced IAS 1 Disclosure of Accounting Policies). Since then IAS 1 has been amended many times to take account of changing user expectations and the changing economic environment in which companies operate. Although there were quite significant amendments of IAS 1 in 2007, 2011 and 2014, IASB did not reconsider many matters. The research project Primary Financial Statements was added to research agenda in 2014 instead (IFRS Foundation, 2018). The project was devoted to changes in IAS 1 and IAS 7 Statement of Cash Flows and finally a new accounting standard IFRS 18 Presentation and Disclosure in Financial Statements (IFRS Foundation, 2024b) was issued in April 2024. This accounting standard should be applied by companies reporting under IFRS for reporting periods beginning on or after 1 January 2027. The aim of this paper is to present the most significant changes in financial reporting resulting from IFRS 18 as compared with IAS 1 and to consider the impact of these changes on the usefulness of the financial statements. The main changes of IAS 1 (especially those improving informative value of financial statements) and summary of other proposed amendments have been also presented.

2.Literature Review

Investors seems to constitute the most significant users of financial statements. It is their decisions that affect the level of capital provided to companies. Investors generally make their decisions on the basis of opinions formulated by a wide range of analysts. Financial analysts are aware of the differences between accrual accounting and cash flows generated by companies (Liapis and Thalassinos, 2013).

For this reason, it is not only the results presented directly in the financial statements that are of interest to investors, but also other measures of performance, among which EBIT (Earnings Before Interests and Taxes) and EBITDA (Earnings Before Interests, Taxes, Depreciation and Amortization) are of particular importance.

The most popular non-GAAP measures are EBITDA, free cash flow, adjusted EBITDA, net debt, adjusted EPS and EBIT (CFA, 2016).

IFRS does not prohibit companies from presenting additional measure outside financial statements. PriceWaterhouseCoopers published the results of their review of financial statements of companies across Europe (PwC, 2006) in the first year of required IFRS reporting in European Union (IFRS reporting is required when preparing consolidated financial statements by companies listed on regulated market.

The survey revealed that companies voluntarily present non-GAAP income measures such as EBITDA (and similar) – 44% in the sample of 1300 companies, profit excluding non-recurring items – 34% in the sample of 1300 companies and 26% in the sample of 250 companies and operating profit/EBIT – 96% in the sample of 250 companies, although there were differences among different countries (PwC, 2006).

They investigated also different terms used by companies for income measures excluding non-recurring items. The survey revealed that there were rather territory than pan-European trends (as far as the Netherlands and Belgium is considered no companies reported such measures as a separate line in income statement, while in Spain and Denmark around 10% of companies presented such a separate line).

There were also different terms used by companies for these measures, the most common: results excluding exceptional items, results before non-recurring items, current operating income and underlying profit.

The EBITDA measure, which is a kind of synonym for operating cash flow, i.e. the cash flow generated by a company's core activities, is considered to be particularly useful (Pratt, Reilly, and Schweis, 1998; King, 2001; Grant and Parker 2002; Brockman and Russell, 2012).

There is currently no single generally accepted methodology for calculating this measure, although usually EBIT is the basis for its calculation. EBIT is also not yet explicitly defined, but is most often equated with operating profit.

Moreover, IAS 1 does not make a clear distinction between core and non-core activities (that results in operating and non-operating earnings), which poses a significant problem and makes it difficult to compare the performance of different companies, which may adopt different approaches to the presentation of results relating to results being thought of as having lower persistence than other components of company’s earnings and other transactions (usually referred to as special items).

This is why according to some authors special items seems to be the factor that decrease the quality of earnings (Donelson, Jennings, and McInnis, 2011).

The choice of how to present special items (as a separate line item on the income statement or aggregated within another line item) had been widely discussed by Riedl and Srinivasan (2006), who investigated if manager discretion regarding presentation within financial statements reflects the companies’ underlying economic performance or opportunistic motivations.

Finally, their findings suggest that manager discretion in the presentation of special items primary reflects economic motivations (Riedl, Srinivasan, 2006). Previous studies conducted by other authors revealed also that presenting operating earnings, non-operating earnings and other special items improves forecasts, what might be important for investors as it could improve the predictive value of financial statements (Fairfield, Sweeney, and Yohn, 1996).

The changes in the structure and content of financial statements had been discussed for many years. IASB ((International Accounting Standards Board) has carried out a number of projects to improve the information presented in the financial statements. IAS 1 (as published in 2007) is the effect of the first stage of common project of IASB.

The project resulted in improvements of IAS 1 issued in 2007 when new element of financial statement was introduced – the statement of comprehensive income (that comprises of information provided earlier by “old” income statement (profit and loss account) and information concerning revenues and costs that are presented as the changes of equity).

This project as well as the issues concerning the change in the form of financial statements' presentation are the subject of research and interest of many authors, as for example: Walińska (2009) - with regard to the change in the presentation of the balance sheet, Gierusz (2007, 2010) - who proposed a new format for the income statement.

The new research project Primary Financial Statements was added to research agenda of IASB in 2014 (IFRS Foundation, 2018). The project was devoted to changes in IAS 1 and IAS 7 ”Statement of Cash Flows” and finally a new accounting standard IFRS 18 ”Presentation and Disclosure in Financial Statements” (IFRS Foundation, 2024) was issued in April 2024.

Before the new standard had been issued, the proposals resulting from agenda papers on Primary Financial Statements and exposure drafts, was the point of interest of many authors who also published their opinions on proposed amendments as well as their own proposals (Elkins, Entwistle, 2018; Hellman, Carenys, Gutierreez, 2018; Baksaas, Stenheim, 2019).

3. Research Methodology

The main research method involved in this paper is desk research (scientific literature, reports, accounting standards, financial reports), and also used deductive method analysing the content of accounting standards and supporting materials.

4. Rules of Financial Statements' Presentation Under Internation Financial Reporting Standards

4.1 IAS 1 and Projects of Its Improvements

The choice of primary users of financial statements and the dispute over priority in financial reporting is ungoing and unresolved (Śnieżek, 2024). Some of the most significant users of financial statements are capital providers. Within capital providers, one can distinguish between individual and institutional investors as well as banks.

Investors, unlike financial institutions, do not usually have the opportunity to obtain detailed information on the asset and financial situation of the entity whose shares they intend to buy (or sell).

They must therefore rely on the information presented in the financial statements. IAS 1 (IFRS Foundation, 2024) is the basis for presentation of general purpose financial statements (statements useful to a wide range of users in making economic decisions).

In details, financial statements provide information is to provide information about the financial position, financial performance and cash flows.

A complete set of financial statements consists of a statement of financial position, a statement of profit or loss and other comprehensive income, a statement of changes in equity, a statement of cash flows, notes including material information about accounting policy and other explanatory information.

As information concerning cash flows seems to be of great importance to different stakeholders there is a separate accounting standard IAS 7 Statement of Cash Flows (IFRS Foundation, 2024).

Despite International Financial Reporting Standards regulates the measurement and recognition of many accounting items in great details, they fail to describe the structure and content of financial statements in similar details.

Moreover, investors and financial analysts seems to be interested in other metrics than only those obligatory disclosed in financial statements.

The accounting standard setters are aware of the expectations of financial statements' users and there is almost an ongoing process of improvements to requirements for presentation of financial statements. Amendments of IAS 1 that has been issued since 2007 resulted in a moderate improvement of usefulness of financial statements but still there were no additional metrics introduced.

Moreover, there are not many items that should be presented as separate line items in the profit and loss section or the statement of profit or loss apart from those resulting from IFRS 9 ”Financial Instruments” and IFRS 17 ”Insurance Contracts”.

One could have hoped in 2008 that the common project of IASB and FASB would result in more informative, more comparable and standardized set of financial statements.

According to this project the objectives of the financial statements should be: to provide a consistent financial picture of the entity's activities, to provide disaggregated information in a manner that is useful for forecasting future cash flows, and to assist users of the report in assessing the entity's liquidity and financial flexibility.

To ensure consistency, it had been proposed that entities should classify revenue, expenses and cash flows into the same sections and categories of the individual components of the financial statements as the related assets and liabilities are classified into.

Within these sections, the following were highlighted: business section, financing section, income taxes and discontinued operations. Unfortunately, on June 24 2010, IASB and FASB effectively discontinued this project, deciding to engage in additional outreach activities before finishing and publishing an exposure draft (there were published only staff draft on 1 July 2010 to seek informal comment) (IAS Plus, 2024).

4.2 IFRS 18 – The Process of Its Development and the Most Important Changes as Compared to IAS 1

The new research project Primary Financial Statements was added to research agenda of IASB in 2014. Actually, the title of the project was changed to Primary Financial Statement in 2015 (firstly it was Performance reporting) and respondents identified this project as priority and recommended focusing on the statements of financial performance (IFRS Foundation, 2015a; IFRS Foundation, 2015b).

The scope of the project (that here will be targeted improvements mainly to the presentation of financial performance) was agreed in December 2016 (IFRS Foundation, 2016). Exposure Draft General Presentation and Disclosures was published in December 2019 (IFRS Foundation, 2019).

Most respondents to the Exposure Draft agreed with the proposals, although they suggested to include more non-GAAP measures.

Finally, a new accounting standard devoted to presentation of financial statements IFRS 18 ”Presentation and Disclosure in Financial Statements” was issued in April 2024.

IFRS 18 will be used for reporting periods beginning from 1 January 2027.

The changes in IFRS 18 as compared to IAS 1 are focused mainly on the statement of profit or loss, as the IASB noticed strong demand for improvements to financial performance reporting.

This finding is in line with results of many past surveys that showed that the income statement is the most influential of the financial statements (EFRAG, 2013) and operating income and other income-based metrics are considered very useful (EFRAG, 2009).

In details there was identified a need for improvements in relation to: subtotals in the statement of profit and loss, aggregation and disaggregation and management defined performance measures.

That is why it has not introduced any changes to statement presenting comprehensive income and statement of changes in equity, and there are only limited changes to specific requirements for statement of cash flows and statement of financial position. T

The main changes introduced by IFRS 18 are as follows: − two new defined subtotals were added to statement of profit or loss: operating profit or loss, profit or loss before financing and income taxes; − income and expenses in the statement of profit or loss should be classified in one of five categories: ***operating, investing, financing, income taxes, discontinued operations***.

Operating profit or loss comprises all income and expenses classified in the operating category, while profit or loss before financing and income taxes is the sum of (a) operating profit or loss and (b) all income and expenses classified in the investing category. It must be highlighted that this new subtotal is not described as EBIT (they say EBIT is not the best way to compare companies with varied financing structures and such description could be misleading) but according to the opinion of the IASB these subtotals would increase comparability between companies (IFRS Foundation, 2024c).

Operating category has not been defined directly. Requirements of classification of income and expense to other categories make it possible to say, that income and expenses from the main business activity of a company are classified as operating (excluding any income and expenses from investments accounted for using the equity method).

In addition, operating category includes all income and expenses that are not classified by an entity in the other categories including such income or expenses that are volatile or non-recurring. IFRS 18 introduced an obligation to disclose in the notes to the statement of profit or loss information about all measures that are management-defined performance measures.

First, IFRS 18 defines management-defined performance measure as a subtotal of income and expenses that:

(a) an entity uses in public communications outside financial statements;

(b) an entity uses to communicate to users of financial statements management's view of an aspect of the financial performance of the entity as a whole; and

(c) is not listed in IFRS 18, or is not specifically required to be presented or disclosed by another standard.

There must be explained what aspect of financial performance is communicated by each measure, how each measure is calculated and there shall be disclosed a reconciliation between the management-defined performance measure and the most directly comparable subtotal.

Moreover, entity is obliged to disclose information that management-defined performance measures are not necessarily comparable with measures sharing similar labels or descriptions provided by other entities. Referring to management-defined performance measure it must be highlighted that they can be only such measures that are subtotals of income and expenses.

That is why any financial ratio can not be considered as management-defined performance measure (an entity may use financial ratios in public communication but such disclosures are outside the scope of IFRS 18). There is also stated what types of communications outside financial statements may be considered as public communication for the purposes of IFRS 18 and particularly management-defined performance measure.

Public communications include management commentary, press releases and investor presentations. On the other hand, public communications exclude oral communications, written transcripts of oral communications and social media posts.

5. Conclusions

The rules for presenting financial statements under International Financial Reporting Standard have been evolving for many years. They are focused on the increasing of usefulness of financial statements for its users.

IFRS 18 can be considered as another step in this direction although there is probably still far from expectations of financial analysts.

On the other hand, financial analysts are not the only category of stakeholders. Standards setters are aware of the fact the different measures cannot be defined precisely and it is probably not possible to make them comparable among different companies.

That is why IFRS 18 has not introduced for example EBIT or EBITDA as obligatory subtotals in the statement of profit or loss.

Unfortunately, there has not been paid much attention to the aspect of special items (non-recurring items) and still many disclosures are subject to the subjective assessment of the management (they have to use judgement to determine whether to present line items or disclose items in the notes).

There is still a need for future changes as IFRS 18 has not introduced changes in other elements of a financial statement. The distinction of individual categories of income and expenses is in line with the concept of the previous IASB/FASB project, but these categories have not been incorporated into the statement of financial position. One can hope that IFRS 18 is not the end of changes in the structure and content of financial statements.

References:

[1] Baksaas, K.M., Stenheim, T. 2019. Proposal for improved financial statements under IFRS. Cogent Business & Management, Volume 6, Issue 1, Article 1642982.

[2] Balios, D., Basiakos, I., Eriotis, N., Kotsilaras, P., Thalassinos, E. 2021. Financial Reporting Quality before and after the Greek Accounting Standards Adoption using NiCE Qualitative Characteristics Measurement Perspective of Competencies Towards Uniformity in Family Business. International Journal of Finance, Insurance and Risk management, 11(2), 28-41 ;

[3] Brockman, C.M., Russell, J.W. 2012. EBITDA: use it…or lose it? International Journal of Business, Accounting, and Finance, 6(2), 84-92;

[4] Cal, C., Jefferson, P.J. 2004. The value-relevance of earnings, operating cash flows, and EBITDA during mergers. Journal of Accounting and Finance Research, 12(3), 32-43;

[5] EFRAG. 2013. The use of information by capital providers. Academic literature review;

[6] Fairfield, P., Sweeney, R., Yohn, T., 1996. Accounting classification and the predictive content of earnings. The Accounting Review, Vol. 71, No. 3, 337-356;

[7] Grant, J., Parker, L. 2002. EBITDA! Research in Accounting Regulation, 15, 205-212.;

[8] Hellman, N., Carenys, J., Gutierreez, S.M. 2018. Introducing More IFRS Principles of Disclosure: Will the Poor Disclosers Improve? Accounting in Europe, 15(2), 242;
[9] IAS Plus 2024. Financial statement presentation — Comprehensive project. https://www.iasplus.com/en/projects/completed/fs/fsp.
[10] IFRS Foundation. 2024a. IAS 1 Presentation of Financial Statements. IFRS Foundation. 2024b. IFRS 18 Presentation and Disclosure in Financial Statements. IFRS Foundation. 2024c. IFRS 18 Presentation and Disclosure in Financial Statements. Basis for Conclusions;
[11] PwC. 2006. Presentation of income under IFRS: flexibility and consistency -. https://www.google.pl/url?sa=t&source=web&rct=j&opi=89978449&url= https://www.pwc.com/gx/en/ifrsreporting/pdf/europesurveynongaapmeasures.pdf&ved=2ahUKEwjy5cajo4WKAxW ;
[12] Riedl, E.J., Srinivasan, S. 2006. The Strategic Reporting of Special Items: Does Management Presentation Reflect Underlying Firm Performance or Opportunism? Unpublished Working Paper. Harvard Business School. https://www.academia.edu/3462438/The_Strategic_Reporting_of_Special_Items_.

Economic Migration and Regional Differences in Romania

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Abstract: Economic migration is a structural process with major implications for the socio-economic development of Romania, influencing the territorial distribution of the active population and the regional dynamics of the labor market. In the context of the persistence of significant economic disparities between the country's regions, this study examines the relationships between economic migration and regional differences, using an empirical approach based on descriptive and correlational analyses. The research integrates relevant indicators such as employment level, unemployment rate, average wage, economic structure and level of regional development, to identify patterns and asymmetries that characterize recent developments. The results highlight the fact that regions with low economic performance and limited opportunities on the labor market register higher levels of economic migration, while more developed areas have a greater capacity to retain the workforce. The correlational analysis confirms the existence of significant links between migration and socio-economic indicators, suggesting that the mobility of the active population is strongly influenced by persistent regional gaps. The findings highlight the importance of territorially differentiated public policies, aimed at reducing economic disparities, strengthening human capital and increasing the attractiveness of vulnerable regions.

Keywords: regional differences, economic migration, labor market, economic disparities.

1. Introduction

Economic migration is one of the most significant socio-economic processes that have influenced Romania in recent decades, both in terms of its magnitude and its implications for regional development and the functioning of the labor market. In the context of the structural transformations of the Romanian economy, the mobility of the active population has become an essential mechanism for adjusting to economic and occupational imbalances, reflecting the persistent differences between regions in terms of employment opportunities, income levels and quality of life. The phenomenon of migration cannot be analyzed independently of labor market dynamics, because individual mobility decisions are strongly influenced by local economic conditions and the capacity of regions to generate stable and attractive jobs.

The labor market in Romania has experienced profound transformations after 1990, marked by industrial restructuring, the increase in the share of the service sector, the intensification of foreign investments and, subsequently, by integration into the European Union. These developments have generated new economic opportunities, but have also accentuated territorial disparities, as the benefits of development have not been distributed evenly. Regions with a diversified economic structure and a high level of investment have managed to attract and retain the workforce, while areas characterized by low productivity, poor infrastructure and limited employment opportunities have experienced high levels of economic migration, both internal and external.

Regional disparities are a central element in the analysis of economic migration, as they influence both individual motivations and the capacity of territories to adapt to economic change. More developed regions, such as Bucharest-Ilfov or VEST, are distinguished by higher wage levels, low unemployment rates and an economic structure oriented towards high value-added sectors. In contrast, the North-East, South-West Oltenia or South-Muntenia regions face persistent structural vulnerabilities, reflected in low employment levels, low wages and a limited capacity to attract investment. These differences determine significant migratory flows, which, in turn, influence the territorial distribution of human capital and can accentuate existing gaps.

The relationship between economic migration and the labor market is a two-way street. On the one hand, local economic conditions influence migration decisions; on the other hand, migration affects the functioning of the labor market by modifying the labor supply, changing the demographic structure and impacting regional development processes. In regions with high levels of external migration, labor shortages can generate pressure on employers, affect economic competitiveness and limit growth potential. At the same time, remittances and the experience accumulated by migrants can contribute to local development, although these effects are often uneven and difficult to quantify.

In this context, the analysis of economic migration and regional differences becomes essential for understanding the mechanisms that shape the mobility of the active population in Romania. The present study aims to investigate the relationships between migration and regional socio-economic indicators through a descriptive and correlational approach, using data relevant to the two components.

2. Literature review

The study of economic migration and regional disparities has experienced significant development in international and Romanian literature, especially in the context of structural transformations of the labour market in Central and Eastern Europe. Internationally, migration theories have evolved from classical push-pull approaches to complex conceptual frameworks, which integrate economic, institutional and behavioural factors. De Haas (2022) proposes a model of aspirations and capacities, arguing that migration is determined both by individuals' desire to move and by the resources that allow them to do so. This perspective is relevant for Romania, where regional differences in income, infrastructure and employment opportunities directly influence the population's capacity to migrate.

In the European context, labour mobility is analysed in relation to economic convergence and the functioning of the single market. Kahanec and Zimmermann (2021) show that intra-EU migration is strongly influenced by wage differences and the structure of the labor market, while Czaika and Reinprecht (2023) highlight the role of institutions and public policies in shaping migration flows. These contributions provide a solid theoretical framework for the analysis of Romanian migration, characterized by increased mobility after accession to the European Union.

The literature on regional disparities highlights the persistence of territorial gaps in Europe, despite economic convergence processes. Rodriguez-Pose (2020) introduces the concept of left-behind places, referring to regions that do not benefit from economic growth and that, consequently, generate high levels of migration. Iammarino, Rodriguez-Pose and Storper (2019) show that regional disparities are fueled by differences in industrial structure, human capital and institutional capacity, aspects that are also found in the case of Romania. Romanian researchers support the idea that economic migration is analyzed in close connection with labor market transformations and demographic developments. Sandu (2024) highlights the role of migration networks in facilitating international mobility, emphasizing that Romanian migration is strongly influenced by community and regional factors. Stoica and Mihăilescu (2023) analyze socio-economic determinants of emigration, showing that income levels, unemployment rates and economic structure are essential factors in the migration decision. Horvath (2022) discusses the impact of migration on demographic decline, highlighting the vulnerabilities of regions with massive losses of active population.

Regional disparities in Romania are extensively documented in recent economic literature. Pîrvu and Bădîrcea (2024) show that regional differences in employment, wages and productivity remain high, despite aggregate economic growth. Goschin (2021) confirms the persistence of these gaps, emphasizing that less developed regions are caught in a vicious circle of underdevelopment, characterized by low investment, insufficient human capital and intense migration. Paraschiv and Ilie (2020) analyze the performance of the labor market at regional level, highlighting significant differences in the occupational structure and in the capacity of regions to generate stable jobs.

International and Romanian literature converge on the idea that economic migration and regional disparities are interdependent phenomena. On the one hand, regional differences in economic opportunities stimulate migration, on the other hand, migration affects the structure of the labor market and the development potential of regions. In Romania, this relationship is amplified by the structural transformations of the economy, demographic decline and intense mobility of the active population. Recent studies emphasize the need for territorially differentiated public policies, aimed at reducing disparities, consolidating human capital and increasing the attractiveness of vulnerable regions.

3. Methodology

The methodology of this study is built to analyze the relationship between economic migration and regional differences in Romania through an empirical approach based on descriptive and correlational analyses. The choice of this strategy reflects the research objective of identifying territorial patterns and connections between socio-economic indicators without resorting to complex econometric models, which would imply additional assumptions regarding temporal dynamics or the existence of endogenous variables. Therefore, the adopted methodology allows for a rigorous but flexible assessment, suitable for exploiting regional phenomena in a context characterized by structural heterogeneity.

The analysis uses secondary data from official sources, recognized for their methodological consistency and comparability. The main databases are: INS, Eurostat, OECD, International Organization for Migration (IOM). The analyzed period is 2010-2024, determined by the availability of data and its relevance for capturing recent developments in migration and the labor market in Romania.

The indicators included in the analysis are grouped into three categories:

Economic migration indicators: emigration rate, number of registered emigrants, internal inter-regional migration, remittances;

Labor market indicators: employment rate, unemployment rate, average net wage, occupational structure;

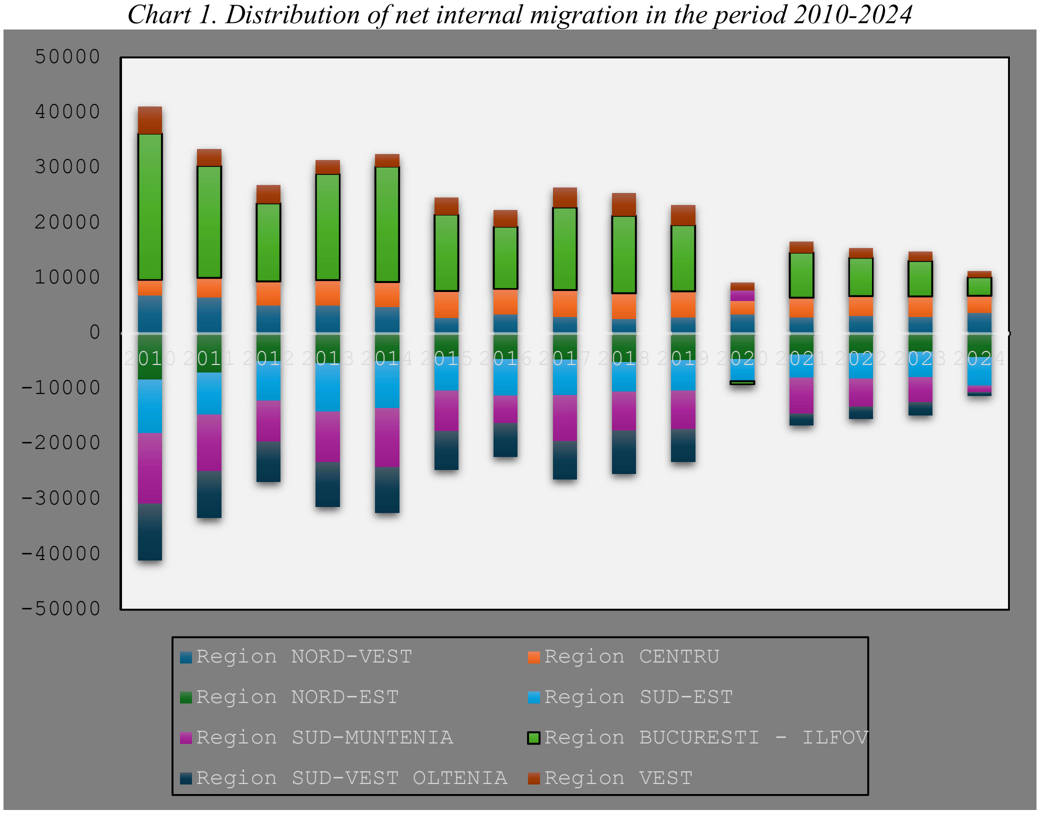
Regional development indicators: GDP/capita, labor productivity, sectoral structure, regional development index.

The selection of these variables is based on the specialized literature, which emphasizes their role in explaining economic mobility and territorial disparities, especially in the context of Central and Eastern Europe.

4. Results

The analysis highlights the existence of significant regional differences in economic migration and associated socio-economic indicators, confirming the conclusions of the specialized literature and revealing patterns specific to Romania. The descriptive analysis shows that during the period 2010-2024 economic migration followed a moderate downward trend at the national level, but with considerable variations between regions.

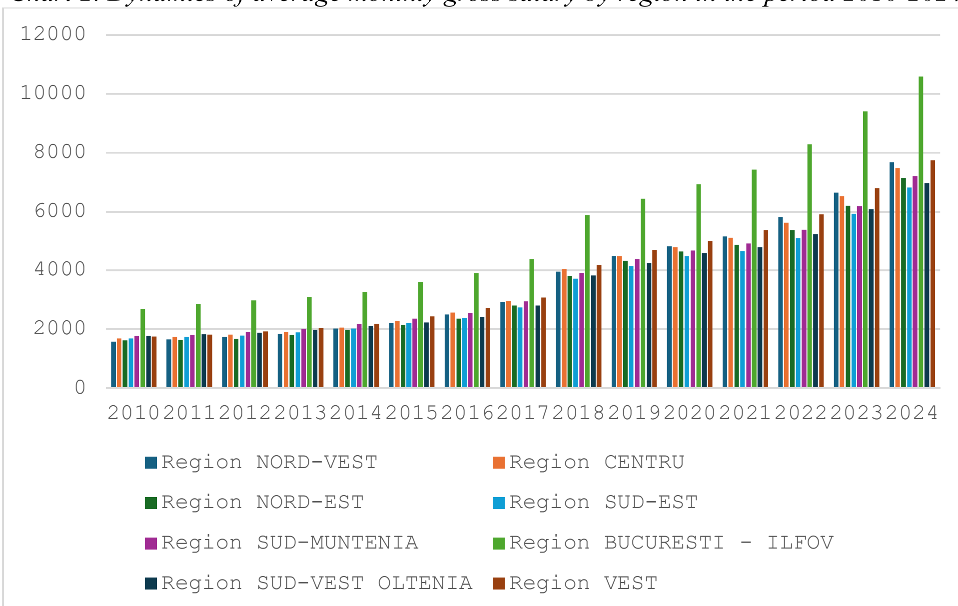
Chart 1. Distribution of net internal migration in the period 2010-2024



Source: author's processing in Excel, based on INS Romania data, Balance of residence changes by residence areas, macroregions, development regions and counties

The North-East, South-Muntenia and South-West Oltenia regions have consistently recorded the highest levels of migration, while Bucharest-Ilfov and the West region have presented significantly lower values. This distribution reflects the structural differences between the regions, especially in terms of employment opportunities and income levels. The analysis of labor market indicators confirms the persistence of pronounced territorial disparities. The employment rate is consistently higher in the West and Bucharest-Ilfov regions, where the economic structure is dominated by high value-added sectors and foreign direct investment. In contrast, the North-East and South-West Oltenia regions present low levels of employment and unemployment rates above the national average. The average net wage follows the same distribution, with differences of over 30% between the most developed and the least developed regions. These results support the hypothesis that economic migration is closely linked to labor market performance, especially wage levels and job availability.

Chart 2. Dynamics of average monthly gross salary by region in the period 2010-2024



Source: author's processing in Excel, INS Romania database, Average monthly gross nominal wage earnings by activities of the national economy (sections and divisions) NACE Rev.2, genders, macroregions, development regions and counties

Correlational analysis provides additional insight into the relationships between migration and socio-economic indicators.

Table 1. Correlation matrix (Pearson coefficient)

	Migration	Unemployed	Salary income	GDP/capita	Education
Migration	1,00	0,48	-0,59	-0,6	-0,42
Unemployed	0,48	1,00	-0,74	-0,69	0,82
Salary income	-0,59	-0,74	1,00	0,99	-0,88
GDP/capita	-0,6	-0,69	0,99	1,00	-0,85
Education	-0,42	0,82	-0,88	-0,85	1,00

Source: author's processing in Excel, INS Romania database

The Pearson coefficients calculated for normally distributed variables indicate a strong negative correlation between average wage earnings and migration (r = -0.59), suggesting that regions with higher wages experience lower levels of economic migration. This relationship is consistent with the international literature, which emphasizes the role of wage differentials in labor mobility. The analysis also reveals a moderate positive correlation between the unemployment rate and migration (r = 0.48), indicating that regions with limited employment opportunities are more prone to losses of the active population.

Regarding regional development indicators, GDP per capita shows a significant negative correlation with migration (r = -0.6), confirming that more economically developed regions manage to retain the labor force. Labor productivity follows a similar pattern, suggesting that the economic structure and the level of regional competitiveness directly influence mobility decisions.

Overall, the study results show that economic migration is strongly influenced by regional differences in labor market performance and economic development. The relationships identified through correlational analysis support the hypothesis of interdependence between migration and regional disparities, suggesting the need for public policies adapted to the territorial specifics.

5. Conclusions

The analysis of the relationship between internal economic migration, the labor market and regional disparities in Romania highlights a set of structural mechanisms that continue to shape the territorial distribution of the active population. Beyond annual or cyclical variations, internal mobility remains a process deeply anchored in differences in economic development, in the structure of local opportunities and in the capacity of regions to generate favorable conditions for employment and living. This dynamic confirms that internal migration is not just a demographic phenomenon, but a synthetic indicator of the functioning of the regional economy.

A first element that emerges from the integrated analysis is the persistent nature of territorial polarization. Regions that have structural advantages – developed infrastructure, economic diversification, access to investment and quality public services – tend to accumulate human capital and consolidate their position in the regional hierarchy. In contrast, regions with historical and economic vulnerabilities face difficulties in retaining the active population, which amplifies existing imbalances. This cumulative logic suggests that internal mobility functions as a territorial selection mechanism, through which individuals adjust their position according to perceived opportunities.

Second, the relationship between the labor market and migration emerges as a central element in understanding regional dynamics. Regions capable of offering stable jobs, competitive wages and attractive career prospects become points of attraction for the active population. In contrast, areas characterized by high unemployment, low productivity or poorly diversified economic sectors tend to be marked by demographic losses. This relationship confirms the role of the labor market as a fundamental determinant of internal mobility and underlines the importance of policies aimed at increasing the quality of employment.

A third relevant aspect is the interdependence between migration and regional development. The mobility of the active population can contribute to the dynamism of expanding regions, but can also accentuate the vulnerabilities of declining regions. In this sense, internal migration acts simultaneously as a symptom and a factor of regional disparities. Regions that lose active population face a shrinking workforce, a decline in investment attractiveness and difficulties in maintaining public services, which can generate a vicious circle of stagnation. Overall, the study shows that internal economic migration is a barometer of the functioning of the regional economy and an essential element in understanding the socio-economic transformations in Romania. An integrated approach, which connects population mobility with labor market dynamics and regional development, is indispensable for the formulation of coherent and effective public policies.

References:

[1] Czaika, M., Reinprecht, C. (2023). Drivers of labour mobility in Europe. Migration Studies, 11(2), 345-367.

[2] de Haas, H. (2022). A theory of migration: The aspirations-capabilities framework. Population and development Review, 48(4), 939-975.

[3] Dustmann, C., Gorlach, J. (2024). The economics of temporary and circular migration. Journal of Economic Perspectives, 38(1), 23-48.

[4] Goschin, Z. (2021). Regional inequalities and economic growth in Romania. Romanian Journal of Economic Forecasting, 24(3), 5-22.

[5] Horvath, I. (2022). Labour migration and demographic decline in Romania. Journal of Balkan and Near Eastern Studies, 24(6), 987-1005.

[6] Iammarino, S., Rodriguez-Pose, A., Storper, M. (2019). Regional inequality in Europe: Evidence and policy implications. Journal of Economic Geography, 19(2), 273-298.

[7] Ionescu, A. M. (2023). Labour market transformations in post-transition Romania. Sustainability, 15(4), 2150.
[8] Kahanec, M., Zimmermann, K. (2021). Labour mobility in the EU: Trends and policy challenges. IZA Journal of Labor Policy, 11(1), 1-22.
[9] Paraschiv, G., Ilie, C. (2020). Regional labour market performance in Romania. Eastern European Economics, 58(5), 403-425.
[10] Pîrvu, R., Bâdîrcea, R. (2024). Regional labour market disparities in Romania. Economic Research-Ekonomska Istrazivanja, 37(1), 112-130.
[11] Rodriguez-Pose, A. (2020). The rise of left-behind places. Regional Studies, 54(1), 1-14.
[12] Sandu, D. (2024). Migration networks and regional development in Romania. Sustainability, 16(2), 889.
[13] Stoica, C. A., Mihăilescu, A. (2023). Socio-economic determinants of Romanian emigration. Social Indicators Research, 167(3), 945-968.

Financial Structure, Profitability and Productivity in the Romanian Pharmaceutical Industry: A 2020–2024 Analysis

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Abstract: The pharmaceutical manufacturing sector is one of the most stable and high-performing sectors of the Romanian economy. This study analyzes the evolution of the financial performance of companies classified under NACE code 2120 (Manufacture of pharmaceutical preparations) for the period 2020–2024. To this end, key financial performance indicators are examined, such as revenue, debt-to-equity ratio, return rates, and labor productivity. The results highlight a constant increase in revenue and net profit, the consolidation of equity, and improved operational efficiency. Ratios of profitability (ROA, ROE, ROS) show an upward trend, and labor productivity confirms the increasingly efficient allocation of resources. The paper provides an integrated perspective on the performance of the pharmaceutical sector during the 2020–2024 period.

Keywords: pharmaceutical industry, financial performance; profitability; rate of return; labor productivity
JEL Classification: L65, M21, G30, O14.

1. Introduction

According to Eurostat data, the pharmaceutical industry generates the highest added value per employee among high-technology sectors, far exceeding the average levels recorded in both high-tech and manufacturing industries. The pharmaceutical industry also records the highest ratio of R&D investment to net sales. As reported in the 2024 EU Industrial R&D Investment Scoreboard, health industries invested around €258.1 billion in research and development in 2023, accounting for 20.5% of worldwide business R&D spending.

The pharmaceutical industry is also a key sector for the Romanian economy. Its importance stems both from its contribution to public health and from its role in economic development and in fostering innovation. The pharmaceutical manufacturing sector (NACE code 2120) is characterized by high levels of investment, strict quality standards, and a highly dynamic market. It is influenced by factors such as demographic trends, legislative changes, and growing demand for medicines. In this context, analyzing the sector's performance is necessary to understand its operating mechanisms and future development directions.

The importance of this study derives from the necessity to identify the sector's financial and structural trends in a period of significant changes. These transformation processes include market consolidation and companies' adjustments to post-pandemic economic conditions. The study aims to analyze the evolution of the pharmaceutical sector's financial performance over the period 2020–2024, focusing on the dynamics of revenue, profitability, financial structure, and labor productivity. At the same time, the study seeks to highlight the competitive position of the industry's leading manufacturers, without focusing on any single company.

The research methodology is based on an analysis of financial data obtained from the platforms risco.ro and listafirme.ro for companies classified under NACE code 2120 (Manufacture of pharmaceutical preparations). The data were statistically processed and interpreted using relevant key performance indicators: revenue, net profit, debt-to-equity ratio, profitability ratios (ROA, ROE, ROS), and labor productivity. This approach enables a comprehensive assessment of the sector's performance and provides a clear overview of its dynamics during the period under review. At the same time, it contributes to a better understanding of recent trends in the pharmaceutical industry.

2. State of knowledge

The performance of the pharmaceutical industry is frequently analyzed in the economic literature due to its essential role in the economy and the healthcare system. The pharmaceutical sector is considered a strategic one, as it contributes to ensuring access to medicines, developing new therapies, and improving quality of life. Studies highlight the changes that occurred during the pre- and post-pandemic periods and how companies have adapted to shifting demand and the regulatory framework (Hada, 2024). Companies have had to adapt rapidly to changes in demand, fluctuations in drug consumption, and frequent adjustments to the regulatory framework.

The literature emphasizes the importance of return rates in evaluating company performance, as they reflect the efficiency of invested capital and provide information on the causes and effects of changes when the analysis covers several successive fiscal years. Studies show that pharmaceutical firms tend to record high levels of profitability due to stable demand, diversified portfolios, and continuous investment in modern technologies.

Another issue debated in the specialist literature is the importance of using labor productivity to assess firms' operational efficiency. Research shows that productivity in the pharmaceutical sector is impacted by digitization, automatization, and workforce specialization. In addition, the authors emphasize that firms that invest in advanced technologies and employee training manage to achieve superior performance. At the same time, they also succeed in consolidating their position in the market (Buelvas et al., 2023).

Furthermore, the literature analyzes the structure of the pharmaceutical market, highlighting the trend toward concentration around a few large companies. These companies possess the resources necessary to support significant investments and influence market dynamics. This concentration is associated with financial stability, but also with competitive pressures on small and medium-sized firms.

In conclusion, the current state of knowledge shows that the performance of the pharmaceutical sector is influenced by several factors, including market structure and the allocation of resources. The level of innovation plays an important role, as does the ability of firms to adapt to economic changes.

3. Research Methodology and Data Set

The purpose of this study is to highlight the general trends in the financial performance of the pharmaceutical manufacturing sector for the period 2020–2024. The study uses an empirical approach based on the analysis of financial data reported by companies classified under NACE code 2120.

To calculate profitability indicators, we used data including net turnovers, net profit, fixed assets, current assets, equity, total liabilities, number of employees, and number of active firms, from risco.ro (Table 1).

Table 1 – Financial data for the NACE code 2120 sector for the period 2020–2024

Year / Indicators	2020	2021	2022	2023	2024
Turnover (RON)	3195647011	3455106886	3979347978	4687114136	5233406484
Net profit (RON)	509105295	526876142	776473303	901422374	1502859347
Fixed assets (RON)	1907461314	2021967250	2318480785	2471347604	3111493704
Current assets (RON)	2827182219	3227851801	3743860521	4401612144	4755494899
Equity (RON)	3293488176	3764645899	4234908902	4858031210	5647694905
Total liabilities (RON)	1441155357	1485173152	1827432404	2014928538	2219293698
Number of employees	6791	6843	6731	6897	6960
Number of companies	122	119	115	113	104
Average turnover (RON/company)	26193828	29034512	34603026	41478886	50321216
Average net profit (RON/company)	3195647011	3455106886	3979347978	4687114136	5233406484

Source: Authors' processing based on data from risco.ro, accessed on July 27, 2025

The formulas used to calculate the profitability indicators analyzed in this study are:

- Return on Assets: ROA = (Net profit)/(Total assets) x 100
- Return on Equity: ROE = (Net profit)/(Equity) x 100
- Return on Sales: ROS = (Net Profit)/(Turnover) x100
- Labor Productivity: W = (Turnover)/(Number of Employees)

4. Results and Comments

4.1 Turnover Trends in the Pharmaceutical Industry

The evolution of turnover reflects both the dynamics of demand and the ability of companies to adapt their operations to economic conditions. The data summarized in Table 1 highlight a clear upward trend for the 2020–2024 period, confirming the sector's resilience in an economic context marked by additional pressures on the healthcare system.

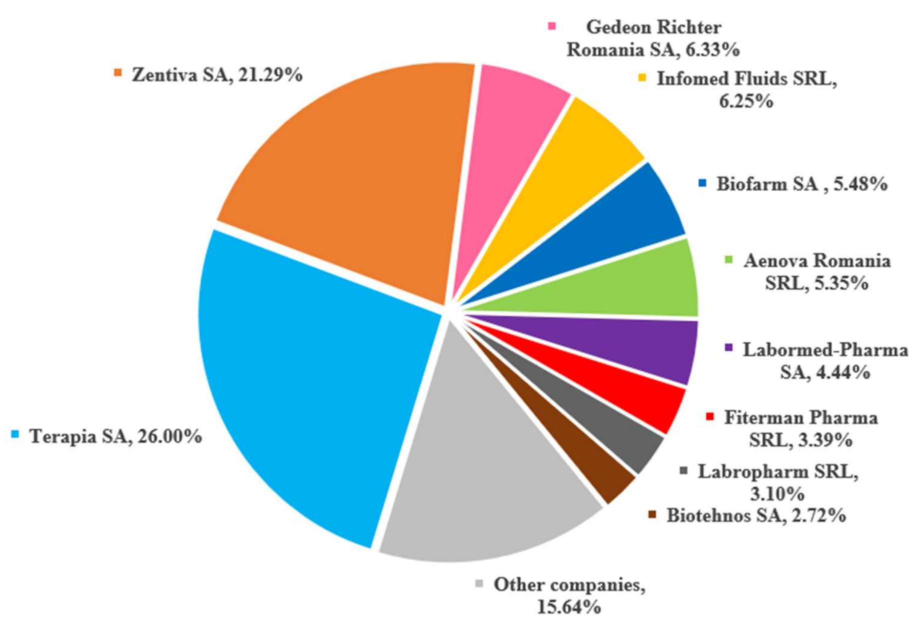
Total revenue increased from 3.19 billion RON in 2020 to 5.23 billion RON in 2024, representing an increase of over 63%. This trend reflects the expansion of economic activity and the rise in demand for pharmaceutical products, particularly in the post-pandemic period.

A notable aspect is the increase in average turnover per firm, which nearly doubled during the period analyzed, from 26.19 million RON to 50.32 million RON. This trend indicates a process of structural consolidation within the sector, also confirmed by the decrease in the number of active companies (from 122 to 104). The businesses remaining in the market are, on average, larger and more efficient.

The market share reflects the proportion of a company's revenue relative to the total sales of the sector in which it operates. For 2024, an analysis of the market shares of the main competitors has revealed significant trends in Romania's pharmaceutical industry. It also provides a clearer picture of the competitive structure within this sector.

Figure 1 presents the market structure of pharmaceutical manufacturers in Romania, based on data from 2024. It includes companies classified under NACE code 2120 that recorded a turnover of over 100 million RON.

Figure 1 – Market Position of Pharmaceutical Manufacturers in Romania in 2024



Source: Authors' processing based on data from risco.ro, accessed on July 27, 2025

The top three manufacturers account for nearly 54% of the market, indicating a dominant position and a strong ability to influence the sector's dynamics.

The market leader is Terapia SA, with a 26% share, followed by Zentiva SA, with 21.29%, and Gedeon Richter Romania SA, with 6.33%. The combined market share of these companies indicates the existence of a group of firms with significant competitive influence in the sector. These firms are distinguished by high production levels, diversified portfolios, and stable access to the main sales channels.

The next positions are held by manufacturers with smaller individual market shares, yet still relevant to the market structure: Infomed Fluids SRL (6.25%), Biofarm SA (5.48%), Aenova Romania SRL (5.35%), Labormed Pharma SA (4.44%), Fiterman Pharma SRL (3.39%), Labropharm SRL (3.10%), and Biotehnos SA (2.72%). These companies contribute to the sector's diversity through their activity in specific therapeutic segments or in contract manufacturing. They also develop product lines with low volume but high added value. This allows the firms to remain competitive within the industry.

The "Other Companies" category, which accounts for 15.64% of the market, includes companies with turnover below 100 million RON. Although they have small market shares individually, together they form a significant segment. This segment is characterized by flexibility, specialization, and the ability to address therapeutic niches or specific market demands.

4.2 Trends in equity and liabilities in the pharmaceutical industry

The evolution of equity between 2020 and 2024 shows a constant rising trend, indicating financial consolidation of companies in the pharmaceutical manufacturing sector. The value of equity has increased significantly, from approximately 3.29 billion RON in 2020 to over 5.64 billion RON in 2024. This trend shows that companies have managed to strengthen their equity, either by reinvesting profits or by attracting external capital through stock offerings.

The increase in equity reflects a process of sustainable development, based on long-term investments and efficient resource management. Overall, companies in the sector have become more stable and more capable of sustaining their operations with their own funds. Furthermore, as stability increases, firms are also reducing their dependence on external financing.

Total debt also increased, though at a more moderate pace. From RON 1.44 billion in 2020, debt reached RON 2.22 billion in 2024, indicating that companies took out loans only when necessary. Through this strategy, companies maintain a controlled level of financial exposure.

According to the literature, a debt-to-equity ratio between 0.5 and 2.0 is considered appropriate, depending on the sector's specific features (Popescu, 2019). In the pharmaceutical sector, companies tend to have lower debt levels. Figure 2 highlights the maintenance of a balanced ratio between equity and debt. This indicates a low level of financial risk and a healthy financing structure across the entire sector.

Figure 2 – Trend in the debt-to-equity ratio in the pharmaceutical industry (2020–2024)

Source: Authors' processing based on data from risco.ro, accessed on July 27, 2025

Figure 2 shows that the debt-to-equity ratio remained consistently below the 0.5 threshold throughout the entire period analyzed. In 2020, the ratio was 0.4376, falling to 0.3945 in 2021, followed by a slight increase in 2022 to 0.4315. In 2023 and 2024, the ratio returned to a downward trend, reaching 0.4148 and 0.3930, respectively.

This trend indicates a stable financial structure, characterized by a low level of indebtedness that has been declining in recent years. The ratio remaining below 0.5 shows that company rely mainly on equity to finance their operations, which limits financial risk and vulnerability to potential repayment difficulties.

Overall, the pharmaceutical manufacturing sector has a solid financial position, supported by growth in equity and prudent debt management. These factors confirm the stability and ability of companies to respond to future economic challenges.

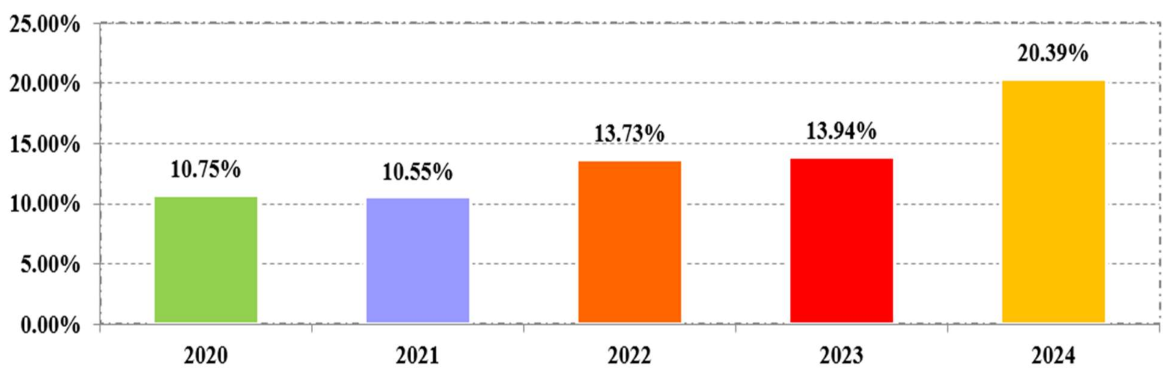
4.3 Profitability trends in the pharmaceutical industry

Profitability in the pharmaceutical manufacturing sector showed a positive trend between 2020 and 2024. Total net profit increased from approximately 509 million RON in 2020 to over 1.5 billion RON in 2024, indicating a significant improvement in economic performance. Furthermore, the average net profit per firm rose from 4.17 million RON to 14.45 million RON, reflecting increased operational efficiency at the individual firm level.

To measure profitability in relative terms, three key indicators were analyzed: ROA, ROE, and ROS. These provide a clearer view of how firms use assets, equity, and revenue to generate profit.

Return on assets (ROA) measures the efficiency of using assets to generate profit. The evolution of ROA for the industry is illustrated in Figure 3.

Figure 3 – ROA Trends in the pharmaceutical industry (2020–2024)



Source: Authors' processing based on data from Table 1

The trend in ROA shows a significant increase in economic efficiency. The indicator increased from 10.75% in 2020 to 20.39% in 2024, the highest level of the period. After a slight decline in 2021, ROA shows growth in 2022, and in 2023 the trend is nearly stagnant, with very modest but still positive growth. In 2024, a more pronounced increase is observed, suggesting a more efficient use of assets and a strengthening of economic performance in the sector.

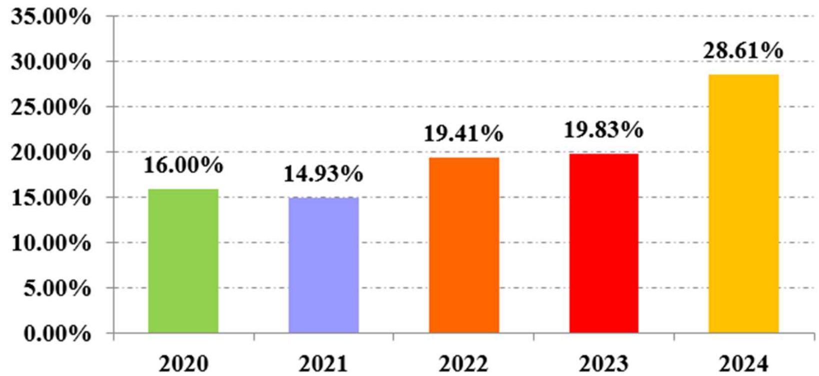
This trend indicates that firms in the pharmaceutical manufacturing sector have consistently improved their economic efficiency. They have managed to achieve higher profits relative to the assets used. This reflects solid financial management. At the same time, it also highlights an increasing ability to adapt to market demands and capitalize on opportunities in the field.

The return on equity ratio expresses a firm's ability to generate net profit using the equity capital invested in its operations.

Figure 4 shows that ROE increased from 16% in 2020 to 28.61% in 2024, nearly doubling over the period analyzed. After a decline in 2021, the indicator returned to an upward trend, reflecting efficient use of equity and increasingly solid financial performance. The high level in 2024 suggests an attractive sector for investors.

This trend reflects an increasing ability of companies in the pharmaceutical manufacturing sector to generate profit from their own resources. The 2024 figure suggests solid financial performance, supported by efficient use of equity and a well-defined growth strategy.

Figure 4 – ROE Trends in the Pharmaceutical Industry (2020–2024)

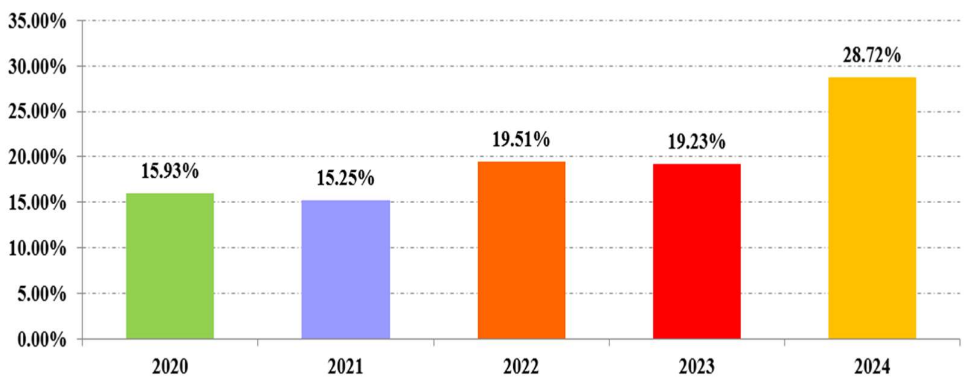


Source: Authors' processing based on data from Table 1

Return on sales is a financial indicator that measures a company's efficiency in generating profit from revenue. ROS shows what percentage of sales revenue is converted into net profit.

Figure 5 highlights a positive trend in ROS, with an increase from 15.93% in 2020 to 28.72% in 2024. Although there were moderate fluctuations in 2021 and 2023, the overall trend is upward. The most significant change occurs in 2024, when the return on sales reaches 28.72%. This result reflects exceptional performance, driven by a combination of innovation, cost optimization, rising demand, and a strengthened market position.

Figure 5 – ROS Trends in the Pharmaceutical Industry (2020–2024)



Source: Authors' processing based on data from Table 1

Overall, this sustained growth in ROS indicates that the pharmaceutical manufacturing sector has become increasingly profitable. It also points to greater efficiency in converting sales into profit. This progress is particularly evident in the post-pandemic period, when companies have managed to adapt more effectively to new market conditions.

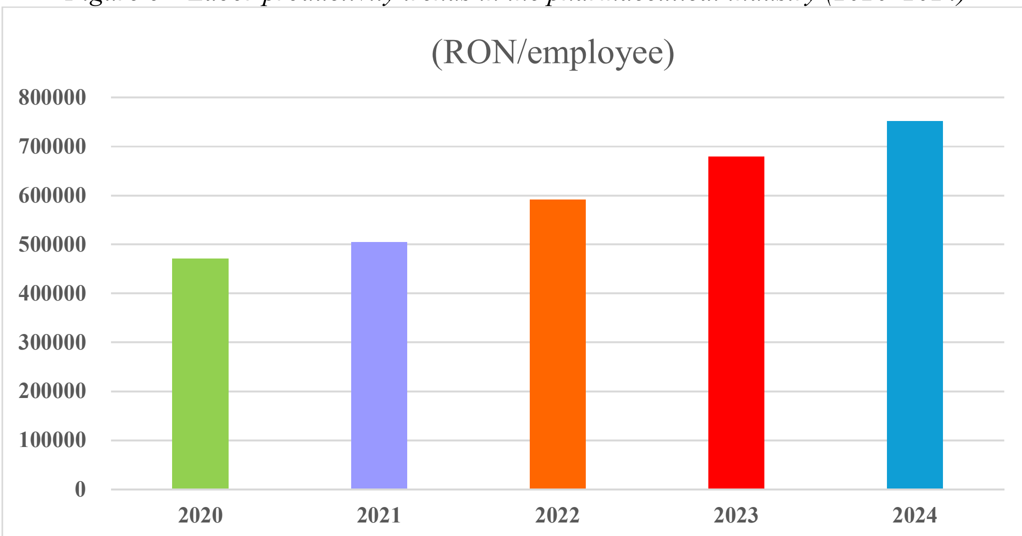
4.4 Trends in labor productivity in the pharmaceutical industry

Labor productivity is a key indicator of workforce efficiency, expressing the amount of revenue generated by each employee. A high level of this indicator reflects an efficient use of human resources and an increased ability to convert inputs into economic outcomes. Labor productivity is calculated by dividing turnover by the average number of employees.

Figure 6 illustrates a continuous increase in labor productivity between 2020 and 2024, indicating a sustained improvement in economic performance. In 2021, productivity rose by 7.30% compared to the previous year. However, in 2022, there was a significant increase of 17.09%, reflecting a much more efficient use of the workforce. The upward trend continued in 2023, with a 14.95% increase, confirming the strengthening of operational efficiency in the pharmaceutical sector.

In 2024, the growth rate tempered, but remained positive, with labor productivity increasing by 10.64% compared to 2023 and reaching the highest level of the period. This sustained evolution reflects both the modernization of production processes and companies' adaptation to market demands and changes in the economic environment.

Figure 6 – Labor productivity trends in the pharmaceutical industry (2020–2024)



Source: Authors' processing based on data from Table 1

5. Conclusions

In recent decades, the global healthcare market has experienced steady growth, particularly during the global COVID-19 pandemic. Along with this rapid growth, the pharmaceutical sector has experienced significant development.

The analysis of the Romania's pharmaceutical manufacturing sector for the period 2020–2024 reveals a solid increase in financial performance. At the same time, it highlights the fact that companies have managed to adapt successfully to the economic challenges of recent years (the COVID-19 pandemic, the energy crisis, etc.).

The analysis presented in this paper shows a steady increase in both turnover and net profit, confirming the sector's strengthened position within the Romanian economy. Equity has trended upward, while debt has grown at a slower rate, maintaining a debt-to-equity ratio below 0.5. This financial structure indicates a low level of risk and limited dependence on external financing.

Return rates (ROA, ROE, ROS) showed a clear upward trend, reflecting an increasingly efficient use of assets, equity, and sales revenue. The high 2024 values confirm the sector's maturity and the companies' ability to generate profit in a competitive environment.

At the same time, labor productivity has grown steadily, indicating greater efficiency in operational processes and improved leverage of human resources. This trend is supported by technological modernization and companies' adaptation to market demands.

Recent developments in the Romania's pharmaceutical manufacturing sector have been characterized by stability and financial performance. At the same time, this sector has significant growth potential and remains one of the most dynamic sectors of the Romanian economy.

This paper makes a valuable contribution to the literature by analyzing both the financial and structural performance of the sector. This approach provides an up-to-date picture of recent trends and the directions in which the pharmaceutical industry is evolving.

References:

[1] Diaconu, A. (2019). Diagnosticul și evaluarea întreprinderii. Editura Economică, București

[2] Hada (Goia), I. D. (2024). Analiza performanței financiare a sectorului industriei farmaceutice din România în perioada pre și post-pandemică, Editura Universitară, București
[3] Buelvas Parra, J. A., Pacheco Ruiz, C., & Niebles Nuñez, W. (2023). Productivity in the pharmacy sector. Journal of Population Therapeutics and Clinical Pharmacology, 616-629
[4] Popescu, I. (2019). Analiza financiară a întreprinderii. Editura Economică, București
[5] https://www.efpia.eu/media/uj0popel/the-pharmaceutical-industry-in-figures-2025.pdf
[6] https://iri.jrc.ec.europa.eu/data
[7] https://targetare.ro/top-firme-cod-caen/2120/fabricarea-preparatelor-farmaceutice
[8] https://www.risco.ro/analiza-sectoriala/
[9] https://www.listafirme.ro/

Green Jobs in Romania in the Context of the Circular Economy: Opportunities, Challenges and Public Policy Directions

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Abstract: The article analyzes the development of the concept of green jobs and the acquisition of green skills in Romania in the context of the transition towards the circular economy, highlighting the connection between employment, environmental protection and the efficient use of resources. The circular economy involves the transition from a linear economic model, based on production, consumption and disposal, towards a model focused on waste reduction, reuse, repair, recycling and resource recovery. Within this framework, green jobs can contribute to the modernization of the labour market and to the creation of professional opportunities in areas such as waste management, recycling, renewable energy, energy-efficient construction, sustainable agriculture, green transport, and repair and reuse services. The aim of the article is to highlight the opportunities, challenges and public policy directions needed for the development of green jobs in Romania. The research is based on a theoretical and descriptive approach, through the analysis of the specialized literature, strategic documents and the main trends regarding the circular economy and green employment. In this context, Romania has significant potential for the development of green jobs, but its valorisation is limited by insufficient recycling infrastructure, the low level of green skills, limited investment and the uneven implementation of public policies. The article emphasizes the need for integrated measures aimed at vocational training, stimulating green investments, supporting circular enterprises and strengthening cooperation between public authorities, the private sector and the education system.

Keywords:green jobs, circular economy, Romania, green skills, labor market transformation, public policies, sustainable development
JEL Classification: J21, J24, J48, O44, Q56, Q58

1 Introduction

In recent decades, climate change, environmental degradation, intensive resource consumption and the increasing amount of waste have led to a gradual reorientation of economic policies towards more sustainable development models. In this context, the circular economy has become one of the main directions of transformation for modern economies, as it promotes the efficient use of resources and the reduction of negative environmental impact. Unlike the linear economic model, based on the principle of "production–consumption–disposal", the circular economy aims to keep products, materials and resources within the economic cycle for as long as possible, through reuse, repair, recycling and recovery.

This transition also has important implications for the labour market. The emergence of new economic activities, the transformation of production processes and the growing demand for sustainable solutions contribute to the development and transformation of jobs associated with environmental protection, pollution reduction, resource conservation and the support of a low-carbon economy. These jobs, generally referred to as green jobs, can appear both in traditional sectors, such as agriculture, construction or industry, and in emerging areas, such as renewable energy, waste management, recycling, eco-design, green transport, and repair and reuse services.

At the international level, the concept of green jobs became visibly defined starting in 2007, with the launch of the Green Jobs Initiative, and was consolidated in 2008 through the report Green Jobs: Towards Decent Work in a Sustainable, Low-Carbon World. At the European level, the concept was more strongly integrated into employment and sustainable development policies after 2009–2010, in connection with the transition towards a low-carbon economy and the objectives of the Europe 2020 Strategy. In Romania, the concept was officially introduced into public policies in 2018, through the approval of the National Strategy for Green Jobs 2018–2025, by Government Decision no. 594/2018.

In Romania, the development of green jobs in the context of the circular economy represents an important opportunity for labour market modernization, economic competitiveness and skills diversification. However, this process also requires the adaptation of the workforce to new demands, especially through the acquisition of green, digital and technical skills. Therefore, education, vocational training and active employment policies become essential for preparing employees and future specialists for the requirements of the green transition.

The development of green jobs in Romania also faces several challenges. These include insufficiently developed infrastructure for separate collection and recycling, the low level of green skills, limited investments in circular sectors, reduced environmental awareness and the uneven implementation of public policies. In addition, there is still a significant gap between the requirements of the green economy and the educational or vocational training offer, which highlights the need for an integrated approach involving public authorities, the private sector, educational institutions and civil society.

The aim of this article is to analyse the role of the circular economy in the development of green jobs in Romania, with a focus on existing opportunities, encountered challenges and necessary public policy directions. The article seeks to highlight the connection between environmental protection and employment, emphasizing that the green transition should not be seen only as an ecological obligation, but also as an economic and social opportunity. In this regard, green jobs can contribute both to reducing environmental impact and to creating a labour market that is more flexible, more inclusive and more future-oriented.

From a methodological perspective, the article has a theoretical and descriptive character, being based on the analysis of specialized literature, strategic documents and the main trends regarding the circular economy, green employment and green skills. The structure of the article includes a presentation of the conceptual framework regarding green jobs and the circular economy, an analysis of the opportunities existing in Romania, the identification of the main challenges and the formulation of public policy directions to support green employment.

2 Literature review

The relationship between environmental protection, employment and sustainable economic development has become increasingly relevant in academic literature and in public policy documents. The transition towards a greener economy has generated growing interest in the way labour markets can adapt to environmental objectives, resource efficiency and climate change mitigation. In this context, the concept of green jobs has been analysed as a key element linking economic development with environmental sustainability and social inclusion.

At the international level, the literature on green jobs was strongly influenced by the report Green Jobs: Towards Decent Work in a Sustainable, Low-Carbon World, published by the United Nations Environment Program (UNEP), the International Labor Organization (ILO), the International Organisation of Employers (IOE) and the International Trade Union Confederation (ITUC) in 2008. This report represents one of the first comprehensive studies on the emergence of a green economy and on the way environmental policies can create and transform jobs (UNEP et al., 2008). The report emphasizes that green jobs should not be understood only as jobs that protect the environment, but also as decent jobs that contribute to social inclusion, income security and better working conditions.

The International Labour Organization has also played an important role in clarifying the relationship between work, environmental protection and sustainable development. According to the ILO, green jobs can be found in traditional sectors such as agriculture, manufacturing and construction, as well as in emerging sectors such as renewable energy, waste management and environmental services (ILO, 2016). This approach is important because it shows that the green transition does not only create new occupations, but also transforms existing jobs through cleaner technologies, resource efficiency and the integration of environmental requirements into daily work activities.

A significant part of the literature highlights that the transition to a green economy produces both opportunities and risks for the labour market. On the one hand, new jobs may emerge in renewable energy, recycling, waste management, sustainable agriculture, green construction, repair services and environmental consulting. On the other hand, certain jobs in polluting or resource-intensive sectors may decline, which makes reskilling and upskilling policies essential. Therefore, the development of green jobs depends not only on environmental investments, but also on the capacity of education and vocational training systems to provide the skills required by the green transition.

At the European level, green jobs have been increasingly linked to sustainable growth, resource efficiency and climate neutrality. The Europe 2020 Strategy promoted smart, sustainable and inclusive growth, encouraging the transition towards a resource-efficient, greener and more competitive economy (European Commission, 2010). Later, the European Green Deal reinforced the objective of transforming the European Union into a climate-neutral economy, while also emphasizing the need for a fair and inclusive transition (European Commission, 2019).

The circular economy has become another major topic in the literature and in European policy documents. The Circular Economy Action Plan adopted by the European Commission in 2020 presents the circular economy as a key component of the European Green Deal and as a framework for making sustainable products the norm in the European Union (European Commission, 2020). The document emphasizes the importance of addressing the entire life cycle of products, from design and production to consumption, repair, reuse, recycling and waste prevention.

From an employment perspective, the circular economy is relevant because it can generate new activities and transform existing value chains. The OECD underlines that the transition towards a resource-efficient and circular economy has the potential to influence employment by creating jobs in sectors related to recycling, repair, reuse, remanufacturing and waste management, while also reducing jobs in more resource-intensive sectors (Chateau and Mavroeidi, 2020). Thus, the circular economy should be analysed not only as an environmental model, but also as a labour market transformation process.

The role of skills is central in the literature on green jobs and circular economy. Cedefop emphasizes that vocational education and training can support the transition from linear thinking to green growth mindsets, by developing the competences required for circular production and consumption models (Cedefop, 2023). Green skills include both technical competences, such as knowledge of recycling technologies, energy efficiency or sustainable production methods, and transversal competences, such as environmental awareness, adaptability, problem-solving and responsible consumption behaviour.

In the Romanian context, the concept of green jobs was officially introduced into public policies through the National Strategy for Green Jobs 2018–2025, approved by Government Decision no. 594/2018. The strategy aimed to stimulate entrepreneurship and the creation of green jobs, improve skills for green employment and strengthen cooperation between public authorities, employers, education providers and social partners (Government of Romania, 2018). This document marked an important step in recognizing green jobs as a policy priority in Romania.

Romania has also adopted the National Strategy on Circular Economy, approved by Government Decision no. 1172/2022. This strategy supports the transition from the linear economic model to a circular model, based on resource efficiency, waste reduction, reuse, repair and recycling (Government of Romania, 2022). The existence of this strategy provides an institutional framework for developing circular economy activities that can also contribute to the creation of green jobs.

Recent analyses show that Romania still faces significant challenges in the transition towards a circular economy. The Circular economy country profile 2024 – Romania, published by the European Environment Agency, provides an updated overview of Romania’s progress and highlights the need for stronger implementation of circular economy policies (European Environment Agency, 2024). These challenges are also reflected in national studies, which indicate difficulties related to waste management, recycling rates, infrastructure, investment and policy coherence.

Romanian academic literature has also started to examine the country’s progress towards circular economy objectives. Pintilie (2021) analyses the progress of European Union countries towards circular economy using specific indicators and provides a useful comparative perspective for understanding Romania’s position within the EU. More recent studies, such as Ghiță-Mitrescu (2024), focus specifically on Romania's progress using the Eurostat Monitoring Framework and identify areas where improvements are still needed. These studies can support the argument that Romania has potential for circular economy development, but also faces structural limitations.

Overall, the literature suggests that green jobs can become an important instrument for linking environmental protection with employment growth. However, their development requires an integrated approach based on investment, education, vocational training, innovation and coherent public policies. In this sense, the circular economy provides a relevant framework for analysing how Romania can create new employment opportunities while reducing environmental pressure and improving the efficient use of resources.

3 Research methodology

This article is based on a theoretical, descriptive and qualitative research approach, aimed at analysing the relationship between green jobs, the circular economy and employment policies in Romania. The research does not seek to test a statistical model, but to provide an analytical overview of the main opportunities, challenges and public policy directions related to the development of green jobs in the context of the circular economy.

The methodological approach is based on the analysis of specialized literature, international reports, European policy documents, national strategies and relevant statistical indicators. The literature review includes studies and reports published by international organizations such as the International Labour Organization, the United Nations Environment Programme, the Organisation for Economic Co-operation and Development, Cedefop and the European Environment Agency. These sources are relevant because they provide conceptual definitions, comparative perspectives and policy recommendations regarding green jobs, circular economy, green skills and sustainable employment.

At the European level, the research takes into account strategic documents such as the Europe 2020 Strategy, the European Green Deal and the Circular Economy Action Plan, which define the general framework for the transition towards a greener, more resource-efficient and climate-neutral economy. These documents are used in order to understand how green employment and circular economy objectives are integrated into European public policies.

For the Romanian context, the analysis is based mainly on the National Strategy for Green Jobs 2018–2025 and the National Strategy on Circular Economy, as well as on data and country profiles provided by Eurostat and the European Environment Agency. These sources allow the identification of Romania's current position in relation to the development of green jobs and the implementation of circular economy principles.

An important methodological limitation is related to the way green jobs are defined and measured in Romania. At present, Romanian authorities do not provide a separate and clearly delimited official list of green jobs. In practice, these jobs are usually identified indirectly, either by reference to economic activities connected with environmental protection, waste management, recycling, renewable energy and resource efficiency, or by reference to industrial activities that use green equipment, apply cleaner technologies or produce environmentally friendly goods and services. Therefore, the statistical measurement of green jobs remains difficult, as these jobs are not always recorded as a distinct category in national labour market statistics.

Moreover, in Romania, available statistical information on green jobs is often connected to projects financed through European funds, especially when such projects include specific indicators regarding the creation of green jobs or the development of green skills. As a result, the analysis of green employment is frequently based on project-level data, sectoral information or proxy indicators, rather than on a unified national statistical classification. This situation limits the precision of the analysis, but also highlights the need for a clearer methodological framework for defining, monitoring and evaluating green jobs at national level.

The research follows three main analytical directions. The first direction concerns the conceptual clarification of green jobs, circular economy, sustainable employment, green transition and green skills. The second direction focuses on identifying the sectors with the highest potential for green employment in Romania, such as waste management, recycling, renewable energy, sustainable construction, repair and reuse services, sustainable agriculture and green transport. The third direction examines the main barriers that may limit the development of green jobs, including insufficient infrastructure, limited green skills, low levels of investment, weak institutional coordination and uneven policy implementation.

The article also uses a comparative perspective, by relating Romania's situation to broader European trends. This approach is useful for identifying gaps, opportunities and possible directions for improvement. However, the research has certain limitations. Since it is based mainly on secondary sources, the article does not include field research, interviews or survey data collected directly from employers, employees or public institutions. Another limitation is related to the availability and comparability of statistical data on green jobs, as this concept is still difficult to measure precisely and is not always reflected as a separate category in national labour market statistics.

Since the analysis relies mainly on secondary sources and proxy indicators, the methodological limitations related to the statistical identification of green jobs in Romania are acknowledged without treating these estimates as fully comparable official data.

Despite these limitations, the methodology allows a structured analysis of the connection between the circular economy and the development of green jobs in Romania. The article provides a basis for understanding how public policies, vocational training, investment and institutional cooperation can support the transition towards a more sustainable and employment-oriented economic model.

4 Conceptual framework: green jobs and circular economy

The concept of green jobs is closely linked to the broader transformation of the economy towards sustainability, environmental protection and efficient resource use. At the international level, the concept became more visible starting in 2007, with the launch of the Green Jobs Initiative, developed by the International Labour Organization, the United Nations Environment Programme, the International Organisation of Employers and the International Trade Union Confederation. In 2008, the report *Green Jobs: Towards Decent Work in a Sustainable, Low-Carbon World* provided one of the first comprehensive approaches to the relationship between the green economy and the world of work.

In general terms, green jobs refer to jobs that contribute to preserving or restoring the environment, either in traditional sectors such as agriculture, manufacturing and construction, or in emerging sectors such as renewable energy, waste management, recycling and environmental services. These jobs support the reduction of pollution, the efficient use of energy and raw materials, the protection of ecosystems and the transition towards a low-carbon economy. Therefore, green jobs are not limited to entirely new occupations, but also include existing jobs that are transformed through the integration of environmental objectives and green skills.

These concepts are interdependent. The circular economy provides the framework for reducing resource use and extending product life cycles, while green jobs represent the labor market response to this transformation. Green skills support workers' adaptation to new economic and environmental requirements.

The development of green jobs is strongly connected to the concept of circular economy. The circular economy represents an alternative to the traditional linear economic model, which is based on the sequence "take–make–consume–dispose". In the linear model, natural resources are extracted, transformed into products, consumed and finally discarded as waste. This model generates high pressure on the environment, increases the demand for raw materials and contributes to pollution and resource depletion.

By contrast, the circular economy aims to keep products, materials and resources in use for as long as possible. It is based on principles such as reducing waste, reusing products, repairing goods, recycling materials and recovering resources. In this model, waste is not seen only as a final residue, but as a potential resource that can be reintroduced into the economic cycle. As a result, the circular economy contributes to reducing environmental pressure and creates opportunities for new forms of economic activity and employment.

Another important concept is sustainable employment, which refers to employment that supports economic development without compromising environmental quality and social well-being. Sustainable employment implies not only the creation of jobs, but also the creation of decent, stable and future-oriented jobs. From this perspective, green jobs must be associated with decent work, adequate skills, fair working conditions and long-term employability.

The green transition refers to the process through which economies, industries and labour markets adapt to environmental objectives, climate policies and resource efficiency requirements. This transition involves both opportunities and risks. On the one hand, it can generate new jobs in circular sectors, renewable energy, sustainable construction, green transport, recycling and repair services. On the other hand, it can lead to the transformation or disappearance of certain jobs in polluting or resource-intensive sectors. Therefore, the success of the green transition depends on the capacity of education systems, vocational training institutions, employers and public authorities to support workers in acquiring green skills.

In this context, green skills become essential. They include the knowledge, abilities and attitudes required to perform tasks in a more environmentally responsible way. These skills may be technical, such as knowledge of recycling technologies, energy efficiency, renewable energy systems or sustainable production methods, but also transversal, such as environmental awareness, problem-solving, adaptability and responsible consumption behaviour. The development of green skills is necessary not only for specialists working directly in environmental sectors, but also for employees in traditional sectors that are gradually adapting to circular economy principles.

The concepts should be understood as interdependent rather than as separate analytical categories. The circular economy provides the economic framework for reducing resource use and extending product life cycles, while green jobs represent the labor market response to this transformation. Sustainable employment gives this process a social dimension, and green skills make it possible for workers to adapt to new production, consumption and environmental requirements.

Therefore, the relationship between green jobs and the circular economy is a direct one. The circular economy creates the economic framework for new activities based on reuse, repair, recycling, eco-design and resource efficiency, while green jobs represent the employment dimension of this transformation. In other words, the transition to a circular economy cannot be achieved without a labour force capable of supporting and implementing sustainable production and consumption models. At the same time, the development of green jobs can make the circular economy more inclusive by connecting environmental objectives with employment, skills development and social progress.

5 Green jobs in Romania: opportunities in the circular economy

The transition towards the circular economy can create important opportunities for the development of green jobs in Romania. Although the country does not yet have a clearly delimited statistical classification of green jobs, several economic sectors can be associated with green employment due to their contribution to environmental protection, resource efficiency and the reduction of waste. These sectors include waste management, recycling, renewable energy, sustainable construction, sustainable agriculture, green transport, repair and reuse services.

At the global level, the employment potential of the green transition is already visible. According to the Annual Review published by the International Renewable Energy Agency (IRENA) and the International Labor Organization (ILO), employment in renewable energy reached 16.2 million jobs worldwide in 2023, representing the highest annual growth recorded in this sector. This confirms that the green transition is not only an environmental process, but also a major labour market transformation. In addition, recent ILO estimates indicate that between 121 and 142 million people are employed worldwide in circular economy activities, representing approximately 5–5.8% of total global employment (ILO, 2025). These figures show that circularity is already an important source of employment at global level, although the measurement of circular jobs remains methodologically complex.

At European level, Eurostat monitors employment in circular economy sectors through the indicator “persons employed in circular economy sectors”, which includes three main areas: recycling, repair and reuse, and rental and leasing activities (Eurostat, 2024). According to the European Environment Agency country profile for Romania, employment in circular economy sectors represented 2.1% of total employment at EU level in 2021. In comparison, Romania recorded 91,467 persons employed in circular economy sectors, representing 1.2% of total national employment and 2.1% of the EU total in circular economy employment in the same year (European Environment Agency, 2024). This indicates that Romania is below the EU average in terms of the share of employment generated by circular economy sectors.

In the study *Dynamics of Circular Economy Indicators in European Countries*, based on Eurostat data, (Giucă, Voicilă and Rodino, 2025) indicate that Romania reached approximately 198 thousand persons employed in circular economy sectors in 2023, ranking sixth among EU Member States in absolute numbers. However, the same source indicates that Romania registered a slight decrease of about 0.55% compared with 2015, when the number was around 200 thousand persons (Giucă, Voicilă and Rodino, 2025). This shows that, although Romania has a significant number of people employed in circular economy-related sectors, the dynamics of these jobs remain relatively weak compared with the potential of the transition.

One of the most relevant areas for green jobs in Romania is waste management. The circular economy requires a shift from landfilling and disposal towards prevention, separate collection, sorting, treatment and recovery of materials. This transformation can generate jobs for waste collection operators, sorting station workers, environmental technicians, recycling specialists, logistics coordinators and specialists in waste traceability. The development of separate collection systems and the implementation of modern waste management technologies can therefore support both environmental objectives and employment creation.

Recycling represents another important source of green employment. In a circular economy, materials such as paper, cardboard, glass, plastic, metals, textiles and electronic equipment should be reintroduced into production cycles instead of being discarded. This creates opportunities for jobs in material recovery facilities, recycling plants, quality control, environmental compliance, circular logistics and secondary raw material markets. In Romania, the National Circular Economy Strategy identifies significant potential for improvement in areas such as resource efficiency, the use of secondary materials and better waste management (Government of Romania, 2022). The EEA country profile also shows that Romania has a high domestic material consumption, reaching 29.2 tonnes per person in 2022, which was 205% of the EU average, indicating a strong need for better resource efficiency and circular practices (European Environment Agency, 2024).

A recent opportunity is linked to the development of the deposit-return system for beverage packaging. Such systems require collection points, reverse vending machines, transport networks, counting and sorting centres, digital traceability systems and recycling partnerships. Even if this type of system does not solve all waste management problems, it can stimulate new activities connected with circular logistics, packaging recovery and recycling infrastructure. In this sense, it can become a practical example of how circular economy mechanisms may support green employment at local and national level.

Another sector with strong potential is renewable energy. The global evolution of employment in renewable energy confirms the capacity of this sector to create green jobs. The increase to 16.2 million renewable energy jobs worldwide in 2023 shows the rapid expansion of employment related to solar energy, wind energy, bioenergy, hydropower and other renewable technologies (IRENA and ILO, 2024). In Romania, the expansion of renewable energy can support new jobs for engineers, installers, maintenance technicians, energy auditors, project managers and specialists in energy efficiency, especially in regions where new investments can generate local employment.

Energy-efficient construction is also an important field for the development of green jobs. The renovation of buildings, thermal insulation, the use of sustainable materials, energy audits, nearly zero-energy buildings and smart energy systems can create demand for new skills and occupations. Construction workers, architects, engineers, building energy auditors and installation specialists increasingly need green skills related to energy performance, sustainable materials and environmental standards. This sector is especially relevant because buildings are major consumers of energy, and improving their efficiency can reduce both emissions and household energy costs.

Sustainable agriculture offers another opportunity for green employment in Romania. Circular economy principles can be applied in agriculture through organic farming, reduction of food waste, composting, efficient water use, bioenergy production and the valorisation of agricultural residues. These activities can create jobs in ecological farming, agro-processing, local food chains, compost production, sustainable land management and environmental consultancy for farms. Given Romania's agricultural potential, the integration of circular practices in rural areas can contribute to both environmental protection and rural employment.

Green transport is another sector that can support the development of green jobs. The expansion of public transport, electric mobility, bicycle infrastructure, alternative fuels and smart mobility services can create employment opportunities in vehicle maintenance, charging infrastructure, urban mobility planning, logistics and transport digitalization. In the circular economy context, green transport is relevant because it reduces emissions, improves resource efficiency and supports cleaner urban development.

The circular economy also creates opportunities in repair, reuse and remanufacturing services. These activities extend the life cycle of products and reduce the need for new raw materials. Jobs can be created in electronics repair, furniture restoration, textile reuse, second-hand markets, equipment refurbishment, remanufacturing and rental services. These areas are particularly important because Eurostat includes repair and reuse activities in the statistical measurement of circular economy employment (Eurostat, 2024).

In addition to sector-specific opportunities, the circular economy can stimulate new professional profiles related to green skills. These include environmental managers, sustainability consultants, circular economy experts, eco-design specialists, waste prevention officers and trainers for green competences. Cedefop emphasizes that the transition to circular production and consumption models requires both technical skills and transversal competences, including environmental awareness, adaptability and problem-solving (Cedefop, 2023).

Overall, Romania has several opportunities for developing green jobs in the circular economy, but these opportunities depend on investment, infrastructure, education and policy coherence. Compared with the EU average, Romania still has a lower share of employment in circular economy sectors, but the existence of national strategies, EU-funded projects and emerging circular economy mechanisms indicates a relevant development potential. The sectors with the highest potential are those where environmental objectives can be directly connected with labour market needs: waste management, recycling, renewable energy, sustainable construction, sustainable agriculture, green transport, and repair and reuse services. In this sense, green jobs should be understood not only as an environmental policy outcome, but also as an employment strategy capable of supporting economic modernization and social development.

Table 1. Comparative overview of green jobs / circular economy employment by green activity field

Field of green activity	Global level	European level	Romania
Total environmental / green economy employment	No single global comparable figure identified	5.8 million FTE jobs in the EU environmental economy in 2023, up from 3.6 million FTE jobs in 2014	No separate official national figure identified for total green jobs
Total circular economy employment	121–142 million jobs worldwide, about 5–5.8% of global employment, excluding agriculture	More than 4 million persons employed in circular economy sectors in the EU in 2021; around 2.1% of total employment	91,467 persons employed in circular economy sectors in 2021, representing 1.2% of total national employment; academic processing of Eurostat data indicates around 198,000 persons in 2023
Renewable energy – total	16.2 million jobs worldwide in 2023	Around 1.8 million jobs in the EU in 2023; previous EU estimates indicated 1.69 million FTE jobs in 2022	No official separate national figure identified
Solar photovoltaic energy	7.1 million jobs worldwide in 2023	Around 720,000 jobs in the EU in 2023; SolarPower Europe reported 648,000 FTE jobs in 2022	No official separate national figure identified
Liquid biofuels	2.803 million jobs worldwide in 2023	Included in EU renewable energy employment statistics, but not easily comparable by sub-sector in the same dataset	No official separate national figure identified
Hydropower	2.324 million jobs worldwide in 2023	Included in EU renewable energy employment statistics	No official separate national figure identified
Wind energy	1.457 million jobs worldwide in 2023	Included in EU renewable energy employment statistics	No official separate national figure identified
Solid biomass	765,000 jobs worldwide in 2023	Included in EU renewable energy employment statistics	No official separate national figure identified

Field of green activity	Global level	European level	Romania
Biogas	681,000 jobs worldwide in 2023	Included in EU renewable energy employment statistics	No official separate national figure identified
Waste management and recovery of materials	Included in the global circular economy estimate of 121–142 million jobs	1.3 million FTE jobs in the EU in 2023, up from 0.9 million FTE jobs in 2014	Included in the Romanian circular economy employment total, but no clear official sub-sector breakdown
Wastewater management	No single comparable global figure identified	0.6 million FTE jobs in the EU in 2023, up from 0.4 million FTE jobs in 2014	No official separate national figure identified
Repair, reuse, second-hand trade, rental and leasing	Included in the global circular economy estimate of 121–142 million jobs	Included in Eurostat's circular economy employment indicator	Included in the Romanian circular economy employment total, but no clear official sub-sector breakdown
Energy efficiency and renewable energy production/equipment	Included partly in renewable energy and green economy estimates	1.0 million FTE jobs in the EU in 2023, up from 0.6 million FTE jobs in 2014	No official separate national figure identified
Energy-efficient construction	No single comparable global figure identified	Included partly in EU environmental economy and energy efficiency employment	No official separate national figure identified; strong potential through renovation and energy efficiency projects
Sustainable agriculture	Not included in the ILO global circular economy estimate mentioned above, which excludes agriculture	Not consistently reported as a separate circular economy employment category	No official separate national figure identified; high potential due to Romania's agricultural profile
Green transport	No single comparable global figure identified	Not consistently reported as a separate green jobs category in the same statistical framework	No official separate national figure identified; emerging potential through electric mobility and public transport investments

Source: Authors' synthesis based on ILO, Eurostat/EEA for European numbers presented; ILO/Circle Economy/World Bank for global estimation of employment in circular economy.

Analysing the above information the Table 1 interpretation, shows that the most measurable green employment areas are renewable energy, the environmental economy and circular economy sectors. At global level, renewable energy reached 16.2 million jobs in 2023, while circular economy activities employed an estimated 121–142 million people worldwide. At European level, the environmental economy generated 5.8 million full-time equivalent jobs in 2023, while circular economy sectors employed more than 4 million persons in 2021. Romania recorded 91,467 persons employed in circular economy sectors in 2021, representing 1.2% of total national employment, below the EU average of 2.1%. More recent academic processing of Eurostat data indicates approximately 198,000 persons employed in circular economy sectors in Romania in 2023. However, because Romania does not have an official separate classification of green jobs, the analysis must rely on proxy indicators, such as employment in circular economy sectors, environmental goods and services, renewable energy and EU-funded green projects.

6 Challenges for developing green jobs in Romania

The development of green jobs in Romania must be analysed in direct connection with the country's circular economy potential, the structure of regional economies and the availability of financial and human resources. As shown in the previous sections, Romania has opportunities in waste management, recycling, renewable energy, energy-efficient construction, sustainable agriculture, green transport, repair and reuse services. However, these opportunities are limited by structural barriers, insufficient investment, weak statistical monitoring and a still developing system of green skills.

A first challenge is the absence of a clearly defined national statistical classification of green jobs. Romanian authorities do not currently provide a separate official list of green occupations. As a result, green jobs are usually identified indirectly, through employment in environmental protection, circular economy sectors, renewable energy, waste management, recycling, repair and reuse activities, or through jobs created by projects financed from European funds. This makes the measurement of green employment difficult and limits the possibility of designing targeted labour market policies. In practice, the analysis must rely on proxy indicators, such as persons employed in circular economy sectors, environmental economy employment, renewable energy employment or jobs created through EU-funded projects.

A second challenge is the unequal regional distribution of green employment potential. The circular economy does not develop uniformly across the country. Industrial regions may have higher potential for recycling, remanufacturing and energy efficiency, agricultural regions may generate green jobs through sustainable agriculture and biomass, while urban regions may concentrate green jobs in services, consulting, transport, waste management and repair activities. Therefore, regional development strategies are essential for transforming green transition objectives into concrete employment opportunities.

The following table presents an indicative distribution of green jobs / circular economy-related jobs in Romania by development region, expressed in thousand persons. The estimates start from the approximate national level of circular economy-related employment, around 198,000 persons in 2023, and distribute this value across regions according to their economic profile and several proxy indicators, such as the concentration of industrial activities, agricultural potential, urban services, waste management and recycling activities, renewable energy potential, transport and logistics functions, and the relevance of just transition processes. Therefore, the figures should be interpreted as analytical estimates, not as official regional statistics.

Table 2. Estimated green jobs / circular economy-related jobs by Romanian development region

Development region	Estimated green jobs / circular economy-related jobs thousand persons	Main potential fields
București-Ilfov	35	Environmental consulting, circular economy services, green public procurement, waste management, repair and reuse services, green transport
Nord-Vest	28	Recycling, sustainable manufacturing, repair services, eco-innovation, renewable energy, circular SMEs
Centru	26	Industrial circularity, wood and furniture reuse, sustainable tourism, renewable energy, energy-efficient construction
Nord-Est	24	Sustainable agriculture, biomass, food waste reduction, repair services, rural circular economy
Sud-Muntenia	23	Industrial recycling, agriculture, logistics, waste management, renewable energy
Vest	22	Advanced manufacturing, circular industrial processes, renewable energy, repair and remanufacturing
Sud-Est	21	Green transport, port logistics, renewable energy, waste management, sustainable agriculture
Sud-Vest Oltenia	19	Just transition areas, energy transition, reskilling, renewable energy, circular industrial activities
Total Romania	198	Estimated circular economy-related employment

Source: Authors' indicative estimation based on Eurostat circular economy employment indicators, the European Environment Agency country profile for Romania and regional proxy indicators related to industrial structure, agricultural potential, urban services, waste management, renewable energy, transport and just transition processes.

Given their indicative character, these regional estimates are intended to highlight potential territorial differences in green employment development, rather than to provide a precise statistical measurement of green jobs at regional level.

The table shows that the largest concentration of green jobs may be expected in București-Ilfov, due to the concentration of services, administration, consultancy, transport and environmental management activities. At the same time, regions such as Nord-Vest, Centru and Vest may have stronger potential for circular industrial activities, repair, remanufacturing and eco-innovation. Regions such as Nord-Est, Sud-Muntenia and Sud-Est may develop green jobs through agriculture, waste management, biomass, food waste reduction and renewable energy. Sud-Vest Oltenia has a specific relevance because it is connected to the just transition process and to the need for reskilling workers affected by the restructuring of carbon-intensive activities.

Another major challenge is the lack of direct and dedicated national investment instruments specifically designed for the circular economy and green jobs. In Romania, financing for circular economy activities, green infrastructure, green skills and green employment is largely dependent on European funds, complemented by national co-financing and, in some cases, by the Environmental Fund Administration. The Sustainable Development Programme 2021–2027 is one of the main instruments for environmental and climate investments in Romania, supporting water management, circular economy, climate change adaptation, energy efficiency, renewable energy, biodiversity and waste-related infrastructure. Its total public contribution is approximately EUR 7.78 billion, including EU investment and national public contribution (European Commission, 2026).

For green skills and labour market adaptation, the Education and Employment Programme 2021–2027 is particularly relevant. It supports access to education and training, inclusive labour market measures and the development of skills needed for the digital and green transitions. The programme also supports vocational education and training, work-based learning, lifelong learning, micro-credentials, second chance programmes and the adaptation of workers and enterprises to change. Its total public contribution is approximately EUR 3.84 billion, of which about EUR 3.10 billion represents EU investment (European Commission, 2026).

Another source of funding is the National Recovery and Resilience Plan, which includes reforms and investments related to the green transition. Romania's plan has a value of approximately EUR 28.5 billion, and 44.1% of it supports climate objectives. The plan includes investments in sustainable transport, building renovation, biodiversity protection, industrial decarbonisation and the deployment of renewable energy. The REPowerEU chapter also focuses on green energy production, energy efficiency of buildings and the reskilling and upskilling of the workforce in the field of green energy production (European Commission, 2024).

The Just Transition Programme is also relevant for regions affected by the transition away from carbon-intensive activities. It can support economic diversification, new green economic activities, reskilling and employment measures in territories exposed to social and economic risks generated by decarbonisation. This is particularly important for areas such as Sud-Vest Oltenia, where the transition from traditional energy activities towards renewable energy, circular industrial activities and new services requires targeted intervention.

At regional level, the Regional Programmes 2021–2027 can finance investments connected with SME competitiveness, energy efficiency, innovation, urban mobility and, in some cases, circular economy activities. These programmes are important because the development of green jobs depends strongly on regional economic specialisation. For example, a region with a strong industrial base may support circular manufacturing and remanufacturing, while an agricultural region may focus on biomass, composting, food waste reduction and sustainable local value chains.

Additional opportunities are provided by European programmes such as LIFE, Horizon Europe, Interreg and Erasmus+. LIFE is particularly relevant for environment and climate action, including circular economy and quality of life projects. Horizon Europe may finance research and innovation related to circular technologies, green transition and sustainable business models. Interreg can support cross-border circular economy projects, while Erasmus+ can finance cooperation in education and vocational training, including the development of green skills.

Another challenge concerns the development of green skills. The circular economy requires workers who can operate recycling technologies, manage waste streams, apply environmental standards, improve energy efficiency, use digital traceability systems, work with renewable energy technologies and design circular business processes. Green skills are not limited to environmental specialists; they are also needed by construction workers, engineers, agricultural workers, technicians, transport specialists, public servants, entrepreneurs and managers.

In Romania, green skills can be developed through several types of institutions. Universities can introduce sustainability, circular economy and environmental management into higher education programmes. Vocational schools and dual education institutions can prepare technicians for recycling, renewable energy, energy efficiency, green construction and repair services. Public and private training providers can offer reskilling and upskilling programmes for adults. Employers can organize workplace training, while county employment agencies can support unemployed persons or workers in transition through active labour market measures.

Financial resources for green skills are available mainly through the Education and Employment Programme, the National Recovery and Resilience Plan, the Just Transition Programme, Erasmus+ and, in some cases, regional programmes or employer-funded training. The Education and Employment Programme explicitly supports the skills needed for the digital and green transitions and expects more than 354,000 participants to gain new qualifications, while more than 1.5 million people are expected to benefit from the programme overall (European Commission, 2026).

The main problem is that these resources are often fragmented across programmes, institutions and project calls. Therefore, the development of green jobs in Romania does not depend only on the existence of funding, but also on the capacity to coordinate funding sources, identify real labour market needs and connect employers with education and training providers. Without this coordination, green jobs may remain project-based and temporary, instead of becoming a stable component of the Romanian labour market.

Overall, the main challenges for developing green jobs in Romania are the lack of a clear statistical definition, insufficient infrastructure, unequal regional development, limited direct investment, dependence on European funds, low levels of green skills and fragmented policy implementation. Addressing these challenges requires a more coherent framework for monitoring green employment, financing circular economy investments and preparing the workforce for the green transition.

7 Public policy directions and alternative policy proposals

The development of green jobs in Romania requires coherent public policies that connect environmental objectives with employment, education, vocational training, investment and regional development. As shown in the previous sections, Romania has potential for green employment in waste management, recycling, renewable energy, sustainable construction, sustainable agriculture, green transport, repair and reuse services. However, this potential cannot be fully exploited without a clear institutional framework, adequate financing and a workforce prepared for the requirements of the circular economy.

A first public policy direction should focus on the development of green skills through education and vocational training. The transition towards the circular economy requires workers who are able to use recycling technologies, apply environmental standards, improve energy efficiency, operate renewable energy systems, manage waste flows and understand circular production models. Therefore, green skills should be integrated into vocational education, university curricula, adult training programmes and workplace learning. Training programmes should target both young people entering the labour market and adults whose jobs are affected by the green transition.

A second direction concerns the financing of green employment and circular economy activities. In Romania, direct national investment instruments dedicated exclusively to green jobs remain limited, and most available resources are connected to European funds, national co-financing and specific programmes. Therefore, public policies should ensure better coordination between the Sustainable Development Programme 2021–2027, the Education and Employment Programme 2021–2027, the National Recovery and Resilience Plan, the Just Transition Programme, the Regional Programmes 2021–2027, LIFE, Horizon Europe, Interreg and Erasmus+. These programmes can support infrastructure, green skills, renewable energy, circular economy projects, SME competitiveness, research, innovation and vocational training.

A third policy direction should support circular enterprises and green SMEs. Companies that develop business models based on repair, reuse, remanufacturing, recycling, eco-design, renewable energy or waste prevention can directly contribute to job creation. Public authorities should provide grants, tax incentives, advisory services, innovation vouchers, simplified access to European funds and green public procurement opportunities. Small and medium-sized enterprises are particularly important because they can create local green jobs and support regional circular economy ecosystems.

A fourth direction should involve the development of regional green employment strategies. Since Romania's development regions have different economic profiles, green jobs should not be promoted through a uniform national approach. Regions with an industrial profile may focus on circular manufacturing, recycling, remanufacturing and energy efficiency. Agricultural regions may develop jobs related to sustainable agriculture, composting, biomass and food waste reduction. Urban regions may focus on green transport, waste management, environmental services, green public procurement and repair activities. Regional strategies should identify local opportunities, available skills and investment needs.

A fifth policy direction concerns the use of public procurement as an instrument for creating demand for green products and services. Public institutions can stimulate green jobs by including environmental and circular criteria in procurement procedures. For example, demand for recycled materials, repair services, energy-efficient buildings, electric transport, reusable products and sustainable public services can encourage companies to develop circular business models and create related jobs.

In addition to these policy directions, this article proposes an alternative public policy focused on the institutional recognition of green jobs in Romania. The main objective of this alternative policy would be the introduction of green occupations into the Classification of Occupations in Romania (COR) and the development of new occupational standards for these jobs. This measure is necessary because, at present, Romania does not have a separate official list of green jobs, and this limits the capacity of authorities to measure, finance and support green employment.

The Classification of Occupations in Romania (COR) is the official national system used for the identification, hierarchy and coding of occupations in the Romanian labour market. It is also used by the national statistical system and is harmonised with the international and European occupational classification ISCO-08. However, the current classification does not provide a distinct category for green jobs, although Romania has already adopted the National Strategy for Green Jobs 2018–2025, approved by Government Decision no. 594/2018.

The proposed alternative policy would include several stages. The first stage would consist of creating an interinstitutional working group involving the Ministry of Labour, the National Institute of Statistics, the National Agency for Employment, the National Authority for Qualifications, environmental authorities, employers' organisations, trade unions, universities and sectoral committees. This group would identify occupations with a strong green component and would define criteria for classifying them as green jobs.

The second stage would involve mapping existing Romanian occupations to European frameworks such as ISCO-08 and ESCO. This is important because the National Authority for Qualifications has already developed work related to the mapping between COR and ESCO, which could be used as a basis for identifying occupations with green tasks and green skills. The mapping should distinguish between three categories: fully green occupations, partially green occupations and occupations in transition. Fully green occupations would include jobs directly linked to environmental protection and circular economy activities. Partially green occupations would include traditional jobs that require green skills. Occupations in transition would include jobs affected by decarbonisation, digitalisation and circular economy requirements.

The third stage would be the introduction or updating of occupations in COR. Possible examples of occupations that could be introduced or better defined include: circular economy specialist, green skills trainer, waste prevention specialist, recycling process technician, renewable energy maintenance technician, energy efficiency technician, eco-design specialist, repair and reuse coordinator, environmental data analyst, circular procurement specialist and sustainability reporting specialist. The inclusion of such occupations in COR would improve statistical monitoring, labour market planning and the design of training programmes.

The fourth stage would consist of developing new occupational standards for green jobs. Occupational standards are essential because they define the competences, skills, knowledge and activities required for a specific occupation. In Romania, the National Authority for Qualifications manages occupational standards and publishes the list of occupational standards, including those valid for the period 2014–2026. The Authority also uses methodologies and guides for the elaboration, validation, approval and management of occupational standards. Therefore, the development of green occupational standards could be integrated into the existing institutional framework. Here are some new standards proposed in the circular economy field:

Table 3. Proposed new occupational standards for green jobs in Romania

No.	Proposed occupational standard	Main area	Key green skills / competences
1	Circular Economy Specialist	Circular economy management	Designing circular economy strategies, analysing material flows, identifying waste prevention solutions, supporting circular business models
2	Green Skills Trainer	Vocational training and adult education	Designing and delivering green skills training programmes, assessing green competences, adapting training to labour market needs
3	Waste Prevention Specialist	Waste prevention and resource efficiency	Developing waste prevention plans, applying reuse strategies, monitoring resource consumption, supporting circular procurement
4	Recycling Process Technician	Recycling and material recovery	Operating recycling equipment, sorting and processing recyclable materials, quality control of secondary raw materials, workplace safety
5	Repair and Reuse Coordinator	Repair, reuse and product life extension	Coordinating repair centres, organising reuse flows, promoting product life extension, managing second-hand and refurbished goods
6	Renewable Energy Maintenance Technician	Renewable energy	Maintaining solar, wind or biomass systems, monitoring technical performance, applying safety procedures, identifying operational faults
7	Energy Efficiency Technician	Energy efficiency in buildings and industry	Monitoring energy consumption, supporting energy audits, implementing efficiency measures, using smart metering systems
8	Eco-design Specialist	Sustainable product design	Applying life-cycle thinking, reducing material use, improving reparability and recyclability, integrating environmental criteria into product design
9	Circular Public Procurement Specialist	Public procurement and circular economy	Developing green and circular procurement criteria, evaluating environmental clauses, promoting recycled and reusable products in public procurement
10	Sustainability Reporting Specialist	ESG and environmental reporting	Collecting environmental data, preparing sustainability reports, monitoring ESG indicators, supporting compliance with reporting standards
11	Environmental Data Analyst	Environmental monitoring and digitalization	Analysing environmental indicators, using digital monitoring tools, interpreting circular economy data, supporting evidence-based policies
12	Circular Logistics Coordinator	Reverse logistics and circular supply chains	Organising reverse logistics flows, coordinating collection and return systems, optimizing transport for recyclable and reusable products
13	Green Transition Adviser for SMEs	Business consultancy	Advising SMEs on circular economy, green investments, resource efficiency, funding opportunities and green compliance
14	Industrial Symbiosis Facilitator	Circular industrial cooperation	Identifying by-product exchange opportunities, connecting companies, reducing industrial waste, supporting circular industrial networks
15	Green Jobs and Skills Counsellor	Employment services and career guidance	Advising workers and jobseekers on green career pathways, identifying training needs, supporting reskilling and upskilling for green jobs

Source: Author's own proposal of Occupational Standards for green jobs in Romania

The proposed occupational standards could support the institutional recognition of emerging green jobs in Romania. Their introduction would help clarify the competences required by the circular economy and would create a stronger link between labour market needs, vocational training and public employment policies. These standards should not replace existing environmental occupations, but should complement them by covering new areas such as circular economy management, green skills training, eco-design, circular public procurement, sustainability reporting, reverse logistics and industrial symbiosis.

By developing such occupational standards, Romania could increase the number of workers with certified green skills and could improve the statistical visibility of green jobs. This would also support access to European funds, because projects aimed at creating green jobs or developing green skills would have clearer occupational references and measurable qualification outcomes.

The fifth stage would link the new occupational standards to vocational training programmes and qualifications. Once green occupations and occupational standards are defined, training providers could develop authorised programmes for these qualifications. This would allow more people to acquire certified green skills and would support the development of a qualified workforce for the circular economy. It would also help employers recruit workers with recognised competences and would support public authorities in monitoring the evolution of green employment.

The alternative policy would have several expected benefits. First, it would improve the statistical visibility of green jobs and allow better measurement of green employment. Second, it would help align education and vocational training with labour market needs. Third, it would support access to European funds, because projects that include green jobs and green skills would have clearer occupational references. Fourth, it would contribute to the professionalisation of circular economy activities. Finally, it would support the implementation of Romania's National Strategy for Green Jobs and of the National Strategy on Circular Economy.

However, the implementation of this policy would also require careful coordination. Green jobs should not be introduced into COR only as formal titles without real labour market relevance. The process must be based on consultation with employers, training providers, sectoral experts and public authorities. In addition, occupational standards should be updated periodically, because green technologies and circular economy practices evolve rapidly.

Overall, the development of green jobs in Romania requires both general public policies and targeted institutional reforms. Financing, training, investment and regional strategies are necessary, but they are not sufficient if green jobs remain statistically and administratively invisible. For this reason, the introduction of green occupations into COR and the development of new occupational standards represent a strategic policy alternative for increasing the number of qualified persons who acquire green skills and can contribute to the transition towards a circular economy.

8 Conclusion

The analysis carried out in this article shows that the development of green jobs in Romania is closely connected to the transition towards the circular economy and to the broader objectives of environmental protection, resource efficiency and sustainable employment. The circular economy creates the economic framework for new activities based on waste reduction, reuse, repair, recycling, recovery of resources, eco-design and energy efficiency, while green jobs represent the employment dimension of this transformation. Therefore, the transition to a circular economy should not be understood only as an environmental objective, but also as an important opportunity for labor market modernization.

A first conclusion of the article is that Romania has relevant potential for the development of green employment, especially in sectors where environmental objectives can be directly connected with economic activity and labor market needs. Waste management, recycling, renewable energy, energy-efficient construction, sustainable agriculture, green transport, repair, reuse and remanufacturing services can generate new jobs and can also transform existing occupations. However, this potential remains unevenly exploited and depends on the capacity to connect environmental policies with investment, infrastructure, vocational training, regional development and institutional coordination.

The analysis also shows that green jobs should not be understood only as new occupations created in environmental sectors. They also include existing jobs that are transformed through cleaner technologies, environmental standards, resource efficiency requirements and the acquisition of green, digital and technical skills. In this sense, the circular economy does not only create additional employment opportunities, but also changes the content of work, the skills required by employers and the way in which professional training should be organized.

Another important finding concerns the structural limitations that affect the development of green jobs in Romania. The absence of a clear statistical classification of green jobs reduces the visibility of this employment area and makes monitoring and policy design more difficult. At the same time, insufficient circular economy infrastructure, uneven regional potential, limited direct investment, dependence on European funding, fragmented financing mechanisms and the still insufficient development of green skills restrict the pace of labour market transformation.

From a policy perspective, the article highlights that the development of green jobs requires an integrated approach. Environmental strategies alone are not sufficient if they are not connected with employment policies, education and training systems, investment programs and regional development strategies. Vocational training and lifelong learning are essential for preparing the workforce for circular economy activities, while support for circular enterprises and green SMEs can contribute to the creation of more stable employment opportunities at local and regional level.

The policy relevance of the analysis also lies in the need to better coordinate existing funding sources and institutional responsibilities. Green jobs are often supported indirectly, through European funds, environmental programs, regional investments or training initiatives. In order to increase their impact, these instruments should be better connected to labor market needs, sectoral priorities and regional economic profiles. Otherwise, green employment risks remaining fragmented, project-based and insufficiently visible in national employment policies.

One of the specific contributions of the article is the emphasis placed on the institutional recognition of green jobs in Romania. The clarification of green occupations, occupational profiles, qualifications and occupational standards could improve the statistical visibility of green employment and create a stronger connection between labor market needs, vocational training and public funding opportunities. Such an approach would also support employers in identifying relevant skills and would help training providers develop programs adapted to the requirements of the circular economy.

The article therefore contributes to the discussion on green jobs in Romania by linking three dimensions that are often treated separately: the circular economy as an environmental and economic model, green jobs as a labor market outcome, and green skills as a condition for workforce adaptation. This integrated perspective is important because the success of the circular economy depends not only on infrastructure and investment, but also on the capacity of workers, companies and public institutions to adapt to new forms of production, consumption and resource management.

In conclusion, green jobs can become an important instrument for connecting Romania’s environmental objectives with employment growth and economic modernization. The circular economy offers a strategic framework for this transformation, but its employment potential depends on coherent public policies, stronger institutional coordination and cooperation between public authorities, employers, education providers and regional actors. For Romania, the development of green jobs is not only an ecological necessity, but also an economic and social opportunity that can support a more resilient and future-oriented labor market.

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References:

[1] Andreea-Daniela Giucă, Daniela Voicilă and Steliana Rodino. (July 2025). Dynamics of Circular Economy Indicators in European Countries, Proceedings of the International Conference on Business Excellence, Volume 19 (2025): Issue 1

[2] Cedefop. (2023). From linear thinking to green growth mindsets: Vocational education and training and skills as springboards for the circular economy. Publications Office of the European Union.

[3] Cedefop. (2023, October 26). The circular economy to step up skill needs and the importance of “thyroid occupations”.

[4] Chateau, J., & Mavroeidi, E. (2020). *The jobs potential of a transition towards a resource efficient and circular economy* (OECD Environment Working Papers No. 167). OECD Publishing. https://doi.org/10.1787/28e768df-en

[5] European Commission. (2010). Europe 2020: A strategy for smart, sustainable and inclusive growth. Publications Office of the European Union.
[6] European Commission. (2019). The European Green Deal (COM(2019) 640 final). Publications Office of the European Union.
[7] European Commission. (2020). A new Circular Economy Action Plan: For a cleaner and more competitive Europe (COM(2020) 98 final). Publications Office of the European Union.
[8] European Commission. (n.d.). Circular economy action plan. Directorate-General for Environment. Retrieved May 14, 2026, from https://environment.ec.europa.eu/strategy/circular-economy_en
[9] European Commission. (2024). https://ec.europa.eu/stories/2024-2029-commission/
[10] European Environment Agency. (2024). *Circular economy country profile 2024: Romania. European Environment Agency.*
[11] Eurostat. (n.d.). *Circular economy monitoring framework. European Commission*. Retrieved May 14, 2026, from https://ec.europa.eu/eurostat/web/circular-economy/monitoring-framework
[12] Eurostat. (2024). https://ec.europa.eu/eurostat/news/events/2024
[13] Ghiță-Mitrescu, S. (2024). *Mapping Romania's progress towards a circular economy using the EU Circular Economy Monitoring Framework.* Ovidius University Annals of Constanta – Series Civil Engineering, 26(1), 156–164. https://doi.org/10.2478/ouacsce-2024-0018
[14] Government of Romania. (2022). *Strategia Națională privind Economia Circulară. Hotărârea Guvernului nr. 1172/2022.*
[15] International Labour Organization (ILO, 2025), *Statistic data on labor, environment, sustainable development*.
[16] Pintilie, N. (2021). *Measuring the progress towards circular economy in European Union countries*. Business Excellence and Management, *11*(1), 19–35.
[17] UNEP, ILO, IOE, & ITUC. (2008). *Green jobs: Towards decent work in a sustainable, low-carbon world*. United Nations Environment Programme.

Financial Innovations and Economic Convergence in the European Union: Evidence from Regional Cohesion Policy Reconfiguring

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Abstract: This study analyses the structural transformations of European cohesion policy in the context of the acceleration of inter- and intra-regional disparities within the European Union, with a focus on the post-2014 period and the specific challenges of the 2021–2027 multiannual financial framework. By capitalising on an integrated theoretical framework, which combines neoclassical convergence theory, institutionalist approaches to regional economics and financial innovation perspectives, the study assesses the capacity of structural financial instruments to generate real and sustainable economic convergence. The empirical analysis uses panel data for 234 NUTS-2 regions from 27 Member States, covering the period 2000–2023, and applies econometric models with fixed effects, complemented by robustness tests using GMM-Arellano-Bond. The results demonstrate that financial innovations, in particular repayable financial instruments (RFIs), social impact bonds and public guarantee mechanisms, significantly amplify the multiplier effect of cohesion funds, with an estimated elasticity of 1.47 compared to 0.89 for classic grants. The article proposes an integrated dynamic allocation model based on composite indices of territorial vulnerability, with direct implications for the architecture of post-2027 cohesion policy.

Keywords: cohesion policy, economic convergence, financial innovations, regional disparities, structural funds, NUTS-2, repayable financial instruments, regional development, European Union, econometric panel model
JEL Classification: R11, R58, O47, F15, G20.

1. Introduction

The European Union's cohesion policy is the most important redistributive instrument of the European project, absorbing approximately one third of the EU budget and aiming to reduce economic, social and territorial disparities between regions of the Member States (Barca, 2009; Crescenzi and Giua, 2020). However, despite the massive financial transfers carried out over five decades of European regional policy, the persistence of regional disparities remains a worrying reality, fuelling heated debates in academic literature and in the sphere of political decisions regarding the real effectiveness of these interventions (Rodríguez-Pose, 2018; Becker et al., 2018).

The post-global financial crisis context and the effects of the COVID-19 pandemic have accentuated territorial asymmetry at the level of the European Union, creating new centers of vulnerability in peripheral and semi-peripheral regions, while large metropolises and regions with high human capital have consolidated their competitive advantages (McCann, 2015; Iammarino et al., 2019). This divergent dynamic calls into question the traditional paradigm of automatic convergence through budgetary redistribution, requiring a conceptual and instrumental reconfiguration of cohesion policy.

This article addresses this issue from the perspective of three complementary axes: (i) a critical assessment of the theoretical framework of regional economic convergence; (ii) an empirical analysis of the differential effectiveness of financial instruments within the cohesion policy 2014–2020 and 2021–2027; and (iii) the proposal of an innovative model for the dynamic allocation of structural resources, which integrates financial innovations as a vector for multiplying the impact. The originality of the approach lies in combining advanced econometric methodologies with the institutionalist-evolutionary perspective, going beyond the limits of the purely quantitative analyses prevalent in the specialized literature.

The article is structured as follows: section 2 presents the theoretical framework and literature review; section 3 describes the methodology and data used; section 4 presents the empirical results; section 5 proposes the dynamic allocation model; section 6 includes discussions and policy implications; section 7 concludes.

2. Theoretical Framework and Literature Review

2.1. Theories of Regional Convergence: From Neoclassical to Institutionalist

The debate on regional convergence within the EU revolves around two fundamental paradigms. The neoclassical approach, rooted in the Solow-Swan model (1956) and extended by the contributions of Barro and Sala-i-Martin (1992), postulates that less developed economies tend to grow faster than advanced ones, due to diminishing returns to capital and technological diffusion. Absolute and conditional beta convergence have been the standard analytical tool for assessing European regional dynamics (Mankiw et al., 1992).

However, post-enlargement empirical developments have often contradicted neoclassical predictions. The new model of economic geography (Krugman, 1991; Fujita et al., 1999) has demonstrated that centripetal forces, agglomeration economies, market access, knowledge externalities, can generate persistent divergence, even in the presence of substantial financial transfers. The concept of “underdevelopment traps” (Rodríguez-Pose, 2018) and that of “regional resilience” (Martin and Sunley, 2015) have added institutional and systemic dimensions to the analysis, highlighting the role of administrative capacity, social capital and local innovation ecosystems in determining the convergence trajectory (Manta, O. and Petreanu, T. E., 2025).

A relevant theoretical contribution to our analytical framework is the Economic Complexity perspective (Hidalgo and Hausmann, 2009), which approaches regional development through the lens of productive diversification and the accumulation of collective capabilities. This perspective suggests that the effectiveness of structural funds critically depends on their ability to stimulate the accumulation of complex productive capabilities, not just to finance one-off investments in physical infrastructure.

2.2. Financial Innovations in Cohesion Policy: Conceptualization and Evolution

The notion of "financial innovation" in the context of cohesion policy refers to the set of instruments and mechanisms that transcend the traditional grant model, introducing elements of reimbursement, risk sharing and leverage on private sources of financing (Dąbrowski, 2018; Wishlade and Yuill, 2016). The main categories of innovative financial instruments include: (i) loans and guarantees managed through the European Investment Fund (EIF) and the European Investment Bank (EIB); (ii) venture capital instruments for innovative SMEs; (iii) social impact bonds (SIB); and (iv) results-based financing mechanisms (Results-Based Financing).

The gradual adoption of these instruments in the architecture of cohesion policy reflects a profound conceptual shift: from the paradigm of "public spending as an end in itself" to the paradigm of "public value maximized by catalysing private investment" (Mazzucato, 2018). The EU regulations for the period 2014–2020 (Reg. 1303/2013) and 2021–2027 (Reg. 2021/1060) have strengthened the legal framework of financial instruments, introducing incentives for Member States that opt for their use instead of traditional grants.

2.3. Gaps in the Existing Literature and the Contribution of the Present Study

Although the literature on the effectiveness of cohesion policy is extensive (Dall'erba and Le Gallo, 2008; Eberle and Werneck, 2021; Fratesi and Wishlade, 2017), we identify three major gaps: (1) the lack of systematic comparative analyses that isolate the specific effect of financial innovations versus classic subsidies, controlling for endogeneity; (2) the absence of integrated models that combine the analysis of allocative efficiency with the institutional dimension of regional administrative capacity; and (3) the rarity of studies that explicitly address the period 2021–2027 and the context of new priorities (green transition, digital transformation, resilience). However, comparatively limited attention has been devoted to disentangling whether financial innovations generate additional convergence effects relative to traditional grant-based mechanisms. This gap is particularly salient when accounting for heterogeneity in institutional quality and the evolving policy architecture characterising the post-2021 programming period. Against this backdrop, three interrelated gaps can be identified. First, there is a paucity of systematic comparative analyses that isolate the marginal effects of financial instruments vis-à-vis classic subsidies while rigorously addressing endogeneity concerns. Second, existing frameworks insufficiently integrate allocative efficiency considerations with the institutional dimension of regional administrative capacity, thereby limiting explanatory power with respect to heterogeneous policy performance. Third, empirical evidence remains scarce regarding the 2021–2027 programming cycle and its reoriented priorities, notably the green transition, digital transformation, and resilience-building objectives. By addressing these gaps, this article advances an original methodological strategy and an expanded analytical framework that explicitly differentiates financial innovations from traditional grant-based mechanisms within the contemporary cohesion policy landscape.

3. Methodology and Data

3.1 Data Sources and Sample

The empirical analysis leverages a panel database built from multiple sources: Eurostat (NUTS-2, GDP/capita in SPA, employment rate, ERIS regional innovation indicator), data on commitments and payments from structural funds (DG Regio- ESIF Open Data), data on financial instruments (EIF Annual Report, EIB Group Survey on Investment), and regional institutional indicators (Becker et al., 2013; Charron et al., 2014- European Governance Quality Index). The sample includes 234 NUTS-2 regions from 27 EU Member States, over the period 2000–2023, resulting in an unsupported panel of 5,616 regional-annual observations.

3.2 Econometric Specification

The basic model aims to estimate conditional beta convergence, with the inclusion of variables specific to cohesion policy:

$$\ln(y_{i,t}/y_{i,t-1}) = \alpha + \beta\cdot\ln(y_{i,t-1}) + \gamma\cdot SF_{i,t} + \delta\cdot FI_{i,t} + \theta\cdot X_{i,t} + \mu_i + \lambda_t + \varepsilon_{i,t} \quad (1)$$

where y represents GDP/capita in SPA, SF denotes the intensity of structural subsidies (% of regional GDP), FI represents the volume of repayable financial instruments (% of regional GDP), X is the vector of control variables (human capital, population density, accessibility, quality of governance), μi are the regional fixed effects, λt are the temporal fixed effects, and ε is the error term. The parameter of central interest is δ, which captures the specific marginal effect of financial instruments compared to that of classical subsidies (γ).

To control for potential endogeneity, with poorer regions systematically receiving more funds, we use the GMM-Arellano-Bond (1991) estimator with lags of endogenous variables, complemented by Sargan/Hansen tests for over identification and AR(1)/AR(2) tests for autocorrelation of residuals. The robustness of the results is checked by alternative specifications with Within-Groups, random effects (Hausman test) and panel heteroskedasticity-corrected (PCSE) estimators.

3.3 Construction of the Territorial Vulnerability Index (TVI)

As a complementary analytical tool, we construct a composite Territorial Vulnerability Index (TVI), aggregating ten dimensions: (1) demographic decline, (2) structural unemployment rate, (3) dependence on traditional sectors, (4) low level of tertiary education, (5) weak institutional capacity, (6) low accessibility to infrastructure, (7) fragility of the innovation ecosystem, (8) exposure to green transition risks, (9) dependence on public transfers and (10) level of social capital. The aggregation uses Principal Component Analysis (PCA) weighting, avoiding the arbitrariness of exogenous weightings.

4. Empirical Results

4.1Regional Convergence and the Effect of Cohesion Policy: Baseline Estimates

Fixed-effects OLS estimates for model (1) confirm the existence of beta conditional convergence (β = -0.042, $p<0.001$), corresponding to a convergence speed of approximately 2.1% per year — a result consistent with previous literature (Arbia et al., 2005). The introduction of policy variables substantially modifies the magnitude of the coefficients, without invalidating the conclusion of convergence.

Table 1 presents a summary of the main estimates.

Table 1. Estimates of conditional convergence and the effect of cohesion instruments (dependent variable: GDP/capita growth rate)

Explanatory variable	OLS-EF coefficient (1)	GMM-AB coefficient (2)	Coef. GMM-AB+Institutional Control (3)
ln(GDP/cap.) initial	-0.042***	-0.038***	-0.035***
SF subsidy intensity (% GDP)	0.089***	0.076**	0.071**
Financial instruments FI (% GDP)	0.147***	0.131***	0.124***
Human capital (% pop. tertiary education)	0.063***	0.058***	0.061***
Governance Quality (EQI)	—	—	0.044**
R² / Hansen p-value	0.61	0.58 / 0.43	0.63 / 0.47
Observations	5,616	5,382	5,382

*Note: *** p<0.01; ** p<0.05; * p<0.10. Robust standard errors (clustered at regional level). Regional and temporal fixed effects included in all specifications.*

The results in column (3), the full GMM specification with institutional control, highlight that repayable financial instruments ($\delta = 0.124$) generate a significantly higher growth effect than traditional grants ($\gamma = 0.071$), the difference of 0.053 percentage points per unit of financial intensity being robust to multiple alternative specifications. This differentiation confirms the main hypothesis of the study: financial innovations amplify the effectiveness of cohesion policy through leverage effects and the selection of projects with demonstrable economic profitability.

4.2. Regional Heterogeneity and Conditional Effects

The analysis of sub-samples reveals significant heterogeneity of effects. Regions in the “less developed” category (GDP/person < 75% of the EU average) benefit most from classical subsidies ($\gamma = 0.091$), probably due to acute needs for investment in basic infrastructure. In contrast, transition regions (75%–90% of the EU average) show a higher sensitivity to financial instruments ($\delta = 0.158$), suggesting that they are at the optimal point for using market-based mechanisms. More developed regions (>90%) show modest effects of both categories of instruments, consistent with the literature on diminishing marginal returns to cohesion policy in prosperous regions.

A particularly relevant result concerns the moderating role of governance quality. The effect of financial instruments is 2.3 times higher in regions with an EQI above the median compared to regions below the median ($\delta = 0.187$ vs. $\delta = 0.081$), confirming the thesis that financial innovations require a favourable institutional environment to manifest their multiplier potential. This finding has direct implications for the design of post-2027 cohesion policy.

4.3. Multiplier Effects and Financial Leverage

The calculation of the multiplier effects estimates that each euro invested through repayable financial instruments generates, on average, 3.2 euros in total investment (public and private combined), compared to 1.9 euros for classic grants. The leverage effect varies significantly depending on the type of instrument: public guarantees show the highest multiplier (4.7x), followed by equity instruments (3.8x) and subsidized loans (2.6x). These estimates are consistently higher than the average reported by the OECD for public financing instruments in other geographical contexts, suggesting that the specific context of European cohesion policy, with its strong regulatory framework and rigorous monitoring, creates favourable conditions for leverage effects.

5. Integrated Dynamic Allocation Model (IDAM)

5.1. Conceptual Architecture of the Model

Based on empirical evidence and an integrated theoretical framework, we propose the Integrated Dynamic Allocation Model (IDAM) as a conceptual tool for optimizing the mix of cohesion instruments at regional level. IAM operationalizes three fundamental principles: (i) The principle of contextual differentiation, the optimal mix of instruments varies depending on the level of development, institutional capacity and regional economic structure; (ii) The principle of dynamic complementarity, classical subsidies and financial instruments are not perfect substitutes, but complementary in different phases of the policy cycle; and (iii) The principle of adaptability, the allocation of instruments should be periodically recalibrated based on performance indicators and changes in context.

5.2 Instrumental Allocation Matrix

Based on the IVT constructed in section 3.3 and the differential effectiveness estimates in section 4, MIAD proposes a four-quadrant instrumental allocation matrix (Figure 1):

Quadrant I (high IVT, low institutional capacity): Predominant allocation in classic grants for basic infrastructure and human capital, with a small share (10–15%) reserved for simple financial instruments (microcredit guarantees). Prioritizing institutional capacity building as a precondition for the transition to more complex instruments.

Quadrant II (high IVT, high institutional capacity): balanced mix of grants/financial instruments (60/40), with an emphasis on SIB-type instruments for acute social challenges and on venture capital funds for emerging strategic sectors.

Quadrant III (low IVT, low institutional capacity): selective approach, concentrating resources in subsidies for projects with local "big push" structuring potential, avoiding wasting resources on small projects with limited impact.

Quadrant IV (low IVT, high institutional capacity): preponderance of financial instruments (70–80%), with the use of EIB/EIF investment platforms, green bonds and co-investment instruments with the private sector, reducing dependence on EU subsidies.

The implementation of MIAD requires a three-level governance architecture: strategic (European Commission), programmatic (national managing authorities) and operational (regional development agencies and financial intermediaries). Vertical and horizontal coordination between these levels is essential for the effectiveness of the model.

6. Discussions and Policy Implications

The results presented have direct implications for the architecture of post-2027 cohesion policy. First, the finding that financial innovations generate higher multiplier effects than classic subsidies argues for a significant increase in the minimum mandatory allocation quota for financial instruments, from the current level of non-binding recommendation to a minimum binding threshold of at least 25% of structural funds, differentiated according to regional typology according to MIAD.

Second, the crucial moderating role of governance quality requires the systematic integration of institutional conditionality into access to complex financial instruments. Regional administrative capacity-building programs should precede, not run parallel to, the allocation of advanced instruments. The Polish model of gradual capacity building (2007–2013 → 2014–2020) provides a relevant example (Bachtler et al., 2019).

Third, the green and digital transitions open up new horizons for financial innovation in cohesion policy. Regional sovereign green bonds, energy transition financing mechanisms and digital investment platforms are instruments with high potential to catalyse private investment, but which require a legal and supervisory framework adapted to European regional specificities.

Limitations of the study include: (i) methodological difficulties in fully isolating the causal effects of cohesion policy from other determinants of regional growth; (ii) limited availability of granular data on financial instruments at NUTS-2 level for the period before 2014; and (iii) the need to consider general equilibrium effects, which can redistribute growth across regions, rather than just generating it across the European economy as a whole. Future research should address these limitations by using detailed administrative data and quasi-experimental (difference-in-differences, RDD) methodologies.

7. Conclusions

This study is consistent with the presence of conditional convergence, contingent upon the type of policy instrument deployed, and support the view that financial instruments are more closely aligned with market-based adjustment processes and regional innovation dynamics. Beyond the empirical contribution, the study advances an integrated analytical framework that links convergence processes, institutional capacity, and financial innovation, offering a more nuanced understanding of cohesion policy effectiveness in heterogeneous territorial contexts. Collectively, these insights underscore the need to rethink the design of cohesion policy instruments in light of evolving regional disparities and the increasing importance of institutional constraints. (1) Main empirical findings

This study has demonstrated, based on robust econometric analyses of an extended panel comprising 234 NUTS-2 regions across 27 EU Member States, that financial innovations within European cohesion policy are associated with stronger regional convergence effects compared to traditional non-reimbursable grant-based instruments. The results indicate a significantly higher elasticity for reimbursable financial instruments (0.124) relative to classic grants (0.071), thereby providing empirical support for the hypothesis that financial instruments are more effectively aligned with market mechanisms and regional innovation dynamics. These findings further suggest the presence of conditional convergence, contingent upon the type of policy instrument employed.

(2) Theoretical contribution

The main theoretical contribution of the article lies in the development of the Integrated Dynamic Allocation Model (IDAM), which operationalises an integrated framework linking convergence dynamics, institutional capacity, and financial innovation in cohesion policy design. IDAM extends existing approaches by explicitly modelling the heterogeneity of territorial conditions and institutional constraints, thereby moving beyond static and uniform policy prescriptions. In doing so, it provides a structured analytical bridge between regional development theory, institutional economics, and the emerging literature on innovative financial instruments.

(3) Policy implications

The implications for post-2027 cohesion policy are threefold. First, policy design should progressively shift towards a more balanced portfolio combining innovative financial instruments and traditional grants, calibrated to regional characteristics. Second, strengthening regional administrative and institutional capacity emerges as a prerequisite for the effective deployment of advanced financial instruments, particularly in less developed regions. Third, cohesion policy should more systematically exploit synergies with the green transition, digital transformation, and resilience agendas through tailored financial mechanisms that reflect differentiated territorial needs.

(4) Limitations and future research

Despite its contributions, the study is subject to several limitations. First, the analysis is constrained by data availability and aggregation at the NUTS-2 level, which may mask intra-regional heterogeneity. Second, while the econometric strategy addresses endogeneity concerns, residual identification challenges may persist. Future research could extend the framework by incorporating micro-level data, exploring dynamic treatment effects over longer time horizons, and further investigating the sequencing mechanisms through which institutional capacity conditions the effectiveness of financial instruments. In particular, a more granular analysis of how regions transition from grant dependency to financial instrument adoption would represent a promising avenue for further inquiry.

References:

[1] Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *The Review of Economic Studies, 58*(2), 277–297.

[2] Arbia, G., Battisti, M., & Di Vaio, G. (2005). Institutions and geography: Empirical test of spatial growth models for European regions. *Spatial Economic Analysis, 5*(2), 113–139.

[3] Bachtler, J., Begg, I., Charles, D., & Polverari, L. (2019). *EU cohesion policy in practice: What does it achieve?* Rowman & Littlefield International.

[4] Barca, F. (2009). *An agenda for a reformed cohesion policy: A place-based approach to meeting European Union challenges and expectations*. European Commission.

[5] Barro, R. J., & Sala-i-Martin, X. (1992). Convergence. *Journal of Political Economy, 100*(2), 223–251.

[6] Becker, S. O., Egger, P. H., & von Ehrlich, M. (2018). Effects of EU regional policy: 1989–2013. *Regional Science and Urban Economics, 69*, 143–152.

[7] Becker, S. O., Egger, P. H., von Ehrlich, M., & Fenge, R. (2013). Going NUTS: The effect of EU structural funds on regional performance. *Journal of Public Economics, 112*, 118–131.

[8] Charron, N., Dijkstra, L., & Lapuente, V. (2014). Regional governance matters: Quality of government within European Union member states. *Regional Studies, 48*(1), 68–90.

[9] Crescenzi, R., & Giua, M. (2020). One or many cohesion policies of the European Union? On the differential economic impacts of cohesion policy across member states. *Regional Studies, 54*(1), 10–20.

[10] Dąbrowski, M. (2018). EU cohesion policy and the role of financial instruments. In S. Piattoni & L. Polverari (Eds.), *Handbook on cohesion policy in the EU*. Edward Elgar Publishing.

[11] Dall'erba, S., & Le Gallo, J. (2008). Regional convergence and the impact of European structural funds over 1989–1999: A spatial econometric analysis. *Papers in Regional Science, 87*(2), 219–244.

[12] European Parliament and Council of the European Union. (2013). *Regulation (EU) No 1303/2013 laying down common provisions on the European Structural and Investment Funds*. *Official Journal of the European Union, L 347*, 320–469.

[13] European Parliament and Council of the European Union. (2021). *Regulation (EU) 2021/1060 laying down common provisions on the European Structural and Investment Funds*. *Official Journal of the European Union, L 231*, 159–706.

[14] Fratesi, U., & Wishlade, F. (2017). The impact of European cohesion policy in different contexts. *Regional Studies, 51*(6), 817–821.

[15] Fujita, M., Krugman, P., & Venables, A. J. (1999). *The spatial economy: Cities, regions and international trade*. MIT Press.

[16] Hidalgo, C. A., & Hausmann, R. (2009). The building blocks of economic complexity. *Proceedings of the National Academy of Sciences, 106*(26), 10570–10575.

[17] Iammarino, S., Rodríguez-Pose, A., & Storper, M. (2019). Regional inequality in Europe: Evidence, theory and policy implications. *Journal of Economic Geography, 19*(2), 273–298.

[18] Krugman, P. (1991). Increasing returns and economic geography. *Journal of Political Economy, 99*(3), 483–499.

[19] Mankiw, N. G., Romer, D., & Weil, D. N. (1992). A contribution to the empirics of economic growth. *Quarterly Journal of Economics, 107*(2), 407–437.

[20] Manta, O., & Petreanu, T. E. (2025). *The implications of the European Commission's funding programs in increasing national safety and security, with a focus on the regions adjacent to the Danube* [Working paper]. SSRN. https://doi.org/10.2139/ssrn.5377632

[21] Martin, R., & Sunley, P. (2015). On the notion of regional economic resilience: Conceptualization and explanation. *Journal of Economic Geography, 15*(1), 1–42.

[22] Mazzucato, M. (2018). *The value of everything: Making and taking in the global economy*. Allen Lane.

[23] McCann, P. (2015). *The regional and urban policy of the European Union: Cohesion, results-orientation and smart specialisation*. Edward Elgar Publishing.

[24] Rodríguez-Pose, A. (2018). The revenge of the places that don't matter (and what to do about it). *Cambridge Journal of Regions, Economy and Society, 11*(1), 189–209.

[25] Solow, R. M. (1956). A contribution to the theory of economic growth. *Quarterly Journal of Economics, 70*(1), 65–94.

[26] Wishlade, F., & Yuill, D. (2016). Measuring the effects of financial instruments in the European structural and investment funds. *European Structural and Investment Funds Journal, 4*(3), 196–208.

Brazil's Renewable Energy Sector and Sustainable Foreign Investment: Opportunities and Institutional Challenges

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Abstract: Brazil stands as Latin America's leading economy because almost 80% of its electricity generation comes from renewable energy, including hydropower, wind, solar, and bioenergy. A geographical blessing and plenty of natural resources give the country an opportunity to become an international leader in green energy, embodying these ambitions in its National Hydrogen Plan, announced in 2021. Studies report that Brazil holds a range of energy sources and fast-growing renewable energy capacities but also suffers persistent plights of difficult bureaucracy, uncertain regulations, and environmental management-related challenges. A survey-based study in which 21 respondents, experts in the Brazilian economy, rated the attractiveness of Brazil's renewable energy and sustainable industries for foreign direct investment. According general consensus of the respondents' opinions, the main competitive advantage for Brazil lies in its abundant natural resources, but the greatest disadvantage comes from bureaucracy. Respondents think that simplifying the administrative process and providing stable legislation will improve investment conditions. Sustainable agriculture and wind energy look to be the priority sectors for development, while international partnerships are the second supporting elements for domestic reforms. The article adds to knowledge of Brazil's renewable energy environment by weaving together stakeholder perspectives with policy and investment analyses, arguing for the necessity of institutional reforms in achieving sustainable economic objectives.

Keywords: Brazil, renewable energy, green energy, foreign direct investment, emerging market, sustainable agriculture, energy transition.
JEL Classification: Q42, F21, O13.

1 Introduction

Geographically, Brazil is ranked fifth in the world in terms of population. The availability of natural resources, large agricultural areas and variety of ecosystems are a significant asset to the population. Brazil is located in an important tropical area and it is characterized by a large amount of climatic phenomena, a diversified hydrographic system and sun exposure. All of these aspects increase Brazil's role as an important contributor to renewable energy. In addition to all of this, Brazil has one of the most advanced economies in Latin America, but is faced with serious issues including social disparities, rapid urban growth, and a highly export-oriented economy largely dependent on natural resource exports (Glaser-Segura et al., 2018).

These points also provide Brazil another opportunity for reindustrialization, while creating green jobs, and to perpetuate its global profile as a clean energy force. Da Silva, Lima, & Oliveira (2024) note that Brazil is generally acknowledged as one of the most innovative emerging economies within the renewable energy space. Approximately 80% of the country's electricity is estimated to come from renewable sources, over 60% from hydropower, 13% from wind power, with 7% from solar power. Brazil's notable strides in renewable energy certainly place it at an advantage in the global decarbonization race.

Brazil's prime renewable energy source broadly, and also of energy in general, is hydropower, which takes advantage of highly valued resources. In addition to hydropower, the energy industry has a long history of using both traditional energy sources, new and more modern biofuels, and also solar and wind power. Recently, Brazil has begun investing directly in green hydrogen, which is a critical resource for reaching net-zero carbon emissions. However, some research indicates that the grid will always be vulnerable to climate change and its impact on water resources because of the reliance on hydropower (Werner & Lazaro, 2023). In order to develop renewable energy sources, Brazil benefits from readily accessible financial resources provided by the Brazilian Development Bank (Banco Nacional de Desenvolvimento Econômico e Social, BNDES). According to the Initiative for Climate Action Transparency (ICAT, 2023), Brazil needs to reduce bureaucratic barriers and clarify the country's regulatory framework. In this sense, Brazil can comply with the Paris Agreement, protect nature and reduce gas emissions by ensuring financing is available for infrastructure development in energy while also reducing bureaucracy.

It is pertinent to state that Brazil is fostering a conducive environment for innovation, research and development, thus promoting advancements in technological innovation in relation to green energy and may become a key player globally for the future export of green energy. A rapidly expanding sector is green hydrogen. The National Hydrogen Plan (PNH2), introduced in 2021 specifies clear goals for the production, utilization and export of non-polluting fuels. The studies by Lira, Kramer, & Quitzow (2025) indicate that the legislation by 2024 provides tax incentives and generates a predictable legal environment for investors, in a sector that Brazil should become a global leader, due to its low production costs and availability of renewable resources. Regarding bioethanol, Brazil has been producing bioethanol from sugarcane since the 1970s, but recent regulations promote innovative bioenergy, including biogas and advanced biofuels (International Energy Agency - IEA Bioenergy, 2024). Berryman et al. (2025) caution that Brazil will always be on the global fringe and may even be excluded if its environmental principles are not applied. According to Costa (2022), the continued flow of foreign investments into clean energy is critical for Brazil's sustainable development goals.

This study examines the experts' perceptions of Brazil's attractiveness for sustainable foreign investment in the green economy. The first objective is to analyse professional perspective of the country's competitive advantages for attracting foreign direct investments into renewable energy and green industries in Brazil. This analysis will include an assessment of Brazil's structural advantages which makes it a leader on the global stage in the green transition, such as natural resources, size and breadth of market, types of institutional support mechanisms available to investors, and the level of international integration. The second objective is to identify the main institutional barriers, that will limit Brazil's appeal to investors, including the perceived difficultly in doing business in Brazil. Due to regulatory instability, bureaucratic inefficiencies & slow bureaucratic processes, infrastructure deficits, fragmented governance structures, and other structural barriers that can affect investors' decision to invest in Brazil. The third objective is to assess which public policies, or support mechanisms, are priorities in order for Brazil to be perceived as a strategic location for sustainable foreign investment. This assessment will be based on experts' perception of the importance of public fiscal incentives, regulatory clarity, public-private partnerships, risk mitigation, international partnerships and institutional coordination, for creating a resilient and innovative green economy in Brazil.

The research has four research questions, to support the analytical framework of the study based on the objective of the research. RQ1: What are Brazil's key competitive advantages for attracting foreign direct investment in the renewable energy and sustainable sectors? RQ2: What institutional and structural barriers most inhibit foreign investors' decisions in Brazil's green sector? RQ3: How effective are current industrial policies perceived to be in supporting the green transition and attracting sustainable foreign investment? RQ4: What forms of public intervention (fiscal incentives, administrative simplification, international partnerships, and risk mitigation mechanisms) are viewed as determining Brazil's competitiveness in the world green economy? Collectively, the four research questions provide a comprehensive analysis of Brazil's structural strengths, institutional constraints, and policy effectiveness in determining its attractiveness for sustainable foreign investment.

2 Literature Review

Brazil has one of the most diversified renewable energy matrices among emerging economies, supported by abundant natural resources, extensive hydrographic networks, strong solar exposure, significant wind potential, and a well-established bioenergy sector. Hydropower continues to dominate electricity generation, while wind and solar energy have expanded rapidly over the last decade, particularly in northeastern regions of the country. In parallel, Brazil has strengthened its position as a global leader in biofuels, especially ethanol and bioelectricity derived from sugarcane biomass. Recent studies also emphasize the country's growing strategic interest in green hydrogen, particularly following the introduction of the National Hydrogen Plan (PNH2), which aims to support research, infrastructure development, and international competitiveness in low-carbon energy production (Werner & Lazaro, 2023; Da Silva et al., 2024; Lira et al., 2025; IEA Bioenergy, 2024).

At the same time, the literature highlights that Brazil's renewable energy potential alone is insufficient to guarantee long-term sustainable development and international competitiveness. Several authors underline the importance of coherent industrial policies, institutional coordination, and regulatory stability for attracting foreign direct investment into green industries. Since the implementation of PROINFA and subsequent renewable energy auctions, Brazil has developed multiple support mechanisms for renewable energy expansion, including fiscal incentives, public-private partnerships, and state-backed financing through institutions such as BNDES. Nevertheless, researchers continue to identify important limitations related to fragmented governance structures, excessive bureaucracy, inconsistent regulatory frameworks, and insufficient infrastructure for emerging sectors such as green hydrogen transportation and storage (Costa, 2022; ICAT, 2023; Werner & Lazaro, 2023; Lira et al., 2025).

Vasconcelos & Castilho (2025) deem the Brazilian wind turbines among the most efficient in the world, with 40% average efficiency. This efficiency has made Brazil's existing forms of wind energy attractive to foreign investment, particularly in Northeastern Brazil, and has led to incentives that have allowed for rapid investment to be recouped by various studies illustrating high wind potential. In an article for the Oxford Academic journal by Seabra, Cavalett, & Lima (2022), they indicate that operating from this renewable source could potentially sufficiently supply Brazil's electricity demand by as much as 15% by 2050. Nevertheless, the energy characteristics among countries vary significantly from natural resources, government policy and from what has been considered as the integration of technological contributions. For example, in Brazil, the largest economy in the region, the context includes challenges distinct from those found in its neighbours: Chile, Argentina, Uruguay, Mexico and Colombia (Kahn & Boulding, 1964; Magadum et al., 2025).

The international dimension of Brazil's green transition is also strongly emphasized in the literature. Brazil is frequently compared with other Latin American economies and with advanced economies such as Germany due to its renewable energy capacity and ambitions regarding sustainable industrial development. While countries such as Uruguay and Chile have made important advances in renewable energy diversification, Brazil benefits from a larger domestic market, abundant renewable resources, and stronger industrial capabilities. At the same time, Germany's Energiewende model is often presented as an example of long-term policy coherence and institutional coordination. Comparative studies suggest that Brazil possesses substantial structural advantages but still faces difficulties in translating these advantages into stable long-term investment confidence due to institutional and regulatory uncertainty (Dincă et al., 2023; Dincă et al., 2025; Agora Industry, 2023; Energiewende, 2025).

Recent research further demonstrates that Brazil has become an increasingly attractive destination for foreign direct investment in renewable energy and sustainable industries. International investors, including actors from China, the European Union, the United States, and the United Arab Emirates, have expanded investments in wind energy, solar energy, bioenergy, and sustainable infrastructure projects. Studies indicate that renewable energy availability, relatively low production costs, and growing global demand for green technologies position Brazil favourably within the global green economy. However, the literature consistently points to institutional fragility, administrative complexity, infrastructure deficits, and legislative instability as the principal barriers limiting Brazil's capacity to attract and retain long-term sustainable investment flows (Aremu et al., 2025; Zhang & Duarte, 2023; Reuters, 2024; UNCTAD, 2023; Xie et al., 2025).

Overall, the literature suggests that Brazil's future competitiveness in the global green economy will depend not only on its structural resource advantages, but also on its ability to implement coherent public policies, strengthen institutional quality, simplify administrative procedures, and ensure regulatory predictability. Consequently, the interaction between renewable resource endowments, industrial policy effectiveness, and institutional governance remains central to understanding Brazil's attractiveness for sustainable foreign direct investment and green economic transformation

3 Methodology

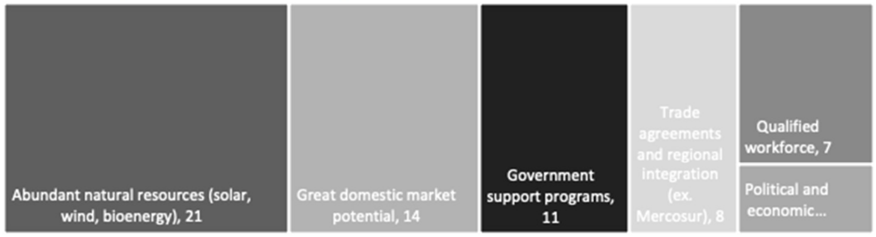
The study's methodology included the use of a structured questionnaire survey to assess key stakeholder perceptions of Brazil's potential as a location for foreign direct investment in renewable energy and sustainable industries. The survey contained closed-ended multiple-choice questions and ratings of attractiveness. The sample included 21 respondents with a high degree of familiarity with the Brazilian economy. Because of their importance and expertise, they were selected using non-probability sampling. The participants included Brazilian ambassadors, Brazilian diplomats, government representatives, entrepreneurs, markets representatives and APEX-Brasil representatives, all selected because of their positions and experience in trade policies and international cooperation. Data was collected using a structured questionnaire that contained nine questions in Portuguese language, which contained both multiple-choice questions (closed ended), with some ordinal scale items and a space to include any additional comments. The use of the authors professional network developed during her work for the Embassy of Brazil in Bucharest allowed the author to contact Brazilian experts who are knowledgeable about the economic and investment climate of Brazil. The data was collected in September, 2025 and a total of 21 respondents completed the questionnaire. The nine questionnaire items were developed in the Portuguese language using closed-ended multiple-choice design. Respondents were given the opportunity to select multiple answers for all nine questions and answered based on a specific set of choices provided. The response choices for each of the nine questions were intended to represent different evaluation categories and provide consistency in response choices, which could facilitate comparisons among the responses.

The content of the survey focused on the socio-professional data of the respondents, the perception of Brazil´s comparative advantages in attracting sustainable investments, the assessment of the effectiveness of existing industrial policy, the identification of barriers for foreign investors, recommendations for the development of adequate policies, the role of international partnerships, which sectors of the green economy present the greatest potential for development, the level of preparedness of local authorities, the elements that influence Brazil´s international image and what government support is perceived to be essential.

4 Results and Discussions

The survey obtained information from 21 individuals working in different positions and institutions such as diplomatic missions and international trade agencies to private companies working in tourism, agriculture, and renewable energy. The varied respondent group gives a multi perspective overview of the opportunities and challenges facing Brazil in attracting sustainable Foreign Direct Investment (FDI), especially in the renewable energy and green industries.

Graph 1: Brazil's Competitive Advantages in Attracting Sustainable Foreign Investment

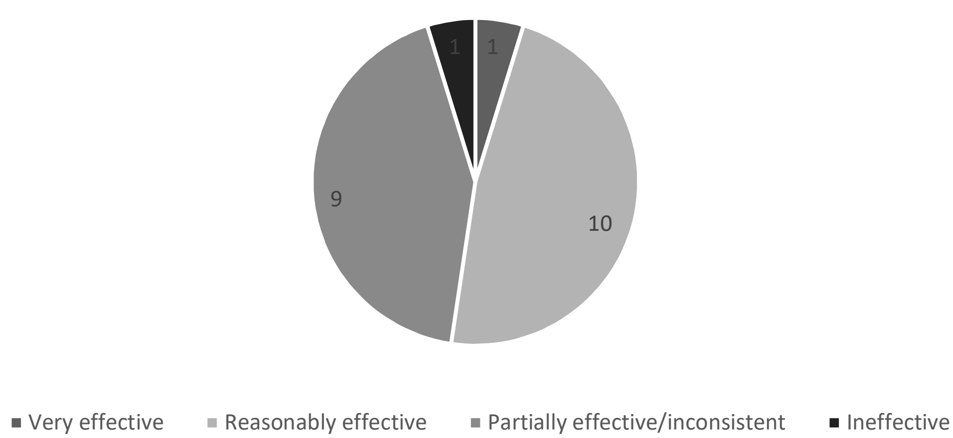


Source: Authors' elaboration

For the first question addressed to the respondents, *In your opinion, what are Brazil's main competitive advantages for attracting foreign investment in renewable energy and sustainable industries?*, the objective was to identify Brazil's advantages in attracting foreign investment in renewable energy. Respondents were presented with a multiple-choice question comprising six possible answers, with the option to select more than one choice (Abundant natural resources, solar, wind, bioenergy; Great domestic market potential; Qualified workforce; Government support programs; Trade agreements and regional integration, e.g. Mercosur; Political and economic stability). All respondents were in agreement that Brazil's most important competitive advantage was an abundance of natural resources (solar, wind, bioenergy), with this being cited in 21 responses. The second most cited aspect of Brazil's competitive advantage was the potential for a strong domestic market, as was cited in 14 responses. Other cited potential advantages included a qualified workforce (7 responses) and relevant government support programs (11 responses). Brazilian studies confirmed that public policy and human capital are critical elements for supporting both the development of innovative ideas and the pursuit of sustainability. According to Pelău et al. (2010), the availability of well-trained personnel and the establishment of coordinated public-private partnerships will facilitate the creation of sustainable innovation ecosystems which can attract investors. Additionally, 8 respondents cited trade agreements and regional integrations (ex: Mercosur) as having potential to support greater investment into Brazil. In contrast, political and economic stability was only cited by 3 respondents, which suggests more of a cautious perception of this particular competitive advantage. This conclusion demonstrates that the same issues were found during recent assessments of Brazil's competitiveness, namely, Brazil will always be a country with tremendous potential. However, many political issues remain as part of the perception of foreign investors as a barrier for investments in Brazil (World Economic Forum, 2022).

Thus, we can argue that compared to Brazil's macro-institutional characteristics, investors are giving more weight to Brazil's structural resource advantages. Therefore, Brazil's competitiveness results more from natural resources than from political and economic stability relative to other nations.

Graph 2: Perception of the effectiveness of Brazilian industrial policies in supporting sustainable investments

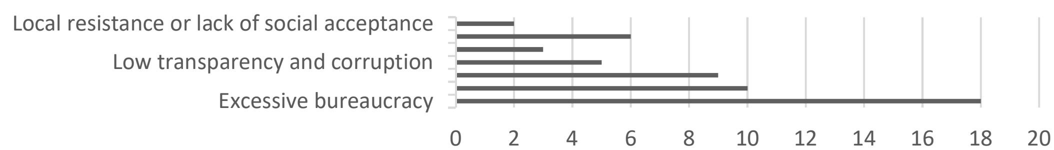


Source: Authors' elaboration

The second question addressed to the respondents, *What is your opinion on the effectiveness of Brazil's current industrial policies in supporting sustainable investment?*, aimed to identify the perceived effectiveness of Brazil’s current industrial policies in supporting sustainable investment. Respondents were presented with a multiple-choice question comprising five possible answers, with the option to select one choice (Very effective; Reasonably effective; Partially effective / inconsistent; Ineffective; I do not know / Cannot say). The responses revealed a mostly constrained view. Most participants (10) felt the policies were reasonably effective, which implied some positive actions in implementation but not enough coherence or systematic application. Almost the same number of respondents (9), classified them as only partially effective or irregular which reflected a perception that there was a lack of coherence and continuity in its design and application.

The existence of strategic and supporting frameworks does not eliminate the concerns related to regulatory complexity. Problems related to weak coordination among institutions and limited long-term strategic alignment have not been resolved either. There is a correlation between the results of the survey and the international academic literature indicating that the limitations of Brazil's industrial policies do not stem from the lack of industrial policy initiatives. Rather, they arise from coherence and implementing these Policies consistently over time. These limitations all contribute to lowering investor confidence in Brazil's transition to becoming a green economy.

Graph 3: The main barriers for foreign investors in the renewable energy and sustainable industries sector in Brazil



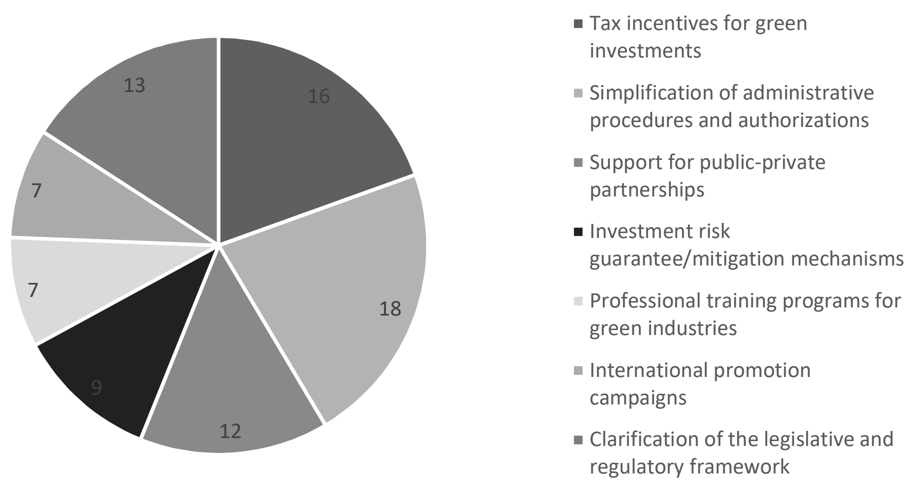
	Excessive bureaucracy	Legislative instability	Lack of infrastructure and logistics	Low transparency and corruption	Difficulty accessing local financing	High administrative costs	Local resistance or lack of social acceptance
Frequency	18	10	9	5	3	6	2

Source: Authors’ elaboration

The third question addressed to the respondents participating in the questionnaire-based survey, *What are the main barriers for foreign investors in renewable energy and sustainable industries in Brazil?*, aimed to identify the main barriers faced by foreign investors in renewable energy and sustainable industries in Brazil. Respondents were presented with a multiple-choice question comprising seven possible answers, with the option to select more than one choice (Excessive bureaucracy; Legislative instability; Lack of infrastructure and logistics; Low level of transparency and corruption; Difficulty accessing local funding; High administrative costs; Local resistance or lack of social acceptance). The survey was able to identify a number of issues limiting the attraction of foreign investment into renewable energy and sustainable industries in Brazil. The most frequently cited barrier was bureaucracy, cited by 18 of the participants, indicating a clear perception of the complexities and slow-moving nature of the administrative process which can disincentivise foreign investment. Legislative instability was cited by 10 participants and reflects the apprehension about the frequency of changes in the regulatory environment and the extreme lack of legal predictability. These are consistent with the findings of the UNCTAD (2023) report, which say that when the regulatory environment becomes unstable, it creates uncertainty, especially for investors in renewable energy projects that are a long-term investment and require a degree of regulatory stability.

Overall, the data indicate that foreign investors perceive excessive bureaucracy, instability in legislative processes, and poor infrastructure as the three most important constraints to their investment. The transaction costs associated with these barriers are increased. The wide variety of regulations creates an unpredictable regulatory environment for participants in the Brazilian market. The result is that foreign investors seeking to invest in renewable energy (which typically require substantial amounts of capital) have the potential of having to overcome significant barriers. Because capital-intensive renewable energy projects are heavily dependent on earning long-term returns, the burden of coordination and regulatory obstacles may outweigh their structural advantages in the determination of whether or not to invest in such projects. In addition, concerns regarding bureaucratic inefficiency, fragmented governance, and a lack of transparency reinforce the perception that Brazil has an institutionally fragile investment environment. Together, these institutional and structural weaknesses create an environment of uncertainty that discourages foreign investors from making ongoing investments in Brazilian green industries, even when Brazil has ample natural resources and potential markets.

Graph 4: Policies needed to be reinforced in order to attract more sustainable foreign direct investment to Brazil

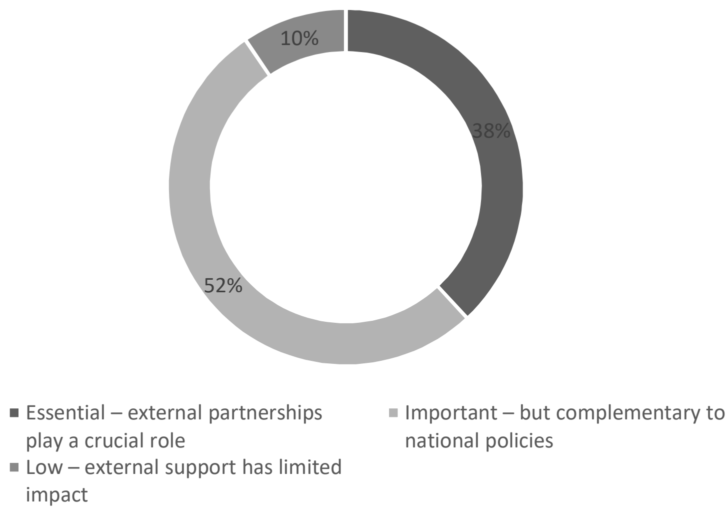


Source: Authors' elaboration

The fourth question in the questionnaire-based survey, *What types of policies should be developed or strengthened to attract more sustainable foreign direct investment (FDI) to Brazil?*, aimed to identify the policies that should be developed or strengthened in order to attract sustainable foreign direct investment to Brazil. Respondents were presented with a multiple-choice question comprising seven possible answers, with the option to select more than one choice (Tax incentives for green investments; Simplification of administrative procedures and authorizations; Support for public-private partnerships; Investment risk mitigation mechanisms; Professional training programs for green industries; International promotion campaigns; Clarification of the legislative and regulatory framework). The respondents pointed out several priority policies that should be developed or strengthened to make Brazil more competitive in the green economy. The most selected option was the simplification of administrative processes and autorizations, chosen by 18 people. This choice showed the need to lower bureaucracy to create a more efficient business atmosphere capable of responding quickly to investment initiatives. Second, with 16 votes was the need to achieve tax breaks related to green investments, which reflects an unambiguous desire to promote the attraction of capital for sustainable projects by way of concrete measures.

The focus on administrative simplification, fiscal incentives, regulatory clarity, and risk mitigation instruments indicates that investors place a premium on policy stability and institutional predictability, as primary factors in determining Brazil's competitiveness as a global green investment market. The evidence of support for public-private partnerships, international promotional strategies, and workforce development initiatives indicates the need for a comprehensive public policy structure to implement these strategies successfully. This structure must be compatible with both Brazil's structural advantages as well as Brazil's governing capabilities. Collectively these insights suggest that Brazil's long-term global green economy competitiveness, will be dependent upon both its natural resource availability and the quality, coherence, and strategic intent of its public policy interventions.

Graph 5: The importance of international partnerships for green investments in Brazil

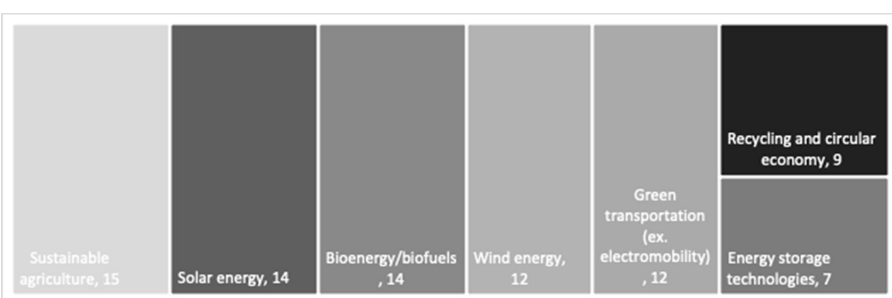


Source: Authors' elaboration

The fifth question addressed to the respondents, How much can international partnerships contribute to the stimulation of sustainable investments in Brazil?, aimed to assess the importance of international partnerships in attracting sustainable investments to Brazil. Respondents were presented with a multiple-choice question comprising five possible answers, with the option to select one choice (Essential – external partnerships play a crucial role; Important – but complementary to national policies; Low – external support has a limited impact; Insignificant – national policies are almost exclusively important; I don't know / No opinion). Almost all participants valued global collaboration in facilitating sustainable investment in Brazil. Yet, most of them (11 participants, or 52%) said international collaboration is necessary for facilitating sustainable investment in Brazil. However, respondents believed that international partnerships should play a supporting role to national government policies. The recent research supports this perspective. It shows that international collaboration can enable sustainable investment when it occurs within the framework of a nationwide set of policies that include: consistent legislation, government leadership, and political will (UNCTAD, 2023).

Hence, respondents view international partnerships as providing added value rather than substituting for domestic reform. A second important group, made up of 8 (37%) representatives, stated that international partnerships are vital, fulfilling an important role attracting green investment. Their opinion stresses the opportunity that international partnerships offers in providing know-how, funding, risk guarantees and strategic connections, and all these elements are essential in stimulating transition to sustainable development in Brazil.

Graph 6: Potential of Brazil's green sectors for foreign investment (2025–2030)



Source: Authors' elaboration

The sixth question addressed to the respondents, *Which sectors of the Brazilian green economy do you consider to have the greatest potential to attract foreign direct investment (FDI) in the next five years?*, aimed to identify the sectors of Brazil's green economy with the greatest potential to attract foreign direct investment over the next five years. Respondents were presented with a multiple-choice question comprising seven possible answers, with the option to select more than one choice (Solar energy; Wind energy; Bioenergy/biofuels; Recycling and circular economy; Sustainable agriculture; Green transport; Energy storage technologies). The results demonstrate a coherent recognition of Brazil's strategic directions for sustainable development and an awareness of which subjects are attractive to international investors. Sustainable agriculture was the most commonly identified sector (15 answers), indicating strong interest in a field in which Brazil is already respected globally.

Participants recognized that agriculture has innovation potential, but faces the pressure that comes with attempts at responsible production which consider the various environmental and social backdrops, in addition to respecting natural resources. Wind energy and green transport (which includes electromobility) received 12 votes each, were generally considered to have good dynamics, good infrastructure development, and good hope for the future of foreign capital. The "less polluting means of transport route" was specifically indicated as a strategic opportunity. Circular economy and recycling were mentioned, by 9 respondents, which suggests there is some emerging interest in sustainable economic models and efforts that can help to minimise waste and valorise resources. At last, it appears that there is a strategic imperative to develop energy storage technologies in order to stabilize grids and integrate renewable energy into the power systems more effectively. The recent analyses of the energy sector support this view by indicating that energy storage will play a vital role in facilitating large-scale renewable installations and is an emerging sector with great investment promise in Brazil in the short to medium term (IEA, 2024).

Graph 7: The capacity of local authorities in Brazil to support foreign investment in green industries

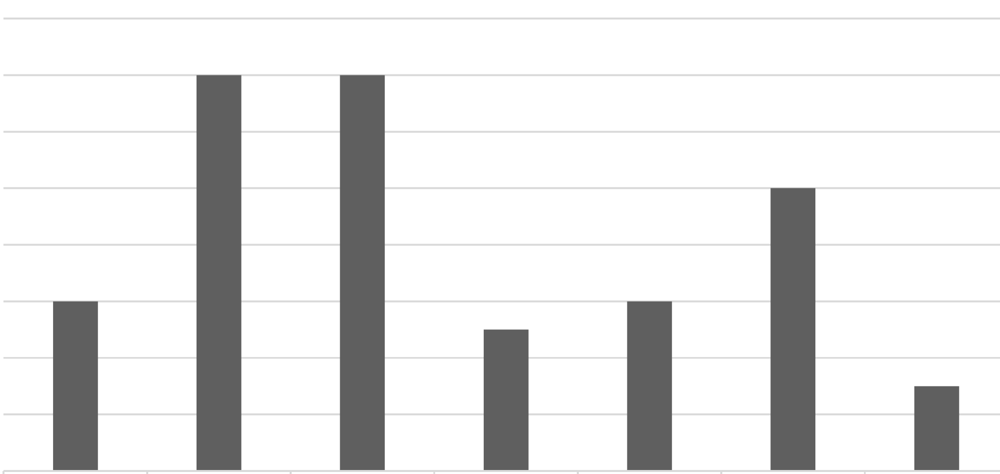
Source: Authors' elaboration

The seventh question in the survey, *How prepared are local and regional authorities in Brazil to collaborate with foreign investors in sustainable industries?*, aimed to assess the level of preparedness of local and regional authorities in Brazil to collaborate with foreign investors. Respondents were presented with a multiple-choice question comprising five possible answers, with the option to select one choice (Very well prepared and open; Prepared, but with some technical or administrative limitations; Prepared only in certain regions; Unprepared or resistant to collaboration; I don't know/I haven't interacted with local authorities). Concerning the readiness of Brazilian local and regional authorities to work with foreign investors in sustainable industries, the participants' views indicate an overall moderately positive assessment, but there are notable issues. Most respondents (10) have a view that the authorities are prepared, but with some technical or administrative limitations. It shows that while there is institutional openness to cooperate there are possible limitations in technical capacity, human resources or bureaucratic aspects that can slow down or complicate engagement with international investors. Seven other survey participants thought that preparedness level varied by region and that such variation is a well-documented feature of Brazil's decentralized governance. One close source (World Bank Group, 2021) came to parallel conclusions to those of the majority, noting the large differences among Brazil's states and municipalities relative to these institutions' capacities, their abilities to promote investments, and their experiences with sustainable projects. Only one participant responded that local authorities were unprepared or even unwilling to engage in international collaboration, which reflects a negative opinion stated out of context, although it cannot be entirely disregarded, particularly, if it is in a local context with a different set of administrative priorities or where there is no awareness of possible green opportunities. Additionally, 3 respondents stated that they did not know or had not engaged local authorities directly, which could imply a lack of communication and transparency or a lack of regional engagement on the part of investors.

Preparedness levels of local and regional governments differ in terms of their ability to work with foreign corporations. Brokerage inefficiencies have an impact on the uneven capacity of local and regional governments. Regulatory inconsistencies among regions and cities lead to a lack of clarity surrounding regulation's legal status. Regulatory inconsistencies give rise to uncertainty with respect to regulatory compliance. All of these elements impede access for foreign corporations investing in capital-intensive and long-term renewable energy projects. Therefore, structural disequilibrium diminishes the overall predictability of Brazil's investment environment for green sector. Subsequently influencing the foreign direct investments that might be strategically distributed throughout Brazil.

A recent study showed that there are many variables on subnational governance and institutional capacity for the management of sustainable projects successfully within Brazil. Reis-Filho (2026) in Environmental Policy and Governance states municipalities are highly variable. with regions that tend to have lower socio-economic indicators exhibiting more of an administrative capacity gap with regulatory process. The conclusion from this article is that improving municipal administration and the standardisation of the local licensing process, will be fundamental pre-requisites necessary to ensure effective implementation of sustainability policies. The research outlined in this paper is consistent with the survey results from this research project. The survey found that local and state governmental jurisdictions are generally willing to work with potential investors. In addition, the survey results also identified numerous technical or administrative limitations that would inhibit successful partnership opportunities. And that there were variable levels of preparedness uniformly within the various regions of Brazil. Significant discrepancies between data collected through surveys and published academic data indicate a need to identify structural barriers. Two of the major issues contributing to the institutional weakness and lack of capacity that exist in the larger investment climate in Brazil are: (1) these two factors are important impediments to the overall investment climate, and (2) they reduce Brazil's capacity to successfully interact with international investors.

Graph 8: Key elements shaping Brazil's image in the field of sustainable investment



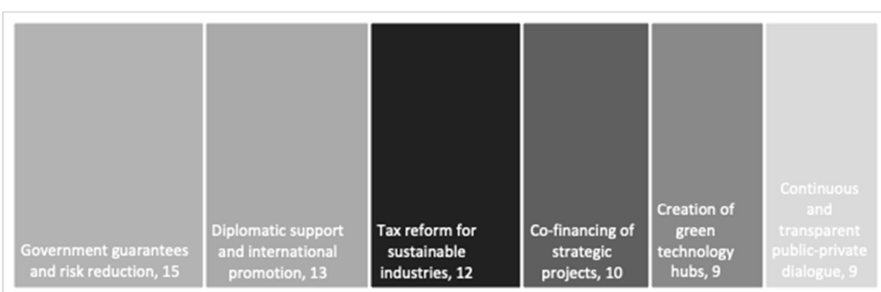
	Political and economic stability	Brazil's international climate commitments	Environmental reputation (ex. the Amazon)	Infrastructure and market access	Level of government corruption/transparency	Environmental legislation and regulations	Civil society engagement
Frequency	6	14	14	5	6	10	3

Source: Authors' elaboration

For the eighth question, *What factors most influence Brazil's image as a destination for sustainable investments?*, the study aimed to identify the factors that most strongly influence Brazil's image as a destination for sustainable investments. Respondents were presented with a multiple-choice question comprising seven possible answers, with the option to select more than one choice (Political and economic stability; Brazil's international climate commitments; Environmental reputation; Infrastructure and market access; Level of government corruption/transparency; Environmental legislation and regulations; Civil society engagement). Brazil is viewed as a place to invest in sustainable development due to a combination of many things including environment, politics, and institutions. Brazil's commitment to international climate issues along with its image regarding the environment were the two most mentioned factors when asking respondents what factors affect their view of Brazil as a sustainable investment destination. 14 respondents mentioned both factors. This result is consistent with the findings of some previously published studies that argue that Brazil's ability to attract foreign investment in working sustainably will depend on its ability to meet its international commitments related to climate change and that its credibility as an environmentally responsible nation is crucial when seeking foreign investment in environmentally sensitive markets like Brazil (UNCTAD, 2023). The fact that so many respondents highlighted environmental reputation as an important area of interest reflects increasing concern for protecting critical natural resources in Brazil, particularly the Amazon rainforest. Recent research indicates that whether Brazil is regarded as a global climate leader or a climate liability can have direct consequences on foreign investment decisions regarding green industries (UNCTAD, 2023).

The evidence demonstrates how Brazil's attractiveness as a sustainable investment country comes from both its structural resource base as well as its international commitments to addressing climate change, reputation for environmental sustainability, and perceived regulatory framework. Reputational capital is significant in building competitive advantage in the green economy because it is influenced by several factors, including environmental credibility and commitment to adherence to international climate accords. Reputational capital is essential in developing competitive advantages within the green economy because of factors like environmental credibility and willingness to obey international climate agreements. As such, Brazil's ability to position itself as both resource abundant and a country that is committed to sustainability reinforces its competitive edge in attracting sustainable foreign capital.

Graph 9: The role of the state in facilitating international cooperation in the field of renewable energy



Source: Authors' elaboration

For the ninth and final question of the survey, *What kind of support should the Brazilian government provide to encourage sustainable collaboration with foreign investors in the green energy sector?*, the study aimed to identify the types of support that the Brazilian government should provide in order to encourage sustainable collaboration with foreign investors. Respondents were presented with a multiple-choice question comprising six possible answers, with the option to select more than one choice (Co-financing of strategic projects; Government guarantees and risk reduction; Creation of green technology hubs; Tax reform for sustainable industries; Continuous and transparent public-private dialogue; Diplomatic support and international promotion). Many concrete ways that the Brazilian state should support sustainable partnerships with foreign investors in the green energy landscape. The responses are representative of expectations tied to both risk reduction of investment and with the wider institutional and diplomatic milieu. The most cited option was government risk abatement nominated by 15 respondents. The responses illustrate a clear need for a proactive state that recognizes its responsibilities and role to assess and reduce ambiguity that disconnects international investors, especially in terms of long-term green infrastructure.

One other important type of support was identified, that is diplomatic support and international promotion of opportunities within the Brazilian green energy sector, mentioned by 13 respondents. Investors value global visibility and institutional support from foreign representations that can facilitate contacts and provide trust in collaborations. According to 12 respondents, one area of public policy that they view as an important tool for building a competitive environment is tax reform for sustainable industries. This finding is consistent with findings from international organisations, which indicate that fiscal incentives, tax exemptions, and targeted subsidies are some of the most effective means for attracting foreign capital to clean energy and sustainable technology (UNCTAD, 2023). State-co-financing of strategic projects (10), is also seen as important policy, where both investors can diminish risk while engaging in a collaborative effort directly with authorities, in large and strategic energy transition projects.

This research relates to research question four (RQ4). There is evident expectation for greater levels of coordinated action by the government to reduce risks associated with capital investment and for increasing confidence of investors. Respondents also stress the importance of financial incentives, regulatory clarity, government guarantees and effective public-private cooperation. Overall, based on the data collected, Brazil's ability to successfully attract sustainable, foreign capital is based not only on Brazil's structural advantages, but also the coherence and credibility of the country's public policy environment.

The results presented in this survey give good exploratory insights from diplomatic, trade and sustainable industry experts; however with only 21 respondents, this is a small sample size; therefore the results should be viewed as representative of expert opinions on Brazil's green economy, and not to be considered statistically representative of all foreign investors or institutional actors involved in Brazil's green economy.

4 Conclusions

The paper conducted a study that collected opinions from experts about Brazil being a good place for sustainable Foreign Direct Investment (FDI) in renewable energy or "green" industries. The paper also wanted to identify Brazil's major competitive advantages, the most significant institutional barriers, and recommendations for policy changes needed for Brazil to be stronger within an international green economy. Overall, the majority of survey respondents said that Brazil's structural advantages continue to be viewed very positively by investors. Even though Brazil's structural advantages are still viewed positively by investors, many institutional frictions remain and impact negatively on the investment climate in Brazil. Additionally, there is a perception that Brazil's policies are unfairly implemented and not consistently effective. The research shows that public sector intervention needs to be strategically coordinated to assist with Brazil’s competitiveness.

With regard to (RQ1) and as indicated by responses received from participants, the respondents unanimously believe that the main source of Brazil’s competitive advantage lies within the resource and market. Abundant natural resources have been identified as a greater competitive advantage than the potential for a domestic market with 21 responses (21 total responses), compared to fewer responses supporting government support programmes (11 responses of 21), trade agreements integration (8 responses of 21), and qualified workforce (7 responses of 21). While the reports indicated that economic stability was less frequently selected as a significant driver (3/21), the data suggests that investors have some inherent understanding of ‘structural’ competitive advantages. Nonetheless, investors have concerns over ‘macro-institutional’ environments. Additionally, participants provided additional factors that could be associated with Brazil’s attractiveness as an investment destination.

With regard to RQ2, the paper report that institutional and structural barriers are still a major factor in determining how foreign investors make their decisions. Bureaucracy was noted as the most significant impediment because 18 of 21 participants indicated this as a limitation, followed by legislative instability (10/21) and infrastructure limitations (9/21). Several other challenges also exist, such as high administrative costs (6/21), corruption/transparency problems (5/21), and difficulty accessing local financing options (3/21). Each of these challenges adds to the perception of higher transaction costs and risk, coming especially into play with large capital projects, that require long-term predictability in regulations. Comments about the governance capacity at the sub-national level indicated that respondents viewed the capacity of local and regional governments as variable. However, the majority noted that regional governments were prepared to implement projects but faced technology and administrative deficiencies (10/21), while a significant percent emphasized that readiness varies regionally (7/21). Overall, evidence of these issues indicates that administrative capacity is not a minor consideration, into the long run administrative capacity issues are primary obstructions to issuing permits, to implementing projects and to promoting ongoing green investment.

As to RQ3, the proportion of respondents who assess the effectiveness of Brazil's current industrial policies is generally moderate, although conclusive indecision also hampers the level of satisfaction with them. Roughly half of all respondents considered the policies to be generally effective (10 out of 21), while just under half rated them as partially effective or inconsistent (9 out of 21). Only one respondent rated them as highly effective (1 out of 21) and one rated them as not effective at all (1 out of 21). According to the available data, the initiatives mentioned have been documented to some extent as actions have occurred within their scope. However, there remains a significant lack of evidence suggesting these actions will result in continued (coherently) effective implementation/continuity or use them consistently as intended to ensure credible, accountable funding for an adequate number of long-term investors. As a result of this, the long-term investor confidence required is still not fully developed. In other words, responses to this survey provide evidence to indicate that the limitation to policy effectiveness lies less in the absence of necessary tools and more in the absence of necessary coordination, predictability, and long-term implementation capability.

Finally, in relation to RQ4, the data shows that all five data collection groups agree on the need for Brazil to have specific public sector interventions to transform the country's structural advantage into sustainable long-term investments in green energy. The two highest ranked measures were: streamline the process for administrative approvals (18/21 responses), and provide tax incentives for investing in green technology (16/21 responses). Additionally, respondents included in their comments support for mitigating investors' risk (9/21 responses), and perceived support from both the Brazilian government and private sector to promote green technology internationally (7/21 responses) by providing professional development programs (7/21 responses). Moreover, there were questions regarding what actions or types of support from the Brazilian government would provide sufficient incentive for respondents to establish and sustain a sustainable partnership with foreign investment. The most commonly selected form of assistance from the Brazilian government was the establishment of government guarantees and risk mitigation mechanisms (with a total of 15 out of 21 selection). The second most commonly selected form of support was related to diplomatic assistance and the promotion of investment opportunities (with a total of 13 out of 21 selection). The third most commonly selected action immigration to provide tax incentives to support sustainable development (with a total of 12 out of 21 selection). The last form of assistance that respondents selected was co-financing of strategic projects from the Brazilian government (with a total of 10 out of 21 selection). Together, these indicators suggest that the investment community expects active and supportive state assistance for green infrastructure development. Investors also want more predictable government actions. Lastly, the presence of dependable and accountable partners will be critical when developing and constructing green infrastructure.

The findings of the research illustrate how Brazil's appeal for sustainable foreign direct investments (FDI) is driven by three key factors: resource endowments, sectoral potential, and reputation as a reliable partner. However, there are some limiting factors to attracting FDI, such as bureaucracy, regulatory volatility, poor infrastructure, and poor institutional capacity. The study also indicates that the effectiveness of Brazil's policies is perceived to be inconsistent, which reinforces the need for administrative reform, improved regulatory clarity, and the development of risk-sharing mechanisms. Consequently, Brazil's future ability to compete globally in the green economy will be dependent on being able to utilize its considerable structural advantages. This must accompany a well-coordinated industrial policy framework. Additionally, it requires coordination of multi-level governance. Public sector interventions are also required to decrease risk while speeding up the process of project implementation.

Limitations of the Research

When interpreting these findings, it's important to note the following constraints associated with the current data. Firstly, the sample size is relatively small in that there were a total of only 21 participants included within the study. While all of the participants had been selected as having both extensive knowledge about and access to the Brazilian economy and investment environment, this limited sample size limits the ability to generalize to a larger population. Secondly, because the respondents were drawn from the author's professional contacts using non-probability sampling methods, each participant has direct ties to the author. Their answers do not reflect the diversity of opinions held by every stakeholder with respect to foreign direct investment in Brazil. Moreover, the closed-ended question format utilised in the study provided for comparability and consistency in terms of how each respondent answered questions, but limited the amount of rich, qualitative data that could have been gathered via an open-ended question format or via interviews. Finally, the perception of respondents was solicited at one specific point (September 2025) in time and does not account for any changes in policy, investment conditions, or market dynamics that might occur over time.

Directions for Future Research

Future research may be able to lessen some of the limits imposed by this research by increasing the size of the sample population through use of more statistically valid probability sampling methods, to ensure that study findings reflect the true characteristics of the overall population. In addition, through comparative analysis of Brazil and some other developing nations having strong renewable energy industry sectors (e.g., Chile and Mexico) additional insights into how to develop sustainable sources of foreign direct investment (FDI) may be uncovered. Furthermore, future research should consider employing a mix of quantitative and qualitative data collection methods (using quantitative survey data along with qualitative interviews or case studies) in order to better understand what motivates FDI; what institutional impediments exist to FDI; and what gaps exist in the implementation of FDI policy. Finally, the study makes three specific recommendations to develop clearer policy and business strategies for renewable energy sources: conducting separate studies for each source (hydrogen, renewable, and bioenergy) to identify how they can be used sustainably and economically.

Recommendations for Theory, Business and Public Policy

The theoretical contribution of these results contributes to existing literature on sustainable FDI by emphasizing how natural resources, institutional quality, and policy coherence impact a country's attractiveness for investment. Future theoretical work on sustainable investment in emerging markets should incorporate administrative capacity and the effectiveness of governance. For business stakeholders, these results highlight that Brazil offers strong investment potential with regards to renewable energy and sustainable agriculture due to lower energy costs and resource availability. Foreign investors should use several risk mitigation strategies such as partnerships with local businesses and government-supported guarantees to manage regulatory and administrative risks. Public Policy demonstrates the importance of reducing unnecessary regulation, clarifying existing regulations, and improving cooperation between levels of government. Improving transparency, institutional capacity and risk mitigation will allow Brazil to take advantage of its natural endowments and position itself as a regional leader in the green economy.

References:

[1] Agora Industry (2023). 12 insights on Brazil's green hydrogen competitiveness. Agora Energiewende Report Series.

[2] Aremu, F. A., dos Santos, A. C., & Morais, F. B. (2025). Quantile analysis of economic growth, foreign direct investment, and renewable energy on CO_2 emissions in Brazil. Sustainability, Vol. 18, No. 3, pp. 152.

[3] Ben Belgacem, S., Younsi, M., Bechtini, M., Alzuman, A., & Khalfaoui, R. (2024). Do financial development, institutional quality and natural resources matter the outward FDI of G7 countries? Sustainability, Vol. 16, No. 6, pp. 2237.

[4] Berryman, A. K., Bucker, J., Senra de Moura, F., Barbrook-Johnson, P., Hanusch, M., Mealy, P., Farmer, J. D., & del Rio-Chanona, R. M. (2025). Skill and spatial mismatches for sustainable development in Brazil. arXiv Papers, No. 2503.05310.

[5] Costa, F. H. D. (2022). Planejamento do setor elétrico brasileiro e transição energética: Perspectivas de integração territorial e industrial. Universidade Federal do Rio de Janeiro.

[6] Da Silva, G. A., Lima, R. F., & Oliveira, T. S. (2024). Barreiras políticas e institucionais para o investimento verde no Brasil e seus impactos na economia verde latino-americana. Instituto Latinoamericano de Estudos para o Desenvolvimento Sustentável.

[7] Dinca, V. M., Dima, A. M., Moagăr-Poladian, S., Săseanu, A. S., & Dinu, V. (2025). Energy consumption and savings behavior under the pressure of energy security, sustainability and cleaner energy transition: The case of Romania. Oeconomia Copernicana, Vol. 16, No. 2, pp. 489–521.

[8] Dincă, V. M., Moagăr-Poladian, S., Stamule, T., & Nistoreanu, P. (2023). The RepowerEU Plan and the main challenges for the transition to renewable energy in Romania. Amfiteatru Economic, Vol. 25, No. 64, pp. 676–690.

[9] Dutton, J., Bartunek, J., & Gersick, C. (1996). Growing a personal, professional collaboration. In P. Frost & S. Taylor (Eds.), Rhythms of academic life, pp. 239–248. Sage.

[10] Fraunhofer ISE (2024). Energy charts: Electricity generation in Germany.

[11] German Federal Ministry for Economic Affairs and Climate Action (2023). Energiewende monitoring report.

[12] Glaser-Segura, D., Nistoreanu, P., & Dincă, V. M. (2018). Considerations on becoming a world heritage site: A quantitative approach. Amfiteatru Economic, Vol. 20, No. 47, pp. 202–216.
[13] Harvard Business Review (2003). How are we doing? Vol. 81, No. 4, pp. 3.
[14] ICAT (2023). Recommendations for improving Brazil's renewable energy policy framework. Initiative for Climate Action Transparency.
[15] IEA (2024). Batteries and secure energy transitions.
[16] IEA Bioenergy (2024). Implementation of bioenergy in Brazil – 2024 update.
[17] Kahn, R. L., & Boulding, E. (1964). Power and conflict in organizations. Free Press.
[18] Lira, F., Kramer, N., & Quitzow, R. (2025). Hydrogen policy in Brazil: Emerging path to green re-industrialization. Springer.
[19] Magadum, T., Murgod, S., Garg, K., & Yadav, V. (2025). Renewable energy transition in South America: Predictive analysis of generation capacity by 2050. arXiv Preprint.
[20] Martins, A. C., da Silveira, J. M., Pereira, M. C., & Pasqualino, R. (2024). Mitigating climate impacts incentives: An analysis of green investments in South America. PSL Quarterly Review, Vol. 77, No. 310, pp. 371–386.
[21] Pelau, C., Vladoi, A. D., Fufezan, M., Dinca, V. M., & Ghinea, V. (2010). The influence of knowledge dynamics on consumer behaviour. Proceedings of the 2nd European Conference on Intellectual Capital, pp. 465–471.
[22] Reis-Filho, J. A., Fiterman, Y. L., Giarrizzo, T., & Noleto-Filho, E. M. (2026). Environmental deregulation by design: Institutional capacities and the perils of Brazil's new environmental licensing law. Environmental Challenges, Vol. 22, pp. 101383.
[23] Reuters (2024). Brazil aims to lure foreign investment with green development platform.
[24] Seabra, J. E. A., Cavalett, O., & Lima, J. M. (2022). Modeling the contribution of bioelectricity to the future Brazilian power mix. Energy, Sustainability and Society, Vol. 12, Article 9.
[25] UNCTAD (2023). World Investment Report 2023. United Nations.
[26] Vasconcelos, G. F., & Castilho, H. A. (2025). A SWOT analysis for the evolution of Brazil's renewable energy sector. Energy Policy, Vol. 191.
[27] Werner, J. A., & Lazaro, W. R. (2023). The policy dimension of energy transition: The Brazilian case. Energy Policy, Vol. 175, pp. 113557.
[28] World Bank Group (2021). Subnational Doing Business in Brazil 2021. World Bank.
[29] World Bank Group (2021). Subnational Doing Business in Brazil 2021. World Bank.
[30] World Economic Forum (2022). The Global Competitiveness Report 2022.
[31] Zhang, Y., & Duarte, P. (2023). Chinese FDI in Brazilian renewable energy: Geopolitics and green capital. Journal of Energy and Development, Vol. 49, No. 1.

Second-Generation Asian Tigers in Global Value Chains: A Comparative Analysis of Backward and Forward Linkages[1]

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Abstract: Considering different patterns and levels of integration into global value chains (GVCs), this paper investigates similarities and differences among the second-generation Asian Tigers from the perspective of their interconnections between industries and countries, i.e., backward and forward linkages. We bring to the forefront Indonesia, Malaysia, the Philippines, Thailand, and Vietnam, and patterns of their integration into GVCs. The starting point of this research is the statistical evidence from the Regional Integration and Value Chain Analyzer (RIVA), developed by the United Nations Economic and Social Commission for Asia and the Pacific, interpreted from a comparative standpoint. After reviewing the relevant literature, in the first part, the investigation focuses on the main characteristics of the five economies, derived from their participation in GVCs covering the time frame between 2015 and 2024. In the second part, the case studies of Indonesia and Vietnam are presented, together with their backward and forward linkages in 2024.

Keywords: second-generation Asian Tigers, backward and forward linkages, global value chains, international trade.
JEL Classification: *F02, F13, F15, F43, O24, O53, O57.*

1. Introduction

The concept of “global value chains” (GVCs) has emerged as a dominant business model, occupying a central role in the development strategies at the level of multinational enterprises (MNEs) and national economies. As a mechanism to transmit global knowledge and production know-how, based on global interdependence, GVCs spanned over countries, showcasing the intricate collaboration required for complex and innovative productions, shaping industries and impacting lives worldwide (ADB, 2026). In this regard, some countries have stood out by intensively integrating into GVCs, currently dominating many industries, as is the case in Southeast Asian countries with a critical role in renewable energy manufacturing, and contributing to their transition from low-cost assembly hubs into central and sophisticated suppliers, as well as innovators. While initially capitalising on labour-intensive exports, Southeast Asian countries have upgraded to higher value-added activities through technology adoption, industrial policy, and deep integration into global production networks (Kee & Tang, 2016; Yu, 2025). Success stories have pointed to innovation as a key mechanism through which MNEs can achieve deeper and more sustainable integration into global production networks (Hoang et al., 2026).

The Asian Tigers of the second-generation (Indonesia, the Philippines, Malaysia, Thailand, and Vietnam, or T5), members of the Association of Southeast Asian Nations (ASEAN)[2], are among the key players in GVCs due to their transformation into global manufacturing hubs (OECD, 2022). Much of their development success over the past several decades has been tied to their openness to trade (even if specific sectors are highly restricted[3]) and engagement with the global economy, including through participation in GVCs (ADB, 2026). The five analysed economies differ widely in their levels of GVC participation, their capabilities, and their intensity of integration and upgrading (ADB, 2026). The main objective of this paper is to underscore these countries’

[1] This paper further capitalizes on Iulia Monica Oehler-Șincai’s doctoral thesis, “The place and role of the Asian Tigers in international trade at the end of the 20th century and the beginning of the 21st century”.
[2] The organisation comprises Brunei Darussalam, Cambodia, Indonesia, the Lao People’s Democratic Republic, Malaysia, Myanmar, the Philippines, Singapore, Thailand, Timor-Leste, and Vietnam.
[3] For instance, the OECD Services Trade Restrictiveness Index (STRI) shows the Philippines, Indonesia, Thailand, Vietnam, and Malaysia, in this order, among the countries with the highest policy restrictions affecting trade in services.

similarities and differences regarding their integration into GVCs from the perspective of backward and forward linkages.

2. Literature review

In a period when GVCs are at an inflection point, as they are being reshaped by geopolitical dynamics, pandemic aftershocks, and the emergence of disruptive technologies, it is high time to evaluate the integration of the second-generation Asian Tigers into these production networks. The world has entered a new phase of globalization, being more fragmented, but also “more digital, high-tech and dynamic”. For Asia, in general, and the T5 economies in particular, this presents both huge growth potential and a massive downside risk to the development outlook, and the region’s future depends on its ability to stay open, innovate rapidly, and adapt proactively to global shifts in geopolitics and protectionist policies (AMRO, 2025).

Production, trade, and investment are more and more concentrated on technologically advanced and regionally integrated hubs. Readiness rather than volume is the new basis of competitiveness, as shown by the Global Value Chain Readiness Index (GVCRI) across six pillars (technology and connectivity, trade and investment, sustainability and energy, institutional and geopolitical, financial and business readiness). At the same time, geoeconomic fragmentation and subsidy competition are reshaping the geography of GVCs: MNEs respond to tariffs, sanctions, and subsidies by rerouting trade and investment through “connector” economies, especially ASEAN countries with ties to multiple (rival) blocs (WTO, 2025). The China plus One strategy adopted by various MNEs, synonymous with the diversification of operations beyond China to mitigate risks, is a valuable accelerator of foreign direct investment (FDI) to ASEAN (Kaushal, 2025). GVCs drive trade integration, and at the same time regional trade agreements, such as the ASEAN Trade in Goods Agreement (ATIGA) and the Regional Comprehensive Economic Partnership (RCEP) stimulate growing involvement in complex GVCs and capabilities in manufacturing and supply chain logistics (ASEAN, 2025).

Recent studies underscore *Vietnam*’s continued specialization in low-complexity assembly tasks with limited domestic value addition (Hoang et al., 2026). Vietnam, together with Thailand, has experienced increases in backward participation, strengthening their roles in processing, assembly, and other downstream activities. Vietnam is the country in Southeast Asia with the highest backward participation rates (relying heavily on imported intermediate inputs, especially from China and South Korea) to export final products (Nguyen et al., 2025). Vietnam has become an important electronics manufacturing and assembly hub, intending to become a global semiconductor & electronics centre, by combining self-reliance with FDI. Vietnam’s electronics development strategy to 2030, with a vision to 2050, is built on the breakthrough formula “C = SET + 1” (Chip, Specialized, Electronics, Talent), where the “+1” stands for Vietnam as “a new, safe node in the global semiconductor supply chain, aiming to become a global hub for chip design, manufacturing, packaging, and testing” (Tran & Trinh, 2026).

Indonesia is a resource-driven economy and plays a relevant role in GVCs through its rich natural resources. Its dominant position in the international nickel market and specific policies oriented towards the support for local processing have led to a strong electric vehicle battery manufacturing (Kim, 2026). At present, Indonesia is tightening its control over other natural resources, with new regulations requiring relevant exports to be handled by state enterprises to acquire a greater “bargaining power” (Tarigan and Delgado, 2026). Scholars are sceptical if similar policies in other mineral segments may have the same magnitude of success, as Indonesia does not have as much market power in other areas as it does in nickel (Kim, 2026). Its supplementary goal is to support the manufacturing sector at the national level, i.e., exporting higher value goods. Indonesia’s Golden Vision to reach high-income status by 2045 places particular emphasis on trade, taking as a model the Asian Miracle success stories that have relied on trade as an important growth driver (Habib, 2026). Enhancing GVCs participation is part of the solution, Indonesia must first address technological, infrastructure, and policy gaps (Nugraha et al., 2025). Athukorala and Patunru (2025) emphasize that the country’s policy ambivalence toward engaging in GVCs (on the one hand, restrictions regarding FDI and even trade, on the other hand, the focus on integrating domestic manufacturing into GVCs to reap the benefits of economic globalization) is a key factor in explaining its unrealized growth potential. OECD (2026) shows that Indonesia faces significant bottlenecks for trade and investment due to widespread regulatory barriers such as local-content requirements and indirect discriminatory impediments that favour domestic firms, hindering MNEs and trade integration.

By contrast, Malaysia, together with Asian Tigers of first generation (South Korea, Singapore, Taiwan-China, and Hong Kong-China) shifted toward higher forward participation, reflecting a greater share of upstream, knowledge- and technology intensive activities (ADB, 2026).

Malaysia is a leading example among developing economies in Asia. It is increasingly competing through innovation, services, and standards-setting, rather than production scale alone. At the same time, it has implemented targeted policies to strengthen manufacturing-related services, "illustrating how policy can support deeper and more diversified GVC integration". It has moved into segments of GVCs where "competitiveness depends less on cost advantages and more on innovation, standards, and governance - while also facing greater exposure to emerging pressures such as automation and evolving regulatory requirements". Malaysia is the only second-generation Asian Tiger which has upgraded into complex GVC tasks. Thailand and Vietnam are one-way upgrading, while Indonesia and the Philippines are two-way upgrading[4] (ADB, 2026).

Considering important differences in knowledge, technology, and productivity, these countries' participation in GVCs follows specific specialization patterns. Taking as an example the electrical vehicle value chain, one can remark Indonesia's contribution to battery materials (lithium and nickel), semiconductor inputs from Malaysia, and electronic components from Malaysia and Thailand, before assembly takes place in Thailand, Indonesia, Malaysia, and Vietnam (ADB, 2026; PwC, 2025).

The novelty of the present investigation lies in the comparative analysis of the five economies in terms of linked exporting sectors and partner economies, for backward and forward linkages, as well as the two case studies of Indonesia and Vietnam. This research gap is the key justification for this study, proving originality and new insights.

3. Methodology of research

The methodological design employs a mixed-methods approach, combining a *quantitative* approach based on the specialised databases, namely *the Regional Integration and Value Chain Analyzer* (RIVA) developed by the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), doubled by other international databases, where is needed, with a *qualitative* analysis constructed on international organisations' reports and academic studies, to *identify the level of integration into GVCs of five Southeast Asian countries, namely Malaysia, Indonesia, Thailand, the Philippines and Vietnam, known as the second-generation Asia Tigers (hereinafter referred to as T5).* In this regard, a *comparative* approach is also envisaged, taking into account the examination of the evolution of the five countries during the period between 2015 and 2024. Throughout the article, personal interpretations and opinions are considered in the context of putting together their ambitious national policies and strategies, also emphasised in international reports, with the data revealed by the RIVA database.

Even if there are other databases tracking GVCs by revealing where and how much value is generated by a country's industries, such as the Trade in Value Added (TiVA) database of the Organisation for Economic Co-operation and Development (OECD) or the Eora of the United Nations Conference on Trade and Development (UNCTAD), RIVA offers the most up-to-date information.

The selected indicators aim to provide an overview of the five countries engaging in international cooperation through the perspective of GVCs, focusing on Indonesia and Vietnam. Indonesia is the largest economy among the T5, is a resource-driven economy, and is the incontestable leader among the five in terms of domestic value-added embodied in its exports of intermediate goods or services. By contrast, Vietnam records the lowest level of domestic value-added. The suitable indicators are expected to reveal the level of dependencies of the two economies on some industries and partners.

The research is conducted on two major directions, as follows: (1) the main characteristics of the five economies, from their forward and backward trade linkages perspective, to emphasise the general characteristics of their participation in GVCs covering the period 2015-2024; (2) two case studies of Indonesia and Vietnam regarding their integration into GVCs, from the perspectives of backward and forward linkages in 2024.

[4] According to OECD, economies that are classified as one-way upgraders saw either an increase in the domestic value added of their exports or diversification in their GVC trade over 2007–2023. Economies that are classified as two-way upgraders saw an increase in both the domestic value added of their exports and diversification in their GVC trade over 2007–2023.

4. Research results

4.1. The Asian tigers in the world trade – a synopsis

Southeast Asian countries, particularly the Asian tigers, are deeply connected to the world economy, playing an important role and being top global trade partners, with 16.12% of global goods exports and 15.03% of global goods imports in 2025, especially from the perspective of their manufacturing dominance. As revealed in Table 1, the Asian tigers rank in the top positions among the world's largest exporters (WTO, 2026).

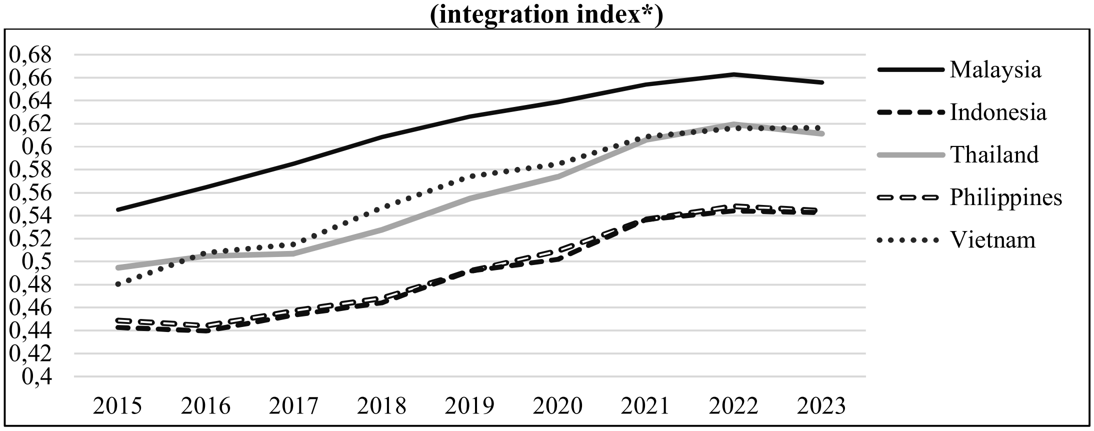
Table 1: The Asian tigers as the leading exporters and importers in the global merchandise trade, in 2025 (in billion dollars and percentage)

Rank	Exporters	Value	Share	Annual percentage change	Rank	Importers	Value	Share	Annual percentage change
First-generation Asian tigers (T4)									
5	Hong Kong, China	754	2.9	17	6	Hong Kong, China	832	3.1	18
8	Republic of Korea	709	2.7	4	12	Republic of Korea	632	2.4	0
12	Chinese Taipei	641	2.4	35	18	Singapore	506	1.9	10
14	Singapore	567	2.2	12	19	Chinese Taipei	494	1.9	23
Second-generation Asian tigers (T5)									
18	Vietnam	473	1.8	17	20	Vietnam	454	1.7	19
23	Malaysia	376	1.4	14	23	Thailand	345	1.3	13
25	Thailand	340	1.3	13	24	Malaysia	340	1.3	13
30	Indonesia	283	1.1	7	30	Indonesia	242	0.9	4
48	The Philippines	84	0.3	15	36	The Philippines	141	0.5	4.4
	Total of above	**4227**	**16.12**	**-**		**Total of above**	**3986**	**15.03**	**-**
	World	**26257**	**100.0**	**7**		**World**	**26608**	**100.0**	**7**

Source: Data collected by the authors from the WTO (2026).

It is worth noting the level of integration of these countries in the Asian region. Since 2015, the T5s integration into the Asia-Pacific has increased, as underscored by data in Figure 1. In 2023, Malaysia (0.66) and Vietnam (0.62) were the most integrated economies among the five, while the Philippines and Indonesia were the least (0.54) (Figure 1).

Figure 1: Second-generation Asian tigers - integration into the Asian region, during 2015-2023 (integration index*)

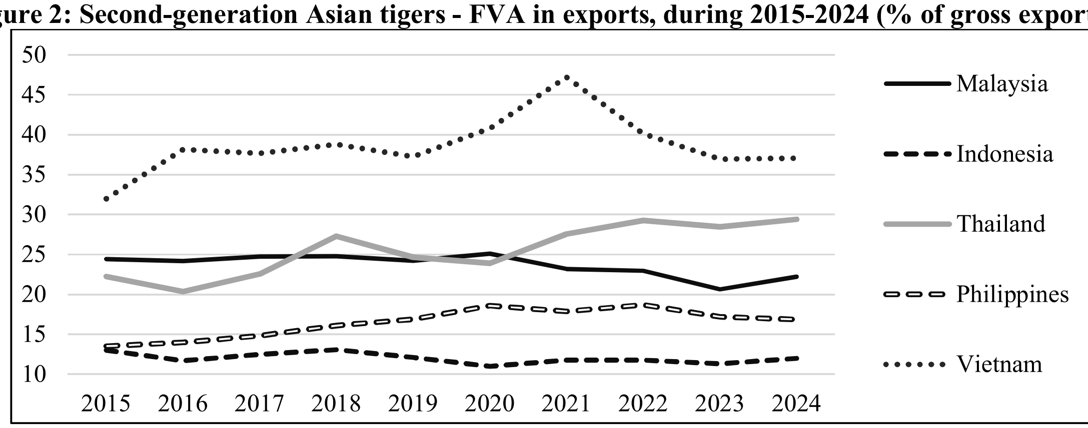


Note: *Integration index takes a value from 0 to 1, where 0 is the minimum level of integration.
Source: Authors' representation based on UNESCAP (2026).

4.2. Second-generation Asian tigers - backward and forward linkages

Backward and forward linkages reflect the interconnections between industries and countries, where the inputs are pulled from suppliers (as is the case in backward linkages) or the outputs are pushed to users (as is the case in forward linkages). The *backward linkages* suggest evidence related to the *foreign value-added (FVA) contained in a country's exports,* reflected in the answers to the following essential questions: what role imports from abroad play in an economy's export production; which export sectors in an economy rely on content imported from other economies; and which other economies contribute most to an economy's exports (UNESCAP, 2026). FVA in exports represents the value of imported inputs used to produce intermediate or final goods and services to be exported by a country, suggesting the measure of the dependency of exporting industries on foreign inputs. Serving as a key indicator of backward integration into GVCs, FVA also reflects the vertical specialisation when expressed as a percentage of a country's gross exports (WTO, n.d.). The backward participation measures a country's integration into GVCs as a processor or assembler, revealing the role of a hub for final assembly of a country, but also its vulnerability to possible supply chain disruptions from its providers, given its position in the downstream. During the period between 2015 and 2024, all second-generation Asian tigers (T5) recorded minor fluctuations in FVA, with Vietnam standing out for the highest value of FVD in its exports (in 2024, 37.06% of national gross exports embedded FVA from aboard, the maximum value being recorded in 2021 with 47.22%), while Indonesia with the lowest level between 2015-2014, in 2024 recording only 12% national gross exports embedded FVA from aboard) (Figure 2). These figures reflect that Vietnam and Thailand rely more on foreign inputs to produce goods for export than Indonesia and the Philippines.

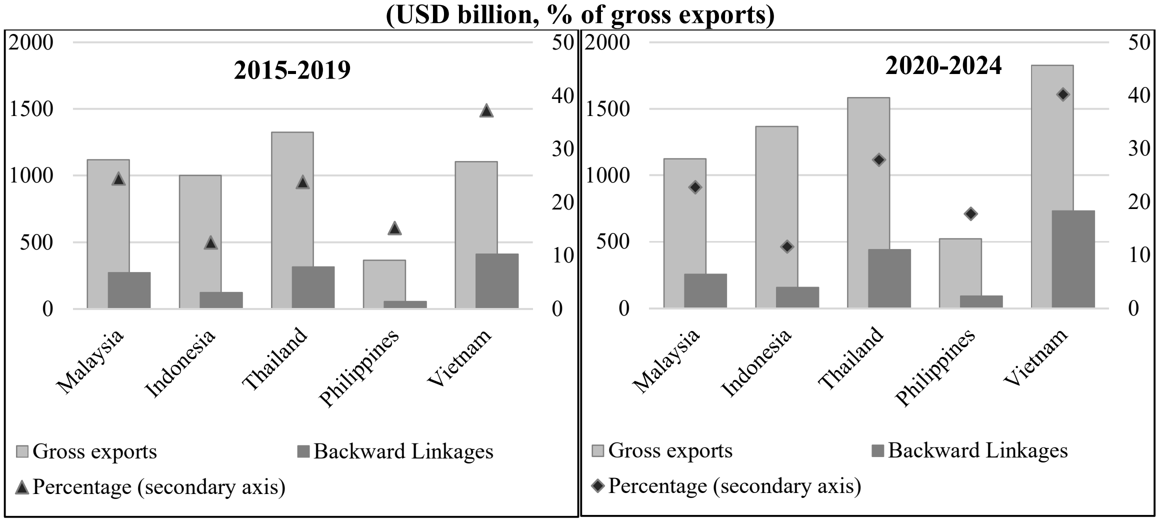
Figure 2: Second-generation Asian tigers - FVA in exports, during 2015-2024 (% of gross exports)



Source: Authors' representation based on UNESCAP (2026).

From the perspective of T5s' foreign value added in their exports, data in Figure 3 also emphasises different, but minor, changes during the period 2020-2024 compared to 2015-2019, as follows: increases for Thailand, the Philippines, and Vietnam, and decreases for Malaysia and Indonesia.

Figure 3: Second-generation Asian tigers - FVA in exports, changes in 2020-2024 compared to 2015-2019 (USD billion, % of gross exports)



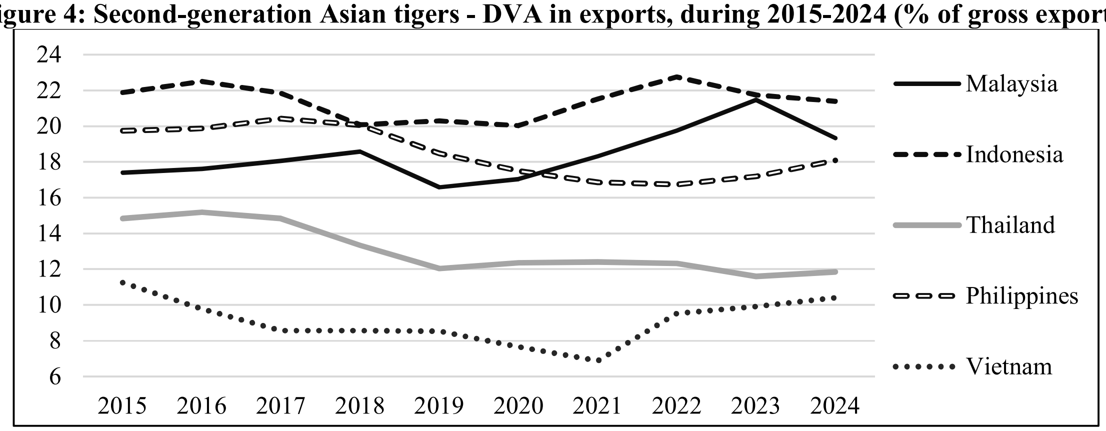
Source: Authors' representation based on UNESCAP (2026).

The *forward linkages* suggest evidence related to the *domestic value-added (DVA) embodied in a country's exports of intermediate goods or services that are then used by the buying country to produce its exports.* DVA is reflected by the answers to the following important questions: how much does an economy's added value embedded in its exports contribute to the export production of other economies; which are the exporting industries with which this economy contributes the most to the export production of other economies; which economies depend the most on this economy's exports for their own export production (UNESCAP, 2026).

DVA in exports measures the value generated within a country, covering domestic resources, including labour and capital, embodied in its exported intermediate or final goods and services. The forward linkages also indicate the level of domestic integration in GVCs. Expressing the share of a country's DVA that is exported and then re-exported by a destination country, the forward linkages represent a country's domestic value subsequently embedded in the gross exports of partner economies, measuring a country's role as a primary supplier of raw materials, high-tech components, or even specialised services (such as design or research), the forward participation indicating the upstream position of a country (UNESCAP, 2026).

During the period between 2015 and 2024, all T5s recorded fluctuations in DVA, with Indonesia standing out for the highest value of domestic value added in its exports throughout the entire period (in 2024, Malaysia's DVA was 21.39% of national gross exports), while Vietnam had the lowest level of DVA (in 2024, Vietnam's DVA was 10.4%) (Figure 4). These figures reflect that Indonesia and Malaysia are important upstream suppliers, managing to export essential resources for other countries to process goods to a much greater extent than Thailand and Vietnam (UNESCAP, 2026).

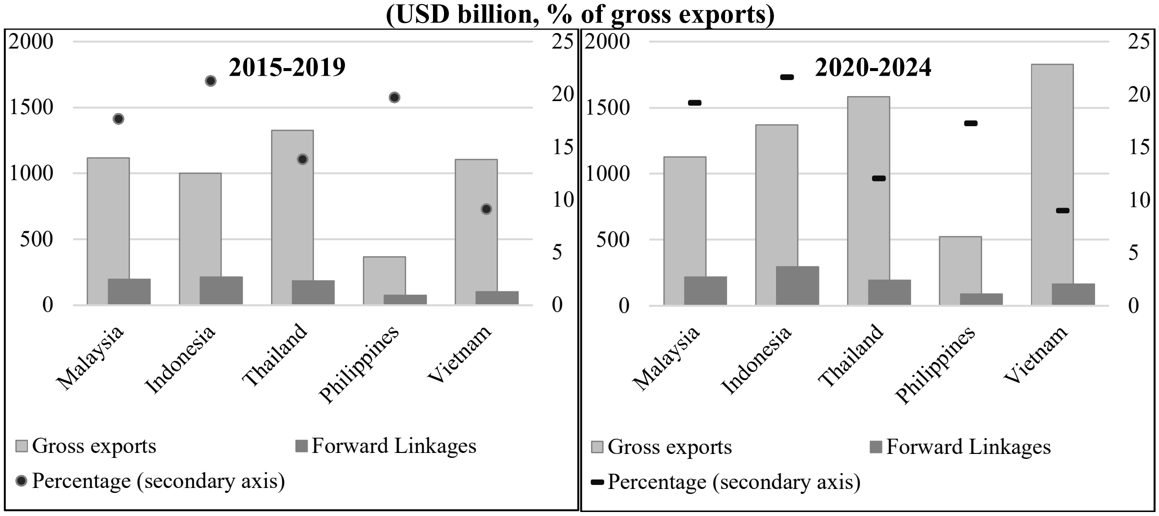
Figure 4: Second-generation Asian tigers - DVA in exports, during 2015-2024 (% of gross exports)



Source: Authors' representation based on UNESCAP (2026).

From the perspective of T5s' value added in foreign exports, data in Figure 5 also emphasises different, but minor, changes in DVA during the period 2020-2024 compared to 2015-2019, as follows: increases in percentages for Malaysia and Indonesia, and decreases for Thailand, the Philippines, and Vietnam (UNESCAP, 2026).

Figure 5: Second-generation Asian tigers - DVA in exports, changes in 2020-2024 compared to 2015-2019 (USD billion, % of gross exports)



Source: Authors' representation based on UNESCAP (2026).

The data in Table 2 highlight the sectoral representativeness of the main backward- and forward-linked export sectors from T5, along with the main linked partner economies, over the period 2020-2024. According to the RIVA database, the results reflect the dominance of electrical equipment in the sectoral ranking, with the highest share of the total value of the sector's exports for Malaysia and Vietnam in terms of backward and forward linkages, and for the Philippines, only for backward linkages. All these economies occupy significant roles within the GVCs related to this sector, as follows: Malaysia dominates in advanced semiconductor packaging and integrated circuit design; the Philippines outperforms in component testing and packaging (Weno et al., 2025); and Vietnam specialises in mass consumer electronics assembly (ILO, 2022).

Table 2: Second-generation Asian tigers – the main linked exporting sectors and partner economies, for backward and forward linkages, during 2020-2024 (USD billion, % of gross exports)

Second-generation Asian tiger countries	FVA		DVA	
	Main backward-linked exporting sector (USD billion/ % of the sector's total export value)	Main backward-linked partner economy (USD billion/ % of national gross exports)	Main forward-linked exporting sector (USD billion/ % of the sector's gross exports)	Main forward-linked partner economy (USD billion/ % of national gross exports)
Malaysia	Electrical equipment USD 90 billion/ 35.1%	China USD 68.6 billion/ 26.8%	Electrical equipment USD 45.8 billion/ 21.2%	Singapore USD 46.5 billion/ 21.5%
Indonesia	Textiles USD 23.6 billion/ 14.9%	China USD 32.5 billion/ 20.5%	Mining USD 82.3 billion/ 27.8%	China USD 52.8 billion/ 17.8%
Thailand	Transport equipment USD 63 billion/ 14.3%	China USD 74.2 billion/ 16.8%	Basic metals USD 19.3 billion/ 10.1%	China USD 24.6 billion/ 12.9%
The Philippines	Electrical equipment USD 29.4 billion/ 31.7%	China USD 21.5 billion/ 23.2%	Business services USD 27.1 billion/ 30%	China USD 7.7 billion/ 10.7%
Vietnam	Electrical equipment USD 384.6 billion/ 52.4%	US USD 242.8 billion/ 33.1%	Electrical equipment USD 44.8 billion/ 27.2%	China USD 37.5 billion/ 22.8%

Source: Authors' data selection based on UNESCAP (2026).

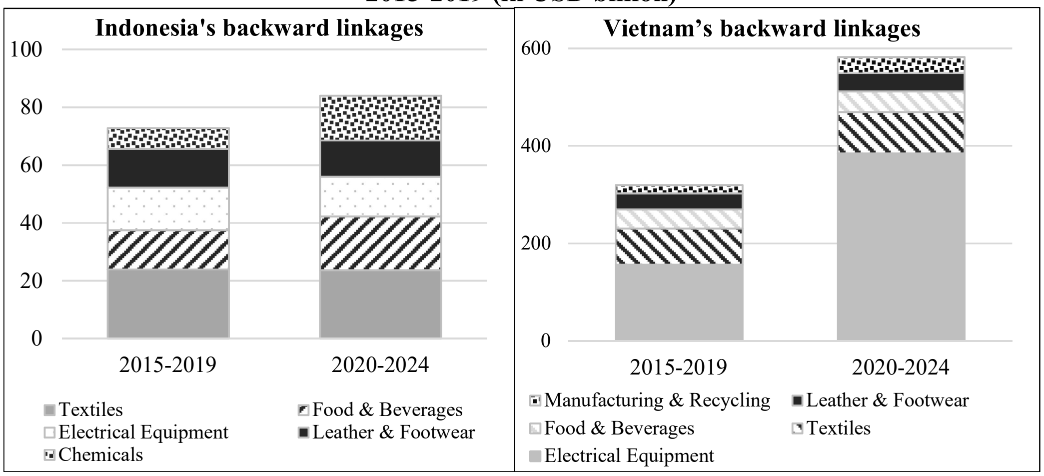
Also, for Thailand, the leading position of the transport equipment industry in backward linkages is supported by its specialisation in automobile production, with this country acting as a massive global and regional export centre, including eco-friendly cars and heavy commercial vehicles, supported by a robust auto parts supply chain (Mordor Intelligence, 2026; ILO, 2024). A situation that deviates from the general trend is the case of the Philippines, with business services ranking in the first position of forward linkages, based on its booming in the information technology and business process outsourcing sector (Pasadilla et al., 2025; Philippine Business Hub, 2026). However, when it comes to partners, China dominates the T5 export partners ranking, with two exceptions: Malaysia and Vietnam, where China ranks second. China is the main trading partner for the second-generation Asian tiger economies, with its massive, regionally integrated manufacturing sector.

4.3. Case study: A comparative analysis of Indonesia and Vietnam, from the perspective of their backward and forward linkages

Among the T5, Indonesia and Vietnam are both rising economic powers in Southeast Asia and key players in ASEAN, but with vast structural differences, and also distinct strategies for capturing global investment and participation in GVCs.

Across the period between 2015 and 2024, the main sectors for *backward linkages* evolved as follows: (i) as for *Indonesia*, during 2020-2024, the backward linkages (USD 158.9 billion) represented 11.6% of total gross exports, with **textile** recording 14.9% of Indonesia's backward linkages, down from 19.1% in 2015-2019; in terms of the evolutions in 2020-2024 as compared to 2015-2019, the top 5 is occupied by the same sectors, with some changes in their position, respectively chemicals replacing electrical equipment on the third ranking position; in 2024, Indonesia's textile exports included USD 5.4 billion in FVA, accounting for 14.4% of the sector's total export value; (ii) as regards *Vietnam*, during 2020-2024, the backward linkages (USD 734.5 billion) represented 40.2% of total gross exports, with *electrical equipment* recording 52.4% of Vietnam's backward linkages, down from 38% in 2015-2019; in terms of the changes in 2020-2024 compared to 2015-2019, the top 5 sectors were maintained in the same ranking position; in 2024, Vietnam's electrical equipment exports included USD 80.6 billion in FVA, accounting for 50.7% of the sector's total export value (Figure 6) (UNESCAP, 2026).

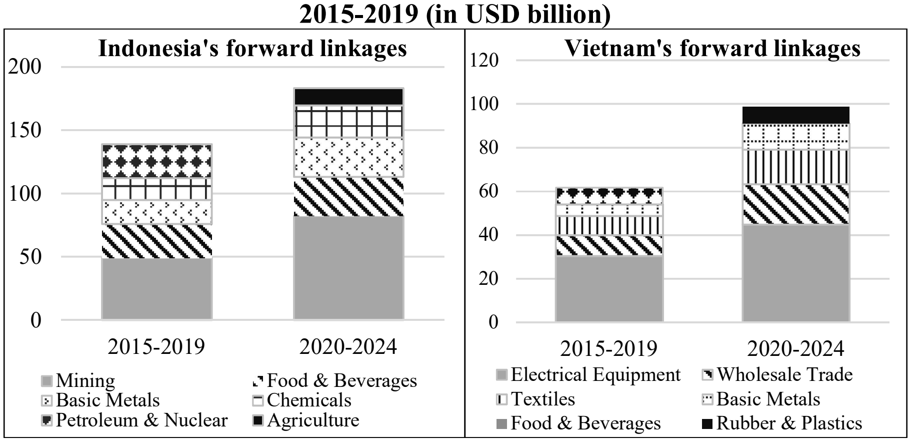
Figure 6: Indonesia and Vietnam - backward linkages by industry, changes in 2020-2024 compared to 2015-2019 (in USD billion)



Source: Authors' representation based on UNESCAP (2026).

The *sectoral* perspective for *forward linkages,* during the period 2020-2024 compared to 2015-2019, offers a detailed image of Indonesia's and Vietnam's integration into GVCs. According to data in Figure 7, both countries experienced changes, as follows: (i) during 2020-2024, *Indonesia's forward linkages* (USD 296 billion) represented 21.6% of total gross exports, with *mining* recording 27.8% of Indonesia's forward linkages, up from 23.1% in 2015-2019; comparing the two periods, some transformations were recorded, the fifth position in 2020-2024 of agriculture replacing petroleum and nuclear sector in 2015-2019; in 2024, Indonesia's mining exports contributed USD 17.7 billion in DVA that was subsequently embedded in partners' exports, the DVA accounting for 47.6% of the sector's gross exports; (ii) between 2020 and 2024, *Vietnam's forward linkages* (USD 164.7 billion) represented 9% of total gross exports, with *electrical equipment* recording 27.2% of Vietnam's forward linkages, down from 30.2% in 2015-2019; comparing the two periods, in 2020-2024 rubber and plastics replaced the fifth position held by food and beverages in 2015-2019; in 2024, Vietnam's electrical equipment exports contributed USD 13.1 billion in DVA that was subsequently embedded in partners' exports, the DVA accounting for 8.2% of the sector's gross exports (Figure 7) (UNESCAP, 2026).

Figure 7: Indonesia and Vietnam - forward linkages by industry, changes in 2020-2024 compared to 2015-2019 (in USD billion)

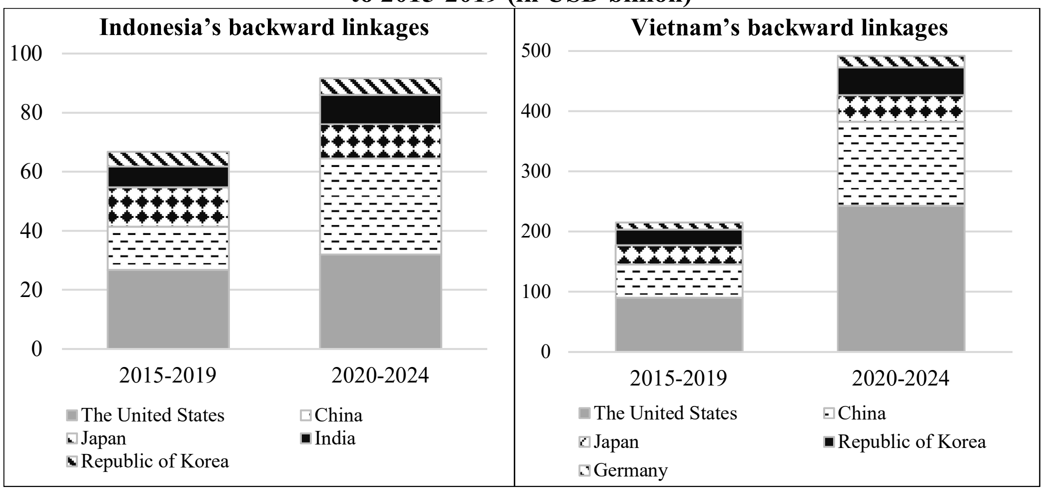


Source: Authors' representation based on UNESCAP (2026).

The data on the main trading partners of Indonesia and Vietnam within backward and forward linkages reflects the *GVCs geography in which the two countries are integrated, where the Asian countries are dominant, with an important share also of the United States (US).* Across the period between 2020 and 2024, the ranking of GVCs sectors for backward linkages was led as follows: (i) for *Indonesia, China* ranked first, with 20.5% of

Indonesia’s backward linkages (almost on par with the US), up from 11.7% in 2015-2019; in 2024, Indonesia’s exports incorporated USD 10.4 billion in foreign inputs from China, accounting for 3.3% of Indonesia’s gross exports; (ii) as for *Vietnam, the US* represented 31.1% of Vietnam’s backward linkages, up from 21.8% in 2015-2019; in 2024, Vietnam’s exports incorporated USD 63 billion in foreign inputs from China, accounting for 14.7% of Vietnam’s gross exports (Figure 8) (UNESCAP, 2026).

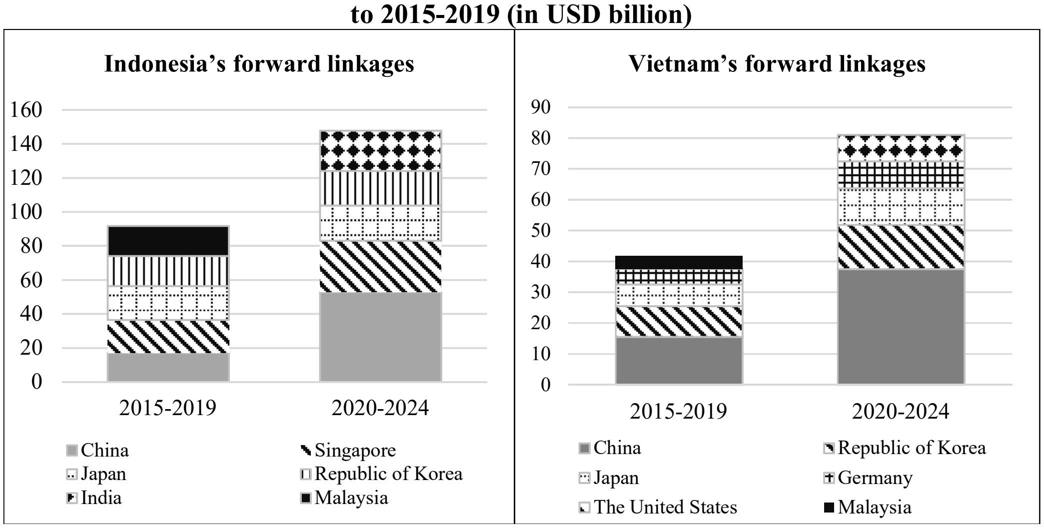
Figure 8: Indonesia and Vietnam - backward linkages by main partners, changes in 2020-2024 compared to 2015-2019 (in USD billion)



Note: The order of countries in both rankings is based on their position from 2015 to 2019.
Source: Authors’ representation based on UNESCAP (2026).

From the perspective of geographical representation for *forward linkages,* between 2015 and 2024, the top GVCs partners in Indonesia and Vietnam have also not experienced radical changes in terms of ranking, but in share, as follows: (i) during 2020-2024, *China* represented 17.8% of *Indonesia’s* forward linkages, up to 8% in 2015-2019, with Singapore replacing Malaysia; in 2024, Indonesia’s exports contributed USD 12.8 billion to China’s export production, accounting for 4.1% of Indonesia’s gross exports; (ii) between 2020 and 2024, *China* represented 22.8% of *Vietnam’s* forward linkages, up from 15.5% in 2015-2019; in 2024, Vietnam’s exports contributed USD 11.8 billion to China’s export production, accounting for 2.7% of Vietnam’s gross exports (Figure 9) (UNESCAP, 2026).

Figure 9: Indonesia and Vietnam - forward linkages by main partners, changes in 2020-2024 compared to 2015-2019 (in USD billion)



Source: Authors’ representation based on UNESCAP (2026).

Continuing our analysis, based on the data presented in Figures 7 and 9, it is observed that *mining products* represent the main domestic value-added product exported by *Indonesia,* and *China* is the main destination of these exports. RIVA database emphasises that, in 2024, DVA in intermediate goods intended for final consumption in China represented 70.3% of Indonesia's gross exports in mining to China, while, DVA in final goods for final consumption in China represented 3.2% of Indonesia's gross exports in mining to China (in other words, 73.5% of Indonesia's gross exports to China represented DVA that was consumed within the export destination, with 70.3% represented by the intermediate exports, and 3.2% by final exports).

At the same time, DVA in intermediate goods exports, further exported by China back to Indonesia, represented 0.5% of Indonesia's gross exports in mining to China, while DVA in intermediate goods exports, further exported by China to a third economy, represented 22% of Indonesia's gross exports in mining to China.

In 2024, 26.5% of Indonesia's gross exports to China was attributable to GVCs, with the following shares: 22.0% was Indonesia's DVA embedded in China's re-exports of intermediate exports to third economies (forward linkages); 0.5% was Indonesia's DVA embedded in China's re-exports of intermediate exports back to Indonesia (returned domestic value added); and 3.0% reflected FVA embedded in Indonesia's gross exports to China (backward linkages).

Moving on to the same logical approach, the *electrical equipment* is the main domestic value-added product exported by *Vietnam*, and *China* is the main destination of these exports.

Synthesising, the data reveals how Indonesia's and Vietnam's gross exports are generated and where they are ultimately used, as well as how these two economies' trade balance looks when measured in value-added terms compared to gross exports. At the same time, it underscores what shares of these two economies' gross exports are attributable to GVCs.

5. Concluding remarks

This analysis offers a useful base for future research considering the trend of nearshoring or reshoring from Asian countries to other locations of production chains to secure their production chains, respectively, to ensure their resilience in the context of geopolitical tensions with impact especially on trade with the US and European countries, two of the main extra-regional trade partners of Southeast Asian countries. Germany is an important partner of Vietnam for both backward and forward linkages, in contrast to Indonesia, where there is no European country among the top five partners. Instead, the United States is the first partner country for both of them in terms of backward linkages.

The paper also underscores the main factors influencing GVCs nowadays, from geopolitical dynamics, rising protectionism, as well as the emergence of disruptive technologies. The fragmentation of the world economy is accompanied by opportunities and threats, and the second-generation Asian Tigers seem prepared to act through proactive policies, strategies, and visions to take advantage of the former, and to cope with the challenges.

The main limitation of this paper is given by the selection of only two case studies instead of five, nevertheless we intend to include in future analysis also the other three countries. It is important to identify factors leading to their specialization and strong relationships with countries such as China, the US, or Singapore. The sector of semiconductors is another area of high interest, having in mind the competitive advantages of the T5 and specific measures to support this sector. Following Malaysia's and Thailand's experience, Vietnam has entered a new stage in its semiconductor development. According to the National Strategy for the Development of Vietnam's Semiconductor Industry to 2030, based on the formula: C = SET + 1, the nation intends to become a safe and reliable destination in the global semiconductor supply chain. Technical specialisation, supported by engineers, researchers, and technicians, as well as strong international cooperation, is seen as a prerequisite for this ambitious strategy.

Beyond similarities and differences in the field of GVCs, what unites the T5 countries is their focus on sustainable and inclusive economic growth, accelerating digitalization, and transitioning to advanced technologies such as Artificial Intelligence. Asia's central role in GVCs is supported by regional partnerships and trade agreements, which make it easier for them to continue to belong to the *Factory of the World*.

One can remark the dominance of electrical equipment in both foreign value-added and domestic value-added for Malaysia and Vietnam, textiles in FVA and mining in DVA for Indonesia, transport equipment in FVA and basic metals in DVA for Thailand. The Philippines has electrical equipment as preeminent in foreign value-added and business services in domestic value-added. Information Technology and Business Process Outsourcing is the sector forming a significant forward-linkage in its value-chain profile, and this deserves more attention in future research. The China plus One strategy adopted by various MNEs, to diversify operations beyond the world's largest emerging economy, stimulates T5's integration into GVCs. However, China remains the most important destination for Indonesia's and Vietnam's, as well as the Philippines' and Thailand's domestic value-added embodied in their exports of intermediate goods or services that are then used by China to produce its exports.

References:

[1] ASEAN+3 Member Economies (AMRO). (2025, September 23). *How Asia Can Thrive in the Next Era of Global Value Chains*, https://amro-asia.org/how-asia-can-thrive-in-the-next-era-ofglobal-value-chains/.

[2] ASEAN (2025, October). *ASEAN Investment Report 2025 - Foreign Direct Investment and Supply Chain Development*, Jakarta: ASEAN Secretariat.

[3] Asian Development Bank (ADB, May 2026). *Global Value Chains and Inclusive Development - Asian Development Policy Report*, https://www.adb.org/sites/default/files/publication/1143716/adpr-2026-main-report.pdf.

[4] Athukorala, P. & Patunru, A. (2025). "Indonesia in global manufacturing value chains: Policy ambivalence and arrested growth," Departmental Working Papers 2025-13, The Australian National University, Arndt-Corden Department of Economics.

[5] Habib, A. (2026). *Golden Vision 2045: Reaping the Gains from Trade: Indonesia*. IMF selected Issues Paper (SIP/26/006). Washington, D.C.: International Monetary Fund.

[6] Hoang, M.A., Bui, N.B., Le, H.P. *et al.* (2026). Firm innovation and participation in global value chains in a developing country. *Discov Sustain* 7, 398. https://doi.org/10.1007/s43621-026-02725-9.

[7] International Labour Organization (ILO). (2022). *Viet Nam's electronics supply chain: Decent work challenges and opportunities*. https://www.ilo.org/sites/default/files/wcmsp5/groups/public/@ed_dialogue/@sector/documents/publication/wcms_865520.pdf.

[8] ILO (2024). Decent work and responsible business practices in Thailand's automotive manufacturing sector. https://www.ilo.org/sites/default/files/wcmsp5/groups/public/%40asia/%40ro-bangkok/documents/publication/wcms_920192.pdf.

[9] Kaushal, S. (2025, March 24). *ASEAN as the super-connector: Unlocking regional trade and global growth, Standard Chartered*, https://www.sc.com/en/news/corporate-investment-banking/asean-as-the-super-connector/.

[10] Kee, H. L. and Tang, H. (2016). *How has China moved-up the global value chains*? https://blogs.worldbank.org/en/developmenttalk/how-has-china-moved-global-value-chains.

[11] Kim, K. (2026). Impacts of the Indonesian Nickel Sector Industrialization. In: S.H. Moerenhout, T., Jobet, J.C. (eds) Downstream Diversification of Mineral-Rich Countries. Future of Energy. Springer, Cham. https://doi.org/10.1007/978-3-032-06139-3_12.

[12] Mordor Intelligence (2026). *Thailand road freight transport market size & share analysis - growth trends and forecast (2026 - 2031).* https://www.mordorintelligence.com/industry-reports/thailand-road-freight-transport-market.

[13] Nguyen, Thu Anh, Linh Nguyen Thi Phuong and Tuoi Vu Hong (2025). Evaluating key determinants of Vietnam's integration into global value chains. *Problems and Perspectives in Management*, 23(3), 780-793. doi:10.21511/ppm.23(3).2025.55

[14] Nguyen, T.O. (2025, November 18). High-value exports drive Vietnam's push towards robust 2025 expansion, Vietnam Investment Review, https://vir.com.vn/high-value-exports-drive-vietnams-push-towards-robust-2025-expansion-140921.html.

[15] Nugraha et al. (2025). Indonesia's Position and Participation in The Global Value Chain of The Agriculture Sector, *Journal of Management and Agribusiness* (JMA), Vol. 22 No. 1, March.

[16] Organisation for Economic Co-operation and Development (OECD). (2022). ASEAN SMEs Integration in GVCs: Opportunities and Challenges in Response to COVID-19, https://asean.org/wp-content/uploads/2022/11/ASEAN-SMEs-Integration-in-GVCs.pdf.

[17] OECD (2026). Foundations for Growth and Competitiveness 2026, OECD Publishing, Paris, https://doi.org/10.1787/40a7532f-en.

[18] Pasadilla, G. et al. (2025). *Services export promotion: the case of Philippine information technology and business process management services*. https://www.wto.org/english/tratop_e/ts4d_e/case_studies_e/philippines.pdf.

[19] Philippine Business Hub (2026). *The Philippine Business Hub* - official site. https://business.gov.ph/home.

[20] PricewaterhouseCoopers (PwC). (2025, February). Overview of the ASEAN-6 Automotive Market, 3rd Market Snapshot by PwC Automotive ASEAN Centre of Excellence, https://www.pwc.com/vn/en/publications/2025/asean-automative-market.pdf.

[21] Tarigan, E. and Delgado, A.L. (2026, May 20). Indonesia tightens state control over exports of vital commodities, The Washington Post.

[22] Tran, **N.**T. and Trinh, N. (2026, April 30). Vietnam's Electronics Industry 2026: A Guide to Emerging Opportunities, Vietnam Briefing, https://www.vietnam-briefing.com/news/vietnams-electronics-industry-guide-emerging-opportunties.html/.

[23] United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP). (2026). *Regional Integration and Value Chain Analyzer.* https://riva.negotiatetrade.org/#/backwardlinkages (accessed May 15, 2026).

[24] Weno, R. et al. (2025). *ASEAN's Emerging Semiconductor Giant: The Philippines' Rising Role in the Global Supply Chain*. https://asean-bac.org/news-and-press-releases/asean-s-emerging-semiconductor-giant-the-philippines-rising-role-in-the-global-supply-chain

[25] World Trade Organization (WTO). (2025). *The Global Value Chain Development Report 2025, Rewiring GVCs in a Changing Global Economy*, jointly published by the Research Institute for Global Value Chains at the University of International Business and Economics (RIGVCUIBE), the Asian Development Bank (ADB), the Institute of Developing Economies-Japan External Trade Organization (IDE-JETRO), the World Economic Forum, and the World Trade Organization (WTO), https://www.wto.org/english/res_e/booksp_e/gvcreport2025_e.pdf.

[26] WTO. (2026, March 19). *Global Trade Outlook and Statistics - March 2026. Middle East conflict weighs further on slowing trade outlook.* https://www.wto.org/english/res_e/booksp_e/gtos0326_e.pdf.

[27] WTO. (n.d.). *Trade in Value Added and Global Value Chains. Country profiles explanatory notes.* https://www.wto.org/english/res_e/statis_e/miwi_e/explanatory_notes_e.pdf#:~:text=Foreign%20value%2Dadded%20content%20of%20exports%20corresponds%20to,intermediate%20or%20final%20goods/services%20to%20be%20exported.

[28] Yu, J. (2025). A Study on China's Position in the Global Value Chain**.** *Highlights in Business Economics and Management* 50:89-94. https://www.researchgate.net/publication/391004684_A_Study_on_China's_Position_in_the_Global_Value_Chain.

Impact of Fees and Commissions on Banks Profitability in the European Union and the Republic of Moldova

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Abstract: The article analyzes the impact of fees and commissions on the profitability of the banking sector in the European Union and the Republic of Moldova during 2015-2024. The research tracks the structural evolution of the main components of total operating income, with a focus on net fees and commissions (F&C) income, in the context of transformations generated by digitalization, European regulations on the capping of interbank fees, increased competition from financial technology companies (fintechs) and changes in monetary policy. The study uses consolidated data published by the European Central Bank and the National Bank of Moldova and applies a comparative and structural analysis of banking profitability indicators. The results highlight the fact that fees and commissions represent a more stable and resilient source of income compared to interest income, especially in periods of macroeconomic volatility. At the same time, the research reveals that the banking sector in the Republic of Moldova is in a transition phase towards a more diversified revenue model but continues to show a high dependence on interest income and international payment processing infrastructures. The conclusions emphasize the need to strengthen the national payment infrastructure, optimize the costs of digital services and develop sustainable models for monetizing financial services.

Key-Words: profitability; fees and commissions; non-interest income; digital banking; interchange fees; banking system; financial stability.
JEL Classification: G21, G28, E42, O33, F36

1 Introduction

In recent decades, the international banking sector has undergone a broad process of structural transformation, driven by digitalization, regulatory changes, increased competition and changes in the behavior of financial services consumers. In this context, traditional profitability models based predominantly on interest income have begun to be complemented and, in some cases, gradually replaced by alternative sources of income, in particular fees and commissions (F&C) income.

The importance of non-interest income has increased significantly, especially after periods of economic and financial instability, when interest rate volatility and pressure on bank margins have led financial institutions to identify more stable and resilient sources of profitability. In parallel, the development of digital banking services, the expansion of electronic payments, the increase in the use of bank cards and the implementation of modern payment infrastructures have contributed to the diversification of fee-generating services.

At the same time, the European banking system has been significantly influenced by changes in the regulatory framework, including the implementation of the Payment Services Directive (PSD2), the capping of interchange fees for card transactions, and the strengthening of transparency and consumer protection requirements. These regulations have had a direct impact on the structure of banking revenues and the profitability of payment services activities.

In the Republic of Moldova, the evolution of the banking sector in recent years has been marked both by the processes of harmonization with European standards and by the need to modernize the financial infrastructure and increase the resilience of the banking system. The implementation of modern payment systems, the development of digital services, the introduction of the MIA instant payment system, as a national infrastructure for instant payments in Moldovan lei, and the accession to European initiatives such as the Single Euro Payments Area (SEPA) have accelerated the transformation of the banking business model and changed the structure of commercial banks' revenue sources.

In this context, the analysis of the impact of income from fees and commissions on banking profitability becomes particularly relevant from both a theoretical and practical perspective. Understanding how these revenues contribute to financial stability and the diversification of profit sources allows assessing the capacity of the banking system to adapt to new economic and technological conditions.

The purpose of this study is to analyze the evolution and role of revenues from fees and commissions in the structure of banking profitability in the European Union and the Republic of Moldova during the period 2015–2024. The research aims to identify the main structural trends, assess the impact of regulations and digitalization on this type of revenue, as well as highlight the differences between the European and national models of banking sector development.

2 Literature review

Bank profitability and diversification of income sources are some of the most intensively analyzed topics in contemporary financial and banking literature, especially in the context of transformations generated by digitalization, liberalization of financial markets and intensification of regulations on the banking sector. Thus, in recent decades, research has highlighted the fact that commercial banks tend to reduce their dependence on traditional interest income and develop alternative sources of profitability based on services and activities generating fees and commissions.

Early research on bank income diversification highlighted the fact that non-interest income can contribute to stabilizing banks' financial performance and reducing the risks associated with interest rate fluctuations (DeYoung & Roland, 2001). Later, Stiroh (2004) demonstrated that the expansion of non-interest income-generating activities can improve banks' ability to cope with periods of economic volatility, but this diversification can also generate additional risks if it is associated with more speculative or volatile activities. An important contribution to the analysis of the relationship between non-interest income and banking stability belongs to Smith, Staikouras and Wood (2003), who found that income from fees and commissions tends to be more stable compared to income from financial trading activities or from foreign exchange market fluctuations. At the same time, DeYoung and Rice (2004) emphasized that the development of modern banking services and the expansion of electronic payments have contributed to the increase in the importance of commission income in the structure of banking institutions' profitability.

In the European literature, the analysis of banking profitability is frequently associated with the effects of monetary policies and the regulatory framework on the structure of banking income. Molyneux and Thrall (1994) highlighted that European banks are significantly influenced by macroeconomic conditions and the level of interest rates, which determines the need to identify more stable sources of income. In the same vein, Howarth and Quaglia (2016) analyzed the impact of the European Banking Union on the operating model of credit institutions and highlighted the role of regulations in reshaping bank profitability strategies.

Digital transformations were another major topic addressed in recent literature. In this regard, Gomber et al. (2018) analyzed the impact of the fintech revolution on the financial sector and concluded that traditional banks are forced to adapt their business models by expanding digital services and developing new sources of income based on electronic financial services. OECD (2020) also highlighted that the digitalization of the banking system simultaneously contributes to both increasing operational efficiency and intensifying competition from new financial service providers.

Regulatory interventions regarding payment services and interchange fees have also played an important role in restructuring European banking revenues. According to the study conducted by Copenhagen Economics (2020), the capping of interchange fees in the European Union reduced the revenues generated by card transactions, but also stimulated the efficiency of payment infrastructures and the development of alternative models for monetizing banking services. At the same time, Busch (2017) emphasized that the implementation of the revised Markets in Financial Instruments Directive (MiFID II) and the revised Payment Services Directive (PSD2) increased transparency and competition in the financial services market, reducing the ability of banks to maintain high margins for certain categories of fees. Regarding emerging economies, the specialized literature highlights the fact that banking systems undergoing European convergence show a higher dependence on interest income and macroeconomic fluctuations (Demirgüç-Kunt & Detragiache, 1998).

In the case of the Republic of Moldova, the process of harmonization with European regulations, the development of digital infrastructure and the modernization of payment services have accelerated the transformation of the banking business model. However, the specialized literature on the impact of fee and commission revenues on banking profitability remains relatively limited.

At the same time, recent research highlights the fact that the development of national payment infrastructures and the reduction of dependence on international processing systems represent an essential factor for improving operational efficiency and reducing the costs of financial services (Koont, 2024). In this context, the implementation of instant payment systems and the integration of electronic payments into the European space are considered important elements for strengthening the resilience of banking systems in emerging economies.

The present article contributes to this underexplored area by providing a comparative analysis of the role of fee and commission income in the banking profitability structure of the European Union and the Republic of Moldova during 2015–2024. Its contribution consists in correlating the evolution of net fee and commission income, the structural shares of banking income and profit margins related to fee-based activities with the broader transformations generated by digitalization, the development of payment infrastructure and regulatory convergence. In this way, the study helps to clarify whether the Moldovan banking sector follows similar diversification trends to those observed in the European banking system and identifies the specific structural constraints that influence the sustainability of fee-based income in an emerging and converging financial system. Thus, the literature demonstrates that fee and commission income has become a strategic component of modern banking profitability, contributing to diversifying revenue sources and increasing financial stability. At the same time, the impact of regulations, digitalization and fintech competition highlights the need for continuous adaptation of banking business models to new economic and technological conditions.

3 Methodology and data

The research is based on a descriptive and comparative analysis of the role of fee and commission income in the structure of banking profitability in the European Union and the Republic of Moldova for the period 2015–2024. The study uses quantitative and qualitative methods, including structural analysis, analysis of indicator dynamics and comparative interpretation of banking income. The purpose of the research is not to estimate a causal relationship through an econometric model, but to assess the contribution and relative importance of fee and commission income in the general profitability model of the banking sector.

The empirical analysis is based on several indicators. Total operating income is used as a general measure of banking operating income and includes net interest income, net fee and commission income, income from financial instruments and foreign exchange operations, as well as other components of net operating income. Net interest income is defined as the difference between interest income and interest expenses. Net fee and commission income is calculated as the difference between fee and commission income and fee and commission expenses. Structural shares are calculated as the ratio of each income component to total operating income and are expressed as a percentage. The profit margin from fee-based activities is calculated as the ratio of net fee and commission income to gross fee and commission income, indicating the proportion of fee and commission income that remains for banks after deducting related expenses.

Data for the European banking system were extracted from the European Central Bank's consolidated banking statistics, while data for the Republic of Moldova were obtained from the supervisory reports published by the National Bank of Moldova. For the European Union, the analysis uses aggregate data expressed in billions of euros, while for the Republic of Moldova, aggregate data expressed in millions of Moldovan lei are used. Given the significant differences in size between the two banking systems and the differences in the reporting perimeter, the comparison is made mainly through relative indicators, such as structural shares, indicator dynamics and profit margins, and not by directly comparing absolute values.

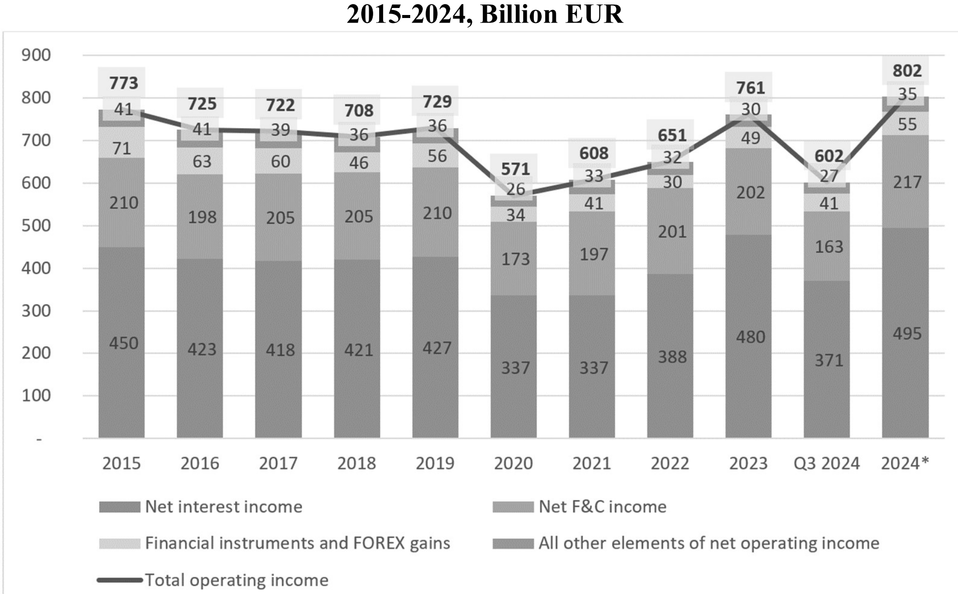
Therefore, the comparison between the European Union and the Republic of Moldova is made at the level of systemic trends and the structure of banking income. This approach allows for the identification of similarities and differences regarding the diversification of banking income sources, the role of fee and commission income and the evolution of profit margins related to these activities. At the same time, the interpretation of the results takes into account the institutional and regulatory context specific to each banking system, including differences in market size, payment infrastructure, regulatory convergence and dependence on international payment processing providers.

For 2024, the European Union data marked with an asterisk are annualized estimates based on available data for the first three quarters of the year, calculated by multiplying the cumulative values for the third quarter by 4/3. For the Republic of Moldova, the values for 2024 are based on available annual data reported by the National Bank of Moldova. Therefore, the results for 2024 should be interpreted with caution, especially for the European Union, where the final year-end values may differ from the annualized estimates.

4 Analysis of income from fees and commissions in the total banking income in the European banking system

The analysis in this section is based on consolidated banking statistics published by the European Central Bank (ECB) for credit institutions from the European Union countries participating in the Single Supervisory Mechanism (SSM). The database includes profit and loss indicators for the period 2015-2024 and covers the aggregate evolution of the banking sector under the ECB supervisory reporting framework. The number of credit institutions included in the dataset decreased from 3278 in 2015 to 2453 as of the third quarter of 2024, reflecting changes in the structure and perimeter of the European banking sector, including consolidation processes, market exits and reporting coverage. Therefore, the results should be interpreted as system-level aggregate trends rather than as a strictly balanced panel of identical institutions over time. To improve comparability, the analysis focuses not only on absolute values, but also on structural shares, growth dynamics and fee-related profit margins. Figure 1 shows the evolution of total operating income and its main components. Thus, during the period 2015–2019, the European banking system was characterised by a relative stability of net interest income and net fee and commission income. However, total operating income recorded moderate decreases: 6.2% in 2016, 0.4% in 2017 and 1.9% in 2018, followed by a slight recovery of 2.9% in 2019. This evolution was mainly influenced by the decrease in income from foreign exchange operations and financial instruments.

Figure 1: Evolution of Total Operating Income and its main components in the EU banking system, 2015-2024, Billion EUR



Source: Elaborated by authors based on the ECB consolidated banking data.

In 2020, the effects of the COVID-19 pandemic were associated with a significant reduction in banking activity. Total operating income decreased by 21.7%, while net interest income decreased by 21.2%. At the same time, net fee and commission income declined by 17.5%, indicating a less pronounced contraction and, implicitly, a higher degree of stability compared to interest income.

Starting from July 2022, the European Central Bank began to tighten its monetary policy after a prolonged period of exceptionally low interest rates. The main refinancing operations rate increased from 0% to

0.5% in July 2022 and subsequently reached 4.5% in 2023. This monetary policy shift took place in the context of strong inflationary pressures, rising energy prices and heightened geopolitical uncertainty following the outbreak of the war in Ukraine. Against this background, net interest income increased significantly from 2022 onwards and became again the main source of growth in banking income.

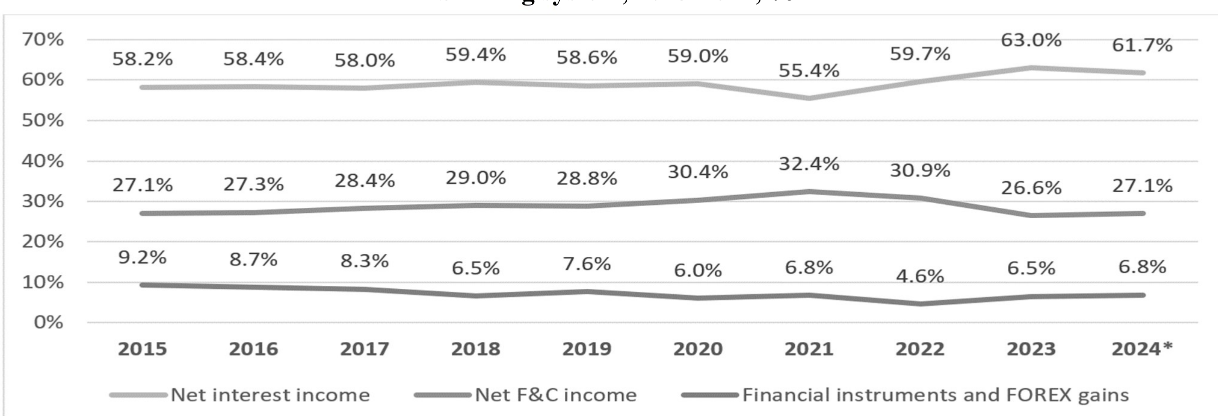
Overall, Figure 1 suggests that fee and commission income followed a more stable evolution compared to interest income. Although this income category was also affected by crises and economic changes, its variations were more moderate, which supports its role in diversifying and stabilizing the profitability of European banks.

The sustained growth of net fee and commission income highlights their increasingly important role in diversifying the sources of bank profitability. Unlike interest income or financial operations, which are strongly influenced by economic cycles, monetary policy and market volatility, fee and commission income is more closely linked to the current activity of customers, the use of banking services and the expansion of digital channels.

Thus, Figure 1 confirms that net fee and commission income has become an element of stability in the structure of total operating income of European banks. Their relatively resilient evolution, including in times of crisis such as 2020, demonstrates the importance of this segment for consolidating a more diversified, more flexible and better adapted banking model to digital transformations and current regulatory requirements.

Figure 2 reflects the change in the structure of banking operating income, analyzing its main components: net interest income, net fee and commission income, and income from financial instruments and foreign exchange operations. Thus, during the period 2015-2021, net fee and commission income had an upward trend as a share of total operating income, even though in the same period the interchange fee cap was applied in the EU: 0.2% for debit cards and 0.3% for credit cards. These caps targeted both domestic and cross-border transactions, and some states applied lower limits, such as Malta, where the cap for debit cards was set at 0.15% (Adyen, 2015). This evolution shows that fee and commission income has consolidated its role in the structure of European banking profitability, despite regulatory pressures.

Figure 2: Structural evolution of net interest income, fee and commission income, and income from financial instruments and foreign exchange operations in total operating income in the European Union banking system, 2015-2024, %



Source: Elaborated by authors based on the ECB consolidated banking data.

Prior to the implementation of the Interchange Fee Regulation (IFR), the level of fees charged on card transactions varied considerably between European Union Member States. For example, Visa fees for consumer cards were around 1.58% in Germany, 1.00% in Austria and 0.87% in the United Kingdom, highlighting the existence of significant differences between European markets before the harmonisation of the regulatory framework (Adyen, 2015).

These differences have highlighted the need to harmonise interchange fees across the European Union. According to a study carried out for the European Commission, the application of the Interchange Fee Regulation resulted in an estimated annual reduction of around EUR 2.7 billion in these fees between 2015 and 2017 (Copenhagen Economics, 2020).

However, the impact on the net fee and commission income of European banks was not structurally significant. Although net fee and commission income did not increase significantly in absolute terms over the period under review, their share of total operating income increased by 5.3 percentage points between 2015 and 2021. Over the same period, the share of net interest income decreased by 2.8 percentage points.

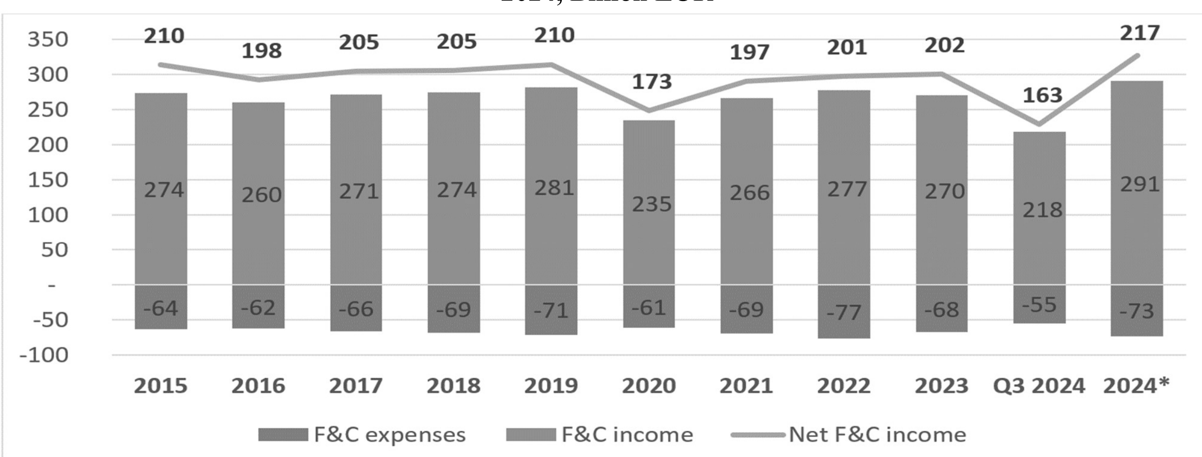
This development suggests that the cap on interchange fees has limited the income of issuing banks, but the negative effect has been partially offset by the development of other categories of bank fees. Therefore, net income from fees and commissions demonstrates a higher resilience not only in relation to macroeconomic factors, but also to regulatory interventions that directly affect them.

Starting with 2022, the share of net fee and commission income in total operating income decreased, although in absolute terms it started to increase. This development is explained by the significant increase in the base interest rate, which stimulated the faster growth of net interest income.

However, taking into account the estimates for the fourth quarter of 2024, the share of net fee and commission income in total income is estimated at least 27.1% at the end of the year. This level is comparable to that of 2015, when the interchange fee cap was not yet applied and the base interest rate was only 0.05%, compared to the range of 4.5%-3.15% recorded in 2024.

Figure 3 analyzes fee and commission income and expenses separately, to highlight the impact of each component on the net result. During the period 2015-2019, the evolution was relatively stable: fee and commission income increased by only 2.6%, while related expenses advanced by 10.9%. This difference reflects the pressure exerted by the cap on interchange fees and the increase in transaction processing costs through international providers, such as Visa and Mastercard. In 2020, fee and commission income reached the lowest level of the analyzed period, against the backdrop of the COVID-19 pandemic, which reduced economic activity, lending and transaction volume. Starting in 2021, the gradual relaunch of economic activity determined a 13.2% increase in income and 13.1% in expenses.

Figure 3: Evolution of the fee and commission income and expenses in the EU banking system, 2015-2024, Billion EUR

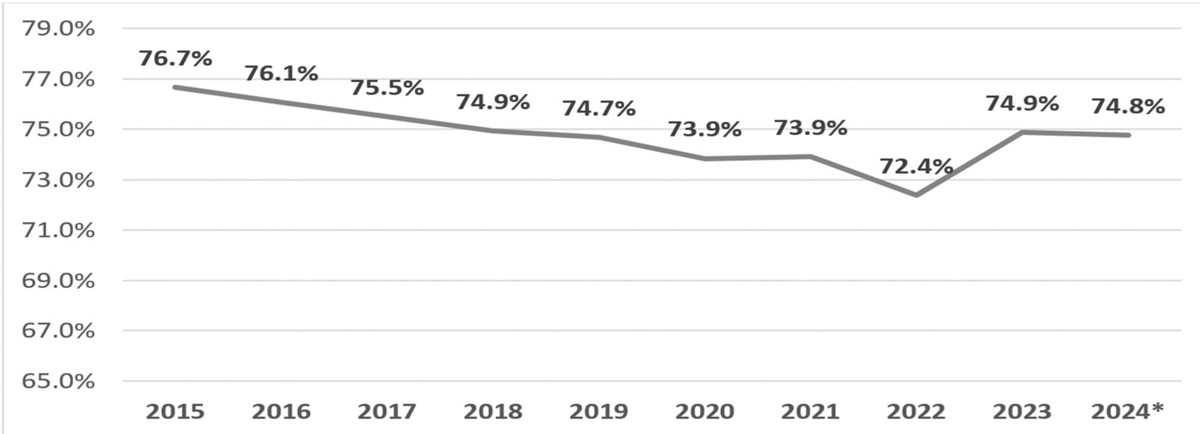


Source: Elaborated by authors based on the ECB consolidated banking data.

In the following years, the evolution remained relatively balanced, and an increase of 7.8% in revenues and 7.3% in expenses is estimated for the end of 2024. This dynamic suggests that revenues and costs related to commission-based activities evolve almost proportionally, which emphasizes the main challenge of banks: maintaining and improving the profit margin from these services.

Figure 4 shows the evolution of the profit margin from fees and commissions in the European Union banking sector over the past decade. The data show a downward trend over the period 2015-2022, followed by some stabilization in recent years. Overall, the margin decreased by approximately 4.3 percentage points, reflecting structural and regulatory pressures on this revenue segment.

Figure 2: Evolution of the fee and commission profit margin in the EU banking system, 2015-2024, %



Source: Elaborated by authors based on the ECB consolidated banking data.

The decrease in the margin may be associated with the tightening of the European regulatory framework, including the implementation of PSD2, MiFID II and the cap on interchange fees. These measures have strengthened consumer protection and market transparency, but have limited the ability of banks to maintain high margins for certain traditional services.

Second, competition from fintechs and non-bank financial institutions has put pressure on banks' fee policies. New providers offer similar services through more flexible and lower-cost digital platforms, which has forced traditional banks to adjust their prices to retain their customers.

Another important factor is the significant investments in digital transformation, including the development of mobile applications, process automation and the modernization of customer services. While these investments are essential for long-term competitiveness, they initially contributed to the compression of profit margins on non-interest income.

Therefore, Figure 4 highlights the process of strategic adaptation of European banks to a more regulated, more digitalized and more competitive environment. The decline in the margin from fees and commissions confirms the need to diversify revenues, optimize costs and adjust pricing strategies in the European banking sector.

5 Analysis of banking income structure and fee and commission dynamics in the Republic of Moldova

As banks diversify their income sources in a context marked by regulatory changes and technological innovations, the ratio between traditional interest income and non-interest income, especially fee and commission income, is gaining increasing strategic importance.

This section provides a statistical and comparative analysis of the main components of banking income, with a focus on the particularities of the banking system in the Republic of Moldova in relation to the trends previously identified at the European Union level.

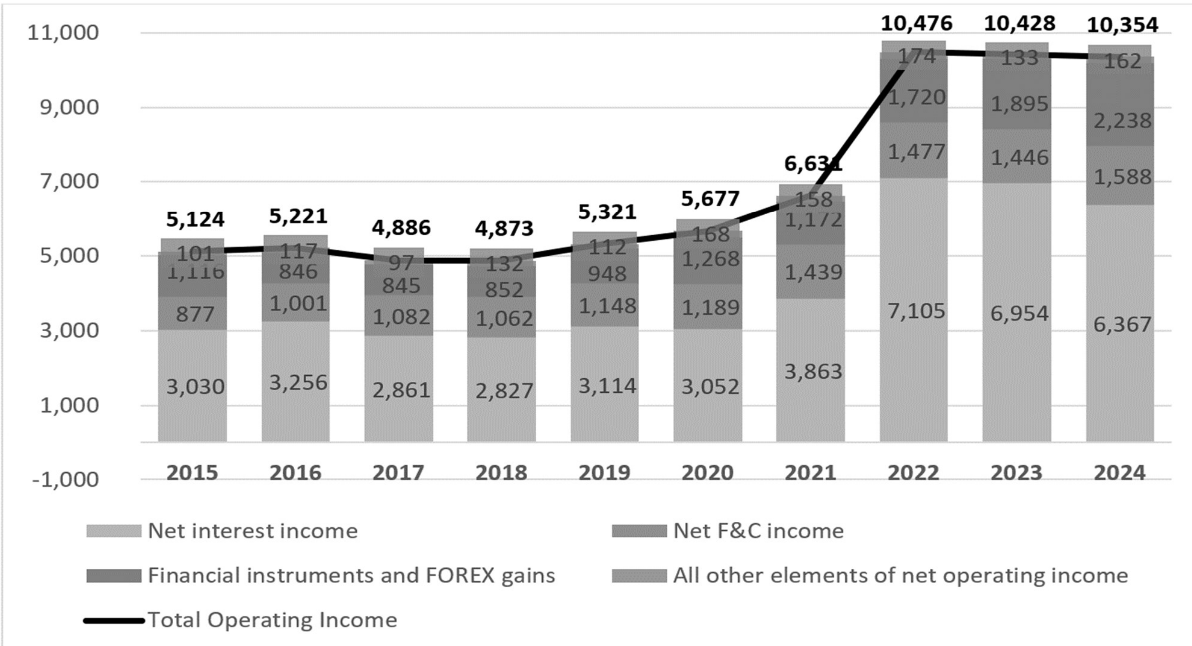
The structure of banking income in the Republic of Moldova is influenced by several external factors, such as European convergence requirements, financial inclusion objectives, the digitalization of services and competition from new financial providers. Although Moldova is a relatively small economy by EU standards, the national banking sector has made significant progress in recent years, including in terms of the development of income from fees and commissions.

The analysis is based on the supervisory reports published by the National Bank of Moldova for the period 2015-2024, including consolidated data for the 11 active commercial banks in the national banking system. Banks in liquidation were not included, and the data used are actual values, without estimates or forecasts.

Figure 5 highlights the evolution of total operating income and its main components in the banking sector of the Republic of Moldova during 2015–2024. Overall, total operating income almost doubled, increasing from 5,124 million MDL in 2015 to 10,476 million MDL in 2022, after which it slightly decreased to 10,354 million

MDL in 2024. The main source of income remained net interest income throughout the period. It remained relatively stable between 2015–2020, ranging between 2,827 million MDL and 3,256 million MDL, but starting in 2021 it registered an accelerated growth: from 3,863 million MDL in 2021 to 7,105 million MDL in 2022.

Figure 5: Evolution of Total Operating Income and its main components in the banking sector of the Republic of Moldova, 2015-2024, Million MDL



Source: Elaborated by the authors based on the NBM consolidated banking data.

In the following years, the indicator decreased slightly, reaching 6,367 million MDL in 2024, but remained at a level much higher than in the previous period. Net income from fees and commissions had a more stable and gradually upward evolution, increasing from 877 million MDL in 2015 to 1,588 million MDL in 2024. Unlike interest income, it did not register major fluctuations, which confirms its more resilient nature in relation to economic and monetary changes.

At the same time, income from financial instruments and foreign exchange operations showed higher volatility. If in the period 2015–2019 they ranged between approximately 845 million MDL and 1,116 million MDL, in 2024 they reached 2,238 million MDL, reflecting the influence of currency fluctuations and market conditions on banking profitability.

Thus, Figure 5 suggests that the increase in the profitability of the Moldovan banking sector after 2021 was largely associated with the growth of net interest income, in the context of rising interest rates and changing monetary conditions. At the same time, income from fees and commissions continued to provide a more stable and predictable source of income for banks.

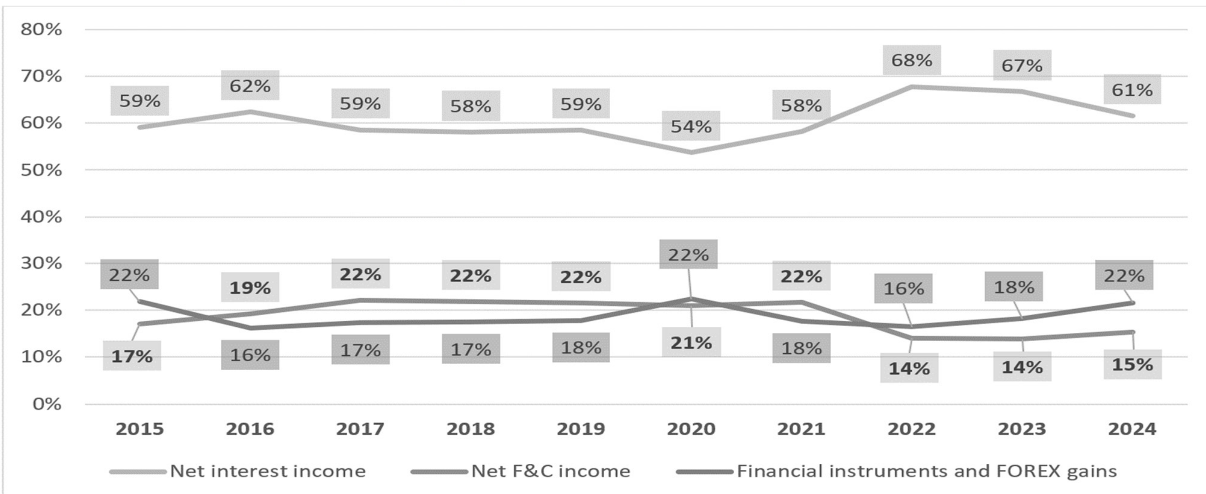
Income from financial instruments and foreign exchange operations had a more volatile evolution, increasing from 1,116 million MDL in 2015 to 2,238 million MDL in 2024. This dynamic shows the high sensitivity of this source of income to market conditions and exchange rate fluctuations, which makes it less predictable in the long term. In contrast, net income from fees and commissions had a more stable evolution. After the level of 877 million MDL in 2015, they gradually increased, reaching 1,588 million MDL in 2024.

Even in times of crisis, this segment was not significantly affected; on the contrary, in 2021 it increased by approximately 21% compared to the previous year. Compared to the European banking system, the Republic of Moldova follows a similar trend by increasing the importance of net interest income in recent years. However, Moldova's fee and commission revenues have demonstrated more pronounced stability during the crisis, confirming their role in diversifying and consolidating banking revenues.

Figure 6 presents the structure of the total operating income of the banking system in the Republic of Moldova, analyzed through the main components: net interest income, net fee and commission income, and income from financial and foreign exchange operations. The largest share over the entire period analyzed belongs to net interest income, which ranged between 54% in 2020 and 68% in 2022.

In the period 2016-2020, a gradual decrease in its share is observed, from 62% to 54%, which reflects the compression of interest margins in an environment characterized by low interest rates and higher competition. Subsequently, in the period 2021-2023, the share of net interest income increases significantly, reaching 68% in 2022, against the background of increasing interest rates and tightening monetary policy. In 2024, the indicator decreases to 61%, suggesting a slight diversification of income sources. Revenues from financial and foreign exchange operations have had a more volatile evolution, oscillating between 16% and 22% of total operating income.

Figure 3: Structural evolution of net interest income, fee and commission income, and income from financial instruments and foreign exchange operations in total operating income in the banking system of the Republic of Moldova, 2015-2024, %



Source: Elaborated by the authors based on the NBM consolidated banking data.

The increase to 22% in 2020 and again in 2024 indicates a greater dependence of banks on foreign exchange and market activities in periods marked by economic uncertainty and exchange rate volatility. At the same time, net income from fees and commissions has had a relatively stable evolution, increasing from 17% in 2015 to approximately 21-22% in the period 2017–2021. This trend reflects the expansion of digital banking services, the development of card payments and the increased use of electronic financial services.

However, in the period 2022-2023 their share decreased to 14%, against the background of the accelerated growth of net interest income and the impact of the cap on interbank commissions. In 2024, a slight recovery to 15% is observed. Compared to the European banking system, the contribution of income from fees and commissions to the profitability of banks in the Republic of Moldova remains lower. While in Moldova their share varied between 14% and 22%, in the European Union it was between approximately 27% and 32%. This difference highlights the fact that the Moldovan banking system continues to be more dependent on interest income and financial market fluctuations than the European banking system.

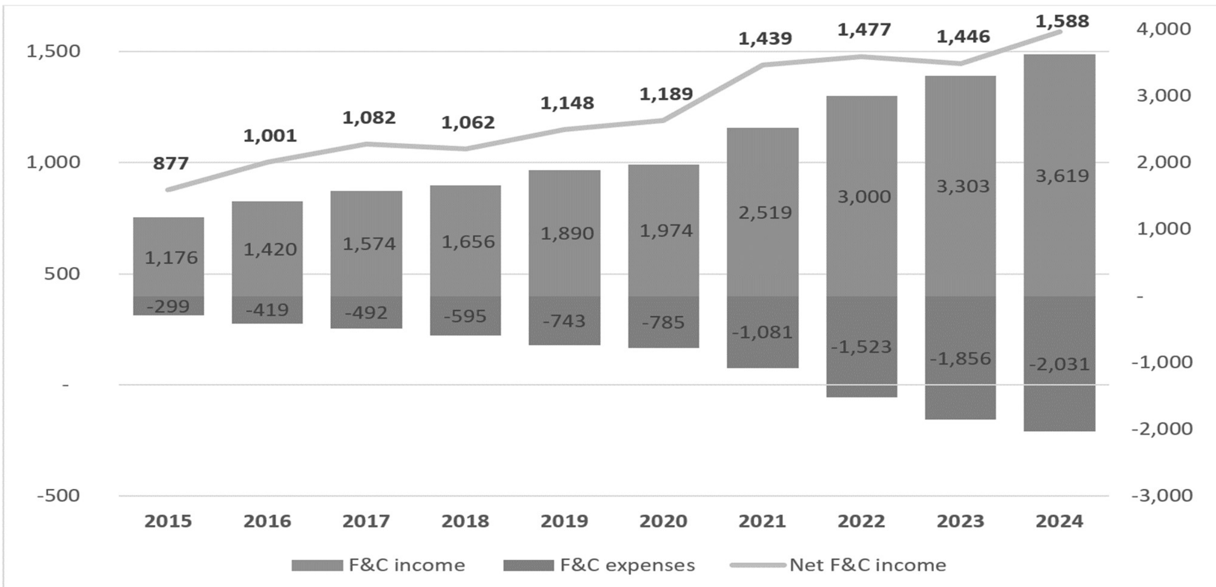
Unlike the Republic of Moldova, the European banking system has operated for a longer period in an environment characterized by relatively stable interest rates and exchange rates. Under these conditions, European banks have been more oriented towards identifying alternative sources of income, more stable and less exposed to market risks.

From this perspective, the European experience can provide a benchmark for the future evolution of the Moldovan banking system, as the national economy advances towards a higher level of financial stability and maturity. Overall, Figure 6 confirms that banks in the Republic of Moldova tend, in periods of stability, to gradually move towards a more diversified income model, although net interest income remains the dominant component.

Income from fees and commissions, as well as from financial and foreign exchange operations, is gaining increasing importance, reflecting the adaptation of the banking sector to a more competitive, more regulated and more digitalized environment. At the same time, the effects of recent changes, such as the capping of interbank fees, the development of digital services and the alignment with European practices, are not yet fully visible, being partially masked by the macroeconomic volatility of recent years. In the medium term, these transformations could accelerate the convergence of the Moldovan banking model with the European one, in which non-interest income plays a more important role in ensuring financial stability and efficiency.

Figure 7 reflects the evolution of income and expenses related to fees and commissions in the banking sector of the Republic of Moldova during the period 2015-2024. The data highlights an accelerated expansion of fee-generating activities, especially after 2020, against the backdrop of the digitalization of banking services and the increased use of electronic payments.

Figure 4: Evolution of the fee and commission income and expenses in the Republic of Moldova banking system, 2015-2024, Million MDL



Source: Elaborated by the authors based on the NBM consolidated banking data.

Income from fees and commissions has grown steadily from 1,176 million MDL in 2015 to 3,619 million MDL in 2024, which represents an increase of more than three times over ten years. The evolution reflects the development of digital banking services, the expansion of card payments, the increase in the number of electronic transactions and the diversification of financial services offered by banks. At the same time, expenses related to fees and commissions have registered a much more accelerated growth after 2020. If in 2015 they amounted to approximately 299 million MDL, in 2024 they reached over 2,031 million MDL.

This evolution indicates an increase in the costs of processing payments and commissions paid to international payment service providers, especially Visa and Mastercard. Until recently, the Moldovan banking system was almost entirely dependent on international payment processing infrastructures. Unlike many European countries, which also have domestic clearing and processing systems, banks in the Republic of Moldova fully bore the costs imposed by international operators, which contributed to the continuous increase in expenses related to activities from fees and commissions.

In this context, the implementation of the MIA instant payment system in 2024 represents an important step towards reducing dependence on external providers and developing the domestic financial infrastructure. Although in the short term this may reduce some bank fee income, in the long term the system has the potential to reduce operational costs and increase the efficiency of payment processing.

A positive systemic contribution is also provided by Mold Media Card (MMC), a locally established payment processing company in the Republic of Moldova, which serves four of the eleven banks in the country. These banks collectively account for approximately 40% of all cards issued in Moldova, 40% of ATMs, and 45% of POS terminals.

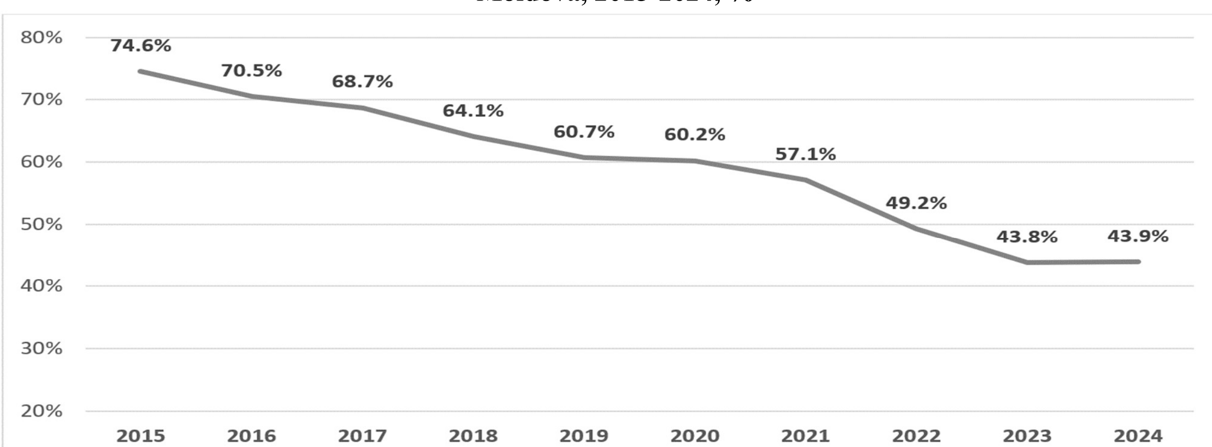
Notably, in early 2023, two banks, Energbank and Eximbank, completed their migration to Moldmediacard's card payment processing system. This integration involved comprehensive projects, including certification with international payment systems such as Visa and Mastercard, migration of card issuance and lending products, and certification of ATM/POS acceptance devices. Additionally, Moldova Agroindbank, the largest commercial bank in Moldova, is affiliated with Moldmediacard, as MMC is a subsidiary of the MAIB group. This has contributed to lower fee and commission expenses for those banks compared to the rest of the banking system.

Although gross fee and commission income increased significantly, net income from this segment advanced at a slower pace, reaching MDL 1,588 million in 2024, compared to MDL 1,189 million in 2020. This difference indicates a compression of the profit margin, as expenses associated with payment services and transaction processing grew faster than income. The trend is in line with European and global developments, where banks are placing increasing importance on fee and commission income.

However, in the Republic of Moldova, this direction is still at a development stage, being affected by high costs, compliance requirements, investments in digitalization, cybersecurity and payment infrastructure. Therefore, Figure 7 highlights both the growth potential of fee and commission income and the main challenge for Moldovan banks: controlling costs and maintaining a sustainable net margin. In the medium term, the efficiency of the digital infrastructure, reducing dependence on external suppliers and optimizing commissioning policies will be essential for consolidating the profitability of this segment.

Figure 8 shows the evolution of the profit margin from fees and commissions, an indicator that shows how much of the income generated by commissionable banking services remains for banks after deducting related expenses. These services mainly include card transactions, account management, interbank transfers and other non-interest activities. The downward trend in the margin indicates increasing pressures on the profitability of this segment. In 2015, banks retained approximately 75 MDL out of every 100 MDL obtained from fees and commissions. By 2023, this value had decreased to 44 MDL, a level that was maintained in 2024. Thus, although income from commissions increased, related costs advanced more rapidly, reducing the net profitability of these services.

Figure 5: Evolution of the fee and commission profit margin in the banking system of the Republic of Moldova, 2015-2024, %



Source: Elaborated by the authors based on the NBM consolidated banking data.

The decrease in the profit margin from fees and commissions may be associated with several cumulative factors. First, the expansion of digital services and the modernization of the payment infrastructure have generated higher costs for banks, including for the maintenance of POS terminals, ATMs, cybersecurity and transaction processing. Second, competition between banks with strong market positions has led to the adjustment of commissions, reducing the income obtained per transaction.

Another important factor is the cap on interchange fees, introduced in the Republic of Moldova starting with 2023, in line with European standards. This has reduced income from card transactions, especially for banks with extensive retail activity.

At the same time, the orientation of customers towards digital channels, which are usually less expensive for users, has contributed to the decrease in margins. In this context, the stabilization of the margin at 44% in 2023 and 2024 may indicate that banks have begun to adjust their cost structure and commission policies to maintain a sustainable level of profitability in this segment.

However, the fee and commission margin could fall below the current level of 44%, given that the final stage of implementation of the interchange fee cap is scheduled for September 2025. Also, the integration of the Republic of Moldova into SEPA may reduce some bank income from payments and transfers, putting additional pressure on the profitability of this segment.

Compared to the European Union, both European and Moldovan banks have recorded a downward trend in the profit margin from fees and commissions. However, the decrease was much more pronounced in the Republic of Moldova: in the period 2015-2022, the margin of European banks decreased by approximately 4.3 percentage points, while in Moldova the decrease was 25.4 percentage points. This difference is largely explained by the high dependence of Moldovan banks on international payment service providers, especially Visa and Mastercard. Unlike some European markets, where domestic processing infrastructures exist, the Republic of Moldova has been more directly exposed to the increase in fees imposed by international card schemes. According to The Brattle Group, these fees have increased cumulatively by 33.9% between 2018 and 2022, i.e. by an average of 7.6% per year, without a proportional improvement in the services offered to merchants and consumers (Reuters, 2025).

Therefore, there is significant room for intervention for banks in the Republic of Moldova in order to optimize costs, reduce dependence on external providers and develop more efficient profitability models for fee and commission revenues.

6 Conclusions

The findings of this study indicate that fee and commission income represents an increasingly important component of the banking profitability model both in the European Union and in the Republic of Moldova. The descriptive and comparative analysis conducted for the period 2015-2024 shows that this category of income has generally had a more stable evolution compared to net interest income and income from financial instruments and foreign exchange operations. This confirms the relevance of fee and commission income for diversifying bank income sources, especially in periods marked by macroeconomic volatility, changes in monetary conditions and transformations of payment services.

In the case of the European banking system, the results suggest that net fee and commission income has maintained a significant role in the structure of total operating income. Although the profit margin related to fee-based activities has decreased over the period under review, this development must be interpreted in relation to a broader set of contextual factors, including regulatory changes, increased competition from fintech companies, the expansion of digital banking services and the costs associated with technological modernization. Since the present research is based on descriptive and comparative analysis, these factors are considered as possible explanatory elements rather than individually isolated causal effects.

For the Republic of Moldova, the results highlight an ongoing process of transformation of the structure of banking income. Net interest income continues to represent the main source of banking profitability, especially after 2021, in the context of increasing interest rates and changing monetary conditions. At the same time, fee and commission income has increased in absolute terms and has become more relevant for diversifying banking income. However, compared to the European banking system, the banking sector in the Republic of Moldova remains less diversified and more dependent on interest income, foreign exchange operations and external payment processing infrastructures.

An important result of the research concerns the evolution of the profit margin related to fee and commission income. In the Republic of Moldova, this margin has decreased more sharply than in the European Union, which suggests the existence of stronger pressures on the net profitability of banking activities based on commissions. This development can be associated with the increase in payment processing costs, dependence on international payment service providers, investments in digital infrastructure and the gradual alignment of the national regulatory framework with European standards. At the same time, the implementation of the MIA instant payment system and the integration of the Republic of Moldova into the Single Euro Payments Area may create opportunities for increasing the efficiency of payment services, although their full impact will only become visible in the medium and long term.

The policy implications of the research point to the need to strengthen the national payment infrastructure, reduce excessive dependence on external processing providers and develop sustainable models for monetizing digital financial services. For banks, the main challenge is to maintain the profitability of fee-based activities, while ensuring accessible, transparent and competitive services for consumers and businesses. This requires a balanced approach between innovation, cost optimization, consumer protection and regulatory convergence with European standards.

Overall, the study confirms that fee and commission income is an important direction for modernizing and diversifying bank profitability. In the European Union, this segment already constitutes a mature component of the bank income structure, while in the Republic of Moldova it remains a developing direction, with significant potential, but also with important structural constraints. Future research could extend the analysis by using bank-level data and econometric methods, to more precisely assess the individual effects of regulation, digitalization, payment infrastructure and fintech competition on fee and commission income and bank profitability.

References:

[1] Adyen (2015). The Latest EU Interchange Fees Cap: Do You Benefit? https://www.adyen.com/en_GB/knowledge-hub/eu-interchange-fees-cap

[2] Busch, D. (2017). MiFID II and MiFIR: stricter rules for the EU financial markets. Law and Financial Markets Review, 11(2–3), 126–142. https://doi.org/10.1080/17521440.2017.1412060

[3] Copenhagen Economics (2020). Study on the Application of the Interchange Fee Regulation. Publications Office of the European Union. https://copenhageneconomics.com/publication/study-on-the-application-of-the-interchange-fee-regulation/

[4] Demirgüç-Kunt, A. & Detragiache, E. (1998). The Determinants of Banking Crises in Developing and Developed Countries. IMF Staff Papers, Vol. 45, No. 1, pp. 81–109. https://www.imf.org/external/pubs/ft/staffp/1998/03-98/pdf/demirguc.pdf

[5] DeYoung, R. & Rice, T. (2004). Noninterest Income and Financial Performance at U.S. Commercial Banks. Financial Review, Vol. 39, No. 1, pp. 101–127. https://ideas.repec.org/a/bla/finrev/v39y2004i1p101-127.html

[6] DeYoung, R. & Roland, K. (2001). Product Mix and Earnings Volatility at Commercial Banks: Evidence from a Degree of Leverage Model. Journal of Financial Intermediation, Vol. 10, No. 1, pp. 54–84. https://www.sciencedirect.com/science/article/abs/pii/S104295730090305X

[7] European Central Bank (2025). Consolidated Banking Data. European Central Bank Statistical Data Warehouse. Available at: https://data.ecb.europa.eu/data/data-categories/supervisory-and-prudential-statistics/consolidated-banking-data.

[8] Gomber, P., Kauffman, R.J., Parker, C. & Weber, B. (2018). On the Fintech Revolution: Interpreting the Forces of Innovation, Disruption, and Transformation in Financial Services. Journal of Management Information Systems, Vol. 35, No. 1, pp. 220–265. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3190052

[9] Howarth, D. & Quaglia, L. (2016). The Political Economy of European Banking Union. Oxford University Press. https://global.oup.com/academic/product/the-political-economy-of-european-banking-union-9780198727927?cc=md&lang=en&

[10] Koont, J. (2024). The Digital Banking Revolution: Effects on Competition and Stability. FDIC Center for Financial Research. https://www.fdic.gov/system/files/2024-09/koont-paper-090324.pdf

[11] Molyneux, P. & Thrall, R. (1994). The Profitability of European Banks: A Cross-Sectional and Time-Series Analysis. The Review of Economics and Statistics, Vol. 76, No. 3, pp. 530–541. https://ideas.repec.org/a/bla/manchs/v72y2004i3p363-381.html

[12] National Bank of Moldova (2017). Strategy for Implementing the Basel III Standards in the Republic of Moldova under the Legal Framework of European Legislation (CRD IV). https://www.bnm.md/en/content/strategy-implementing-basel-iii-standards-republic-moldova-under-legal-framework-european.

[13] National Bank of Moldova (2023). National Bank of Moldova Launched the Instant Payments System MIA. https://bnm.md/en/content/video-live-premiere-financial-market-republic-moldova-national-bank-moldova-launched-instant.

[14] National Bank of Moldova (2023). NBM Decision: Card Payment Fees Will Be Lowered. https://www.bnm.md/en/content/nbm-decision-card-payment-fees-will-be-lowered.

[15] National Bank of Moldova (2024). Annual Report 2023. National Bank of Moldova. https://www.bnm.md/ro/content/raportul-anual-2023

[16] National Bank of Moldova (2025). Consolidated Banking Data. https://www.bnm.md/bdi/pages/reports/drsb/DRSB6.xhtml.

[17] National Bank of Moldova (2025). Questions/Answers about the Benefits of Joining SEPA. https://www.bnm.md/en/content/questionsanswers-about-benefits-joining-sepa.

[18] OECD (2020). Digital Disruption in Banking and its Impact on Competition. OECD Publishing. https://www.oecd.org/en/publications/digital-disruption-in-banking-and-its-impact-on-competition_b8d8fcb1-en.html
[19] Reuters (2025). Retailers Urge European Commission to Crack Down on Visa, Mastercard. https://www.reuters.com/sustainability/boards-policy-regulation/retailers-urge-european-commission-crack-down-visa-mastercard-2025-05-14/ .
[20] Smith, R., Staikouras, C. & Wood, G. (2003). Non-Interest Income and Total Income Stability. Bank of England Working Papers. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=530687
[21] Stiroh, K.J. (2004). Diversification in Banking: Is Noninterest Income the Answer? Journal of Money, Credit and Banking, Vol. 36, No. 5, pp. 853–882. https://www.jstor.org/stable/3839138

Semi-Structural Macroeconomic Modelling for the Republic of Moldova: A Parsimonious Annual Framework[1]

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Abstract: The Republic of Moldova has remained underrepresented in the post-Soviet macroeconometric literature: while Bayesian quarterly frameworks have been developed for monetary transmission, no publicly documented annual demand-side framework with explicit elasticity estimates has been available. This paper addresses that gap by proposing, to the author's knowledge, the first publicly documented annual semi-structural macroeconometric framework for Moldova, comprising five behavioural equations estimated by Ordinary Least Squares (OLS) (for private consumption, exports, imports, gross capital formation (GCF), and government consumption), closed by the expenditure-side accounting identity. The framework is estimated on annual data 2014-2024 (N = 11) under the European System of Accounts (ESA) 2010 and the Moldovan classification of economic activities (CAEM Rev.2). Three indicative findings, conditional on the small-sample environment, emerge from the estimates. The elasticity of Moldovan exports to EU27 real GDP is estimated at the upper end of the trade-elasticity range documented for small open economies, while the import elasticity to total absorption suggests that external shocks are amplified rather than dampened by the open-economy multiplier. The real exchange rate is statistically indistinguishable from zero in the import equation; under the parsimonious specification adopted, the variable was not included in the export equation. The policy interest rate fails to enter the investment equation significantly, consistent with the shallow domestic credit market. The framework outperforms AR(1) and reduced-form VAR(1) benchmarks on out-of-sample GDP fit while underperforming the random walk on a validation window characterised by Moldovan output stagnation. The contributions are illustrative and conditional on the small-sample environment; the framework is fully replicable from public data sources and complements the established Bayesian quarterly tradition for Moldova.

Keywords: semi-structural macroeconometric framework, parsimonious annual specification, short-sample OLS estimation, trade elasticity, exchange rate transmission, small open economy, Republic of Moldova, post-Soviet economies
JEL Classification: C32, C51, E10, E17, F41

1 Introduction

This paper addresses the empirical estimation of a semi-structural macroeconometric framework for the Republic of Moldova, a small open post-Soviet economy for which no publicly documented annual macroeconometric model has previously been published in the international literature. The research problem addressed is the empirical quantification of Moldovan macroeconomic transmission channels, trade elasticities, exchange rate effects, fiscal pass-through, and the investment-credit channel, under the constraint of a short annual sample (N = 11) imposed by the implementation of the ESA 2010 / CAEM Rev.2 framework in Moldovan national accounts since 2014.

The study is important for three reasons. First, the Moldovan case has remained underrepresented in the post-Soviet macroeconometric literature: while Bayesian quarterly frameworks have been developed by Pârțachi

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and Mija (2013, 2015a, 2024) and Mija (2022) for monetary transmission, no annual demand-side framework with explicit elasticity estimates has been published. Second, the country is at a critical macroeconomic juncture, having received EU candidate status in 2022 and facing acute external vulnerabilities documented in successive IMF Article IV consultations (IMF, 2022, 2023, 2024). Third, the empirical questions addressed, particularly the magnitude of external transmission and the operational scope of exchange rate management, bear directly on the design of stabilisation policy under the existing managed-float regime of the National Bank of Moldova (NBM).

The paper addresses this issue by specifying five behavioural equations in log-linear form, each comprising one or at most two right-hand-side variables, deliberately parsimonious in recognition of the eleven-observation sample. Estimation proceeds by Ordinary Least Squares with heteroscedasticity-robust standard errors. The system is closed by the expenditure-side accounting identity GDP = C + C_NPISH + G + GCF + (X - M), where C_NPISH denotes consumption of non-profit institutions serving households (NPISH). In-sample fit, pseudo out-of-sample validation, robustness diagnostics, and benchmark comparison against AR(1), reduced-form VAR(1), and random walk alternatives complete the empirical investigation.

In relation to existing literature, the framework contributes, to the author's knowledge, the first publicly documented annual semi-structural macroeconometric specification for Moldova, complementing the established Bayesian quarterly tradition (Pârțachi and Mija, 2015a, 2024; Mija, 2022) by addressing distinct transmission channels, demand-side aggregates rather than monetary policy, and operating at annual rather than quarterly frequency. The methodological template draws on the parsimonious annual tradition for small economies (Ganev, 2015 for Bulgaria; Grech et al., 2013 for Malta), the trade-elasticity tradition (Goldstein and Khan, 1985; Hooper et al., 2000; Bussière et al., 2013), and the closure architecture of the HERMIN family of models (Bradley and Untiedt, 2009). The remainder of the paper is organised as follows: Section 2 reviews the relevant macromodelling tradition; Section 3 specifies the model; Section 4 documents the data; Section 5 presents the empirical results; Section 6 discusses the findings and their limitations; Section 7 concludes.

2 Macromodelling tradition for short-sample small economies

The macromodelling literature for small open economies with short data samples follows three interrelated traditions. The general principle that overspecified models with too many parameters relative to available observations systematically underperform on out-of-sample tests is well established in the time-series and Bayesian macroeconometric literature. The Bayesian shrinkage tradition addresses this concern through informative priors that effectively reduce the dimensionality of the parameter space, exemplified by the time-varying parameter VAR of Cogley and Sargent (2005) and the large Bayesian VAR with Minnesota-style shrinkage of Bańbura, Giannone and Reichlin (2010). The OLS counterpart of the same parsimony principle, adopted in the present work, restricts the specification a priori to one or at most two right-hand-side variables per equation, accepting the loss of richness in exchange for tractability under N = 11. This parsimony principle motivates the structure of the present model.

The trade-elasticity tradition for small open economies, established by Goldstein and Khan (1985), formalises the absorption-augmented import equation and the EU-anchored export specification adopted here. Hooper, Johnson and Marquez (2000) document G-7 elasticities clustering around 1.5-2.0; Imbs and Mejean (2015) report cross-country elasticities mostly between 0.7 and 2.5 for advanced economies; Bussière et al. (2013) report 0.9-2.3 for emerging Europe. The present empirical results, reported in §5.2 and discussed in §6.1, place Moldova's estimated export elasticity at the upper end of this range.

The existing macromodelling tradition for Moldova consists primarily of Bayesian VAR / VECM frameworks at quarterly frequency. Pârțachi and Mija (2013, 2015a, 2015b, 2024) and Mija et al. (2013) develop the monetary policy transmission framework with structural VAR specifications; Mija (2022) extends this in his doctoral dissertation. These contributions document the price-level pass-through of exchange rate movements at quarterly frequency. The present framework does not duplicate this work; instead, it complements it by addressing demand-side aggregates at annual frequency through OLS estimation, with the trade-elasticity and exchange-rate-transmission findings reported below being conceptually distinct from the monetary transmission documented by Pârțachi and Mija. Naval (2019) provides one of the few academic input-output references for Moldova prior to recent reconstructions.

3 Model specification

3.1 Accounting framework and behavioural equations

The model rests on the standard expenditure-side decomposition of GDP at constant 2014 prices:

$$GDP\_t = C\_t + C\_NPISH,t + G\_t + GCF\_t + (X\_t - M\_t) \qquad (1)$$

where C is private final consumption, C_NPISH consumption of NPISH (treated as exogenous, share 1.2-1.5% of GDP), G government final consumption, GCF gross capital formation (gross fixed capital formation plus changes in inventories per ESA 2010), X exports of goods and services, and M imports. Identity (1) holds with absolute residual below 0.01% of GDP across all eleven sample years. The closure architecture follows Bradley and Untiedt (2009): the five behavioural equations specified below model the demand-side determinants of C, X, M, GCF, and G; identity (1) recovers GDP without an additional GDP equation.

The five behavioural equations, in log-linear specification, are:

$$\log C\_t = \alpha\_1 + \beta\_1,1 \cdot \log GDP\_t + \varepsilon\_1,t \qquad (2)$$

$$\log X\_t = \alpha\_2 + \beta\_2,1 \cdot \log DEX\_t + \varepsilon\_2,t \qquad (3)$$

$$\log M\_t = \alpha\_3 + \beta\_3,1 \cdot \log (GDP\_t + X\_t) + \beta\_3,2 \cdot \log RER\_t + \varepsilon\_3,t \qquad (4)$$

$$\log GCF\_t = \alpha\_4 + \beta\_4,1 \cdot \log GDP\_t + \varepsilon\_4,t \qquad (5)$$

$$\log G\_t = \alpha\_5 + \beta\_5,1 \cdot \log VEN\_t + \varepsilon\_5,t \qquad (6)$$

Equation (2) follows the absolute-income consumption hypothesis. Equation (3) employs EU27 real GDP (DEX) as external demand proxy, with EU27 absorbing approximately 65% of Moldovan exports in 2023 (NBS trade statistics). Equation (4) follows the Goldstein-Khan absorption framework, with imports specified against total absorption (GDP + X) rather than GDP alone, recognising that Moldovan exports have substantial imported intermediate-input content; the real exchange rate (RER) enters as a price-competitiveness term. Equation (5) follows the accelerator principle. Equation (6) specifies fiscal pass-through, with VEN denoting total general government revenue (taxes plus social contributions plus health insurance contributions) at constant prices.

3.2 Estimation method and counterfactual scenarios

The five behavioural equations are estimated by OLS on the full sample 2014-2024 with heteroscedasticity-robust standard errors (Newey-West HAC, truncation lag 1). OLS is preferred over Bayesian alternatives for three reasons: (i) replicability without prior-specification justification; (ii) direct interpretation of coefficients as long-run elasticities under log-linear specification; (iii) robustness to prior-specification sensitivity that would be acute at N = 11 in Bayesian alternatives. The trade-offs of N = 11 are acknowledged: stationarity tests have low statistical power, the Diebold-Mariano test is not feasible, and the sample size precludes vector error-correction modelling.

Counterfactual scenarios are implemented by altering an exogenous variable from its observed value to a counterfactual path, re-evaluating the behavioural equations using the OLS coefficients estimated on the historical sample, and aggregating the modified components through identity (1). Four scenarios are explored: a 5% contraction in EU27 demand, a 10% fiscal impulse via revenue increase, a 15% nominal depreciation of the leu, and a 10% productivity-driven GDP increase. Scenarios assume static behaviour and apply OLS coefficients as if the relationships were structurally invariant, a strong assumption at N = 11 acknowledged as a limitation in §6.

4 Data

The model is estimated on annual data 2014-2024 (N = 11), the full period for which NBS Moldova publishes ESA-2010-compliant national accounts under the CAEM Rev.2 framework. Moldovan macroeconomic series, GDP, C, C_NPISH, X, M, IFBCF, Δ_Stocks, G, the GDP deflator P, are taken from NBS (2025), expenditure approach. Total general government revenue (VEN) is from the NBS series "Bugetul public național" (Statistical Yearbook 2024, Table 22.1), covering the consolidated fiscal account. Gross capital formation (GCF), denoted FBC in Moldovan national accounts terminology, is constructed as IFBCF + Δ_Stocks per ESA 2010. The MDL/EUR exchange rate (NER) and NBM policy rate (i, annual average) are from NBM statistical bulletins. EU27 real GDP at 2010 prices (DEX) is from Eurostat (namq_10_gdp series). All Moldovan nominal series are deflated to constant 2014 prices using the GDP implicit deflator. The accounting identity GDP = C + C_NPISH + G + GCF + (X - M) holds with maximum absolute residual below 0.01% of GDP across all eleven years. The

bilateral real exchange rate against the euro is constructed as RER_t = NER_t × (P_foreign,t / P_domestic,t), with euro area inflation approximated at 1.5% per year. All variables, except the policy interest rate (which enters as log(1 + i_t/100)), are transformed to natural logarithms.
The sample exhibits trend behaviour expected of a small economy growing in real terms: GDP rises from MDL 132 bn (2014) to MDL 156 bn (2024), cumulative real growth of 18%. Components display heterogeneous patterns: consumption tracks GDP closely; exports show pronounced volatility (a 30% nominal jump in 2022 driven by energy-crisis re-export activity); GCF is the most volatile component, with year-on-year real changes ranging from -9% (2020) to +21% (2018); government spending exhibits the smoothest profile. External variables (NER, DEX) are relatively stable; the policy rate exhibits the highest within-sample variation, ranging from 3.5% (2020) to 16.6% (2022) reflecting NBM's response to the energy crisis.

5 Results

5.1 Baseline OLS estimates

Table 1 reports the baseline OLS estimates. All five equations are jointly significant at conventional levels, with adjusted R^2 ranging from 0.42 (E4) to 0.87 (E5). The point estimates carry direct economic interpretation as long-run elasticities under log-linear specification. The income elasticity of private consumption is 0.70 ($p < 0.001$), indicating a marginal propensity to consume below unity. The elasticity of Moldovan exports to EU27 GDP is 1.97 ($p < 0.005$), placing Moldova at the upper end of the trade-elasticity range for small open economies (Goldstein and Khan, 1985; Bussière et al., 2013). The income-side elasticity of imports against total absorption is 1.32 ($p < 0.01$). The fiscal pass-through coefficient $\beta\_VEN = 1.41$ ($p < 0.001$) indicates that government final consumption rises by approximately 1.4 percent for each percent increase in tax revenue. The real exchange rate enters the import equation with a coefficient indistinguishable from zero ($p > 0.80$), and the policy interest rate enters the investment equation only marginally ($p > 0.40$).

Table 1: Baseline OLS estimates of the five behavioural equations

Variable	E1 log C	E2 log X	E3 log M	E4 log GCF	E5 log G
Constant	1.317* (0.599)	-28.288** (7.761)	-2.625 (2.381)	-2.867 (2.238)	-2.255** (0.667)
log GDP	0.703*** (0.120)	-	-	1.288* (0.449)	-
log DEX	-	1.968** (0.475)	-	-	-
log (GDP + X)	-	-	1.322** (0.389)	-	-
log RER	-	-	0.039 (0.152)	-	-
log VEN	-	-	-	-	1.407*** (0.174)
R²-adj	0.769	0.618	0.695	0.420	0.865
F p-value	0.0002	0.0025	0.0035	0.0185	<0.0001
Durbin-Watson	1.729	1.633	1.431	1.806	1.565
N	11	11	11	11	11

Notes: *OLS estimates on annual data 2014-2024 (N = 11). All variables in natural logarithms; real values at 2014 prices (Moldovan series); EU27 GDP at 2010 prices (DEX). Standard errors in parentheses. Significance: * p<0.05, ** p<0.01, *** p<0.001. Source: Author's calculations on NBS Moldova, NBM, World Bank and Eurostat data.*

5.2 Three indicative findings from the baseline estimates

The baseline estimates produce three indicative findings, discussed below with the small-sample caveats noted in §6. First, external vulnerability is asymmetric and substantial: $\beta\_DEX = 1.97$ implies that a one-percent decline in EU27 real GDP translates into approximately a two-percent decline in Moldovan exports, with the open-economy multiplier amplifying rather than dampening the externally generated cycle. Combined with the export-import differential structure (exports averaging 35% of GDP, imports 60%) and the import elasticity to total absorption of 1.32, a 5% EU27 contraction would translate into approximately a 9% reduction in Moldovan exports.

Second, real exchange rate transmission is statistically indistinguishable from zero in the import equation, where it was tested; under the parsimonious specification strategy, the real exchange rate was not included as a regressor in the export equation. The null finding is consistent with the structural features of the Moldovan economy: dominance of EU-denominated commodity trade, substantial role of remittances (averaging 18-22% of GDP) that generate income flows insensitive to domestic price developments, and high pass-through of import prices documented by the NBM (2022, 2023). The implication for stabilisation policy is that the conventional exchange rate channel of monetary transmission has limited efficacy in Moldova. This result complements Pârțachi and Mija (2015a), who document substantial exchange rate transmission to inflation at quarterly frequency: the two findings reflect distinct channels, price-level pass-through (their result) and trade-flow non-response (the present result), that are jointly consistent with rapid pass-through neutralising the relative-price effect on trade flows.

Third, the investment-to-interest-rate channel is also weak: when included additively, the policy rate is statistically insignificant in E4. This indicates that conventional credit-channel effects of monetary policy on fixed capital formation are limited in Moldova, consistent with the shallow domestic credit market (private credit ≈ 30% of GDP, low by EU standards) and the high share of foreign-financed investment (EU Eastern Partnership infrastructure funds, IMF Extended Credit Facility disbursements).

5.3 In-sample fit, out-of-sample validation and benchmark comparison

Aggregate GDP is reconstructed via identity (1) by inserting OLS-implied components, with NPISH consumption taken as observed. The aggregate GDP forecast achieves an in-sample MAPE of 2.05% with Theil U = 0.0117, with 98.9% of squared error variance attributable to the covariance component (U_C), 0.4% to bias (U_M), and 0.7% to variance (U_S). This composition indicates that the model captures the dynamic profile of GDP accurately. At component level: consumption MAPE 1.50%, government 3.68%, imports 4.15%, exports 5.36%, GCF 7.73%. The relatively weaker fit of GCF reflects the structurally volatile nature of investment in Moldova, with year-on-year changes driven by lumpy infrastructure projects and external financing pulses.
Pseudo out-of-sample validation re-estimates the equations on 2014-2022 (N_train = 9) and forecasts 2023-2024 (N_test = 2). Aggregate GDP MAPE_OOS is 2.69%, only 31% above the in-sample value, a moderate deterioration that is indicative, but cannot be confirmed as structural reliability given N = 11. Consumption remains essentially unchanged across the cut (MAPE_OOS 1.47% vs. MAPE_IS 1.50%); government spending actually improves (MAPE_OOS 1.02% vs. 3.69%); GCF deteriorates substantially (MAPE_OOS 23.0% vs. MAPE_IS 7.7%), reflecting post-2022 compression of investment activity driven by the persistent effects of the energy crisis, regional security tensions, and the cumulative impact of restrictive monetary policy.

Table 2 reports the benchmark comparison. Against AR(1) on log GDP, the framework reduces OOS MAPE by 2.27 pp (1.85-fold improvement); against reduced-form VAR(1), by 0.57 pp despite using fewer parameters (8 vs. 12). Both indicate that the cross-equation theoretical restrictions add genuine forecasting value. Against the random walk, however, the framework underperforms (2.69% vs. 0.77%) on a validation period (2023-2024) characterised by Moldovan output stagnation (annual growth 1.0% and 0.6% respectively); in low-drift environments, the random walk is structurally difficult to outperform on short horizons (Atkeson and Ohanian, 2001; Stock and Watson, 2007; Diebold, 2015). The result is interpreted as reflecting the temporary stagnation of the validation sample rather than the relative analytical merit of the structural approach: the random walk produces no economic information, no elasticities, no scenarios, no decomposition.

Table 2: Forecasting performance: structural OLS vs. alternative benchmarks

Model	MAPE_IS GDP (%)	MAPE_OOS GDP (%)	N parameters	Interpretability
Semi-structural OLS (this paper)	2.05	2.69	8	High (elasticities + scenarios)
Random walk on log GDP	4.43	0.77	0	None
AR(1) on log GDP	4.31	4.96	2	Low (single AR coefficient)
VAR(1) reduced form	3.42	3.26	12	Low (reduced-form coefficients)

Notes: *In-sample period 2014-2024 (or 2015-2024 where the benchmark consumes the first observation). Out-of-sample period 2023-2024 (estimation on 2014-2022). The strong performance of the random walk on the validation window reflects the unusual stagnation of Moldovan real GDP in 2023-2024 (annual growth 1.0% and 0.6% respectively); see Atkeson and Ohanian (2001), Stock and Watson (2007). Source: Author's calculations.*

5.4 Robustness diagnostics

Three robustness diagnostics confirm the structural integrity of the baseline specification within the limits permitted by $N = 11$. Chow tests applied at the 2020 break point yield F-statistics ranging from 0.10 to 2.10, with all p-values exceeding 0.10, no detectable structural break across the COVID-19 boundary. Augmented Dickey-Fuller tests reject the unit-root null at 5% for all five equations (statistics from -2.12 to -4.08, all below the -1.95 critical value); KPSS tests with the opposite null yield statistics from 0.13 to 0.27, all below the 0.46 critical value at 5%. The convergence of ADF rejection and KPSS non-rejection across all five equations provides indicative support for residual stationarity, consistent with the spurious-regression concern being limited within the sample window (though the statistical power of these tests at $N = 11$ should be acknowledged). Durbin-Watson statistics fall within the indeterminate range [1.32; 2.18] for $N = 11$, ranging from 1.43 (E3) to 1.81 (E4); Cochrane-Orcutt-equivalent corrections confirm that AR(1) adjustment does not materially alter coefficient estimates or significance.

6 Discussion

6.1 Asymmetric external vulnerability and the null finding on exchange rate transmission

The export elasticity $\beta\_DEX = 1.97$ places Moldova at the upper end of the international trade-elasticity literature: G-7 elasticities cluster at 1.5-2.0 (Hooper, Johnson and Marquez, 2000); cross-country estimates for advanced economies fall mostly between 0.7 and 2.5 (Imbs and Mejean, 2015); panel estimates for emerging Europe span 0.9-2.3 (Bussière et al., 2013). Moldova's estimated elasticity falls in the upper part of this range; comparable upper-bound estimates have been reported for small open economies of the Central and South-Eastern European region during their pre-accession period (Ganev, 2015 for Bulgaria). The economic interpretation is direct: a one-percent decline in EU27 GDP translates into roughly a two-percent contraction of Moldovan exports. The asymmetry of transmission becomes apparent once the import side is incorporated: with import elasticity to total absorption at 1.32, the same EU27 shock generates a 0.7-percent reduction of imports for every 1-percent fall in EU27 GDP. The difference between export contraction (1.97%) and import contraction (0.7%) compounds across the trade balance, amplifying GDP impact through the open-economy multiplier. In the absence of effective exchange rate transmission, external shocks of the magnitude experienced in 2022 (effective shock of roughly 2.4 percentage points on EU27 growth) translate into substantially larger Moldovan output contractions than in less externally exposed economies.

The null finding on real exchange rate transmission in the import equation requires interpretation rather than dismissal. Three structural features converge to suppress real-exchange-rate transmission in Moldova. First, dominance of euro-denominated trade reduces the effective bilateral exposure to MDL/EUR fluctuations. Second, remittances from Moldovan migrants abroad (18-22% of GDP) generate an income flow largely insensitive to domestic price developments. Third, high pass-through of import prices to domestic prices, documented by the NBM in successive Financial Stability Reports (2022, 2023), neutralises the price-competitiveness mechanism. Calvo and Reinhart (2002) document analogous patterns in their analysis of "fear of floating". A complementary perspective comes from Pârțachi and Mija (2015a), who report substantial exchange rate transmission to inflation at quarterly frequency: the two findings are jointly consistent with a structural pattern in which exchange rate movements pass through to domestic prices rapidly, neutralising the relative-price effect on trade flows that the Marshall-Lerner mechanism would conventionally predict. The macroeconomic implication is that NBM exchange rate management has limited stabilisation effect through the trade channel, framing the limited macroeconomic value of competitive devaluation as a development strategy for Moldova.

6.2 The investment channel, situating the results, and limitations

The fixed capital formation equation E4 yields the lowest R^2-adj (0.42) and the largest OOS deterioration (MAPE rising from 7.7% to 23.0%). Both findings reflect substantive features of the Moldovan investment environment: structurally low private credit penetration (25-30% of GDP, against 60-90% in EU member states at comparable income levels per the World Bank Global Financial Development Database), and the predominance of foreign-financed investment uncorrelated with domestic demand growth. The post-2024 OOS deterioration is concentrated in disbursement pulses from EU Eastern Partnership funds and the IMF Extended

Credit Facility, which the parsimonious specification cannot capture; this limitation is intrinsic to the present specification rather than an estimation artefact.

Within the Moldovan macromodelling tradition, the present results enter dialogue with Pârțachi and Mija (2013, 2015a, 2024) and Mija (2022) through three points of comparison. On exchange rate transmission, the divergent findings, substantial price-level pass-through at quarterly frequency (their result) and zero trade-flow response at annual frequency (the present result), are best understood as documenting distinct channels. On forecasting performance, the present annual MAPE_OOS of 2.69% complements their Bayesian quarterly framework over a 20-quarter horizon: both confirm that disciplined macromodelling is feasible for Moldovan GDP despite data-environment limitations. On methodological complementarity, the two traditions are best understood as parallel research programmes addressing the same economy from distinct methodological angles, with comparative advantages: Bayesian frameworks exploit informative priors when well-justified; classical OLS frameworks deliver fully replicable results without prior-specification sensitivity. Within the Moldovan institutional landscape, where IMF Article IV consultations and NBM internal forecasting systems are not publicly disclosed, the present paper contributes, to the author's knowledge, the first publicly documented and fully replicable annual framework.

Three limitations should be acknowledged. Sample size: with $N = 11$, the estimation rests on a degrees-of-freedom margin that is uncomfortable by macroeconometric standards; statistical tests for stationarity, structural stability, and forecast accuracy comparison have low statistical power. Static structure: the model has no lagged endogenous variables and no error-correction representation; with $N = 11$, the inclusion of lags would require sacrificing further degrees of freedom. Treatment of stocks: the aggregated specification (with GCF = IFBCF + Δ_Stocks, denoted FBC in Moldovan national accounts) closes the identity but conflates two structurally distinct components. These limitations are intrinsic to the data environment and define the boundary of the current contribution; as additional observations accumulate under the CAEM Rev.2 framework, the model should be re-estimated and its specification expanded.

7 Conclusions

This paper has presented, to the author's knowledge, the first publicly documented annual semi-structural macroeconometric framework for the Republic of Moldova, comprising five behavioural equations estimated by Ordinary Least Squares (OLS) closed by the expenditure-side accounting identity, estimated on annual data 2014-2024 ($N = 11$). The empirical results yield three indicative findings, conditional on the small-sample environment: (i) the elasticity of Moldovan exports to EU27 demand is 1.97 ($p < 0.005$), placing Moldova at the upper end of the trade-elasticity range and implying that external shocks are amplified rather than dampened by the open-economy multiplier; (ii) the real exchange rate is statistically indistinguishable from zero in the import equation, where it was tested; under the parsimonious specification strategy, the variable was not included as a regressor in the export equation, indicating limited efficacy of the conventional exchange rate channel for stabilisation; (iii) the policy interest rate fails to enter the investment equation significantly, consistent with the shallow domestic credit market. The framework outperforms AR(1) and reduced-form VAR(1) benchmarks on out-of-sample MAPE while underperforming the random walk on a validation window characterised by Moldovan output stagnation.

The expected impact of these results is threefold. First, the asymmetric external transmission identified by the model suggests that fiscal stabilisation, rather than exchange rate management, may play the primary role in demand-side stabilisation against external shocks — a model-based indication consistent with successive IMF Article IV consultations and quantified here, to the author's knowledge for the first time, on annual demand-side aggregates. Second, the null finding on real exchange rate transmission in the import equation indicates that the trade channel of monetary transmission appears to be limited in Moldova within the sample window — a model-based result that should be interpreted with caution given the small-sample environment, but which is consistent with the structural features documented in §6.1. Third, the framework provides a public quantitative platform on which future Moldovan macroeconomic policy debates can be grounded; the model is replicable from documented data sources and OLS coefficients.

Three extensions warrant attention as the data environment evolves. The accumulation of additional observations under the CAEM Rev.2 framework will, by approximately 2030 with $N \geq 17$, support the introduction of dynamic structure (lagged endogenous variables, error-correction representations) currently precluded. Integration of the aggregate framework with the input-output reconstruction of the Moldovan economy will permit a sectorally disaggregated analysis of the same shocks, exploiting bridging methodologies between reduced-form macroeconometric and structural input-output diagnostics. The methodological template, parsimonious semi-structural specification with identity closure, is directly transferable to other small post-Soviet economies (Armenia, Georgia, Kyrgyzstan) confronting analogous data constraints; the broader research programme is the institutionalisation of replicable, public-domain macroeconometric work for the small post-Soviet economies underrepresented in the published literature.

References

[1] Atkeson, A. & Ohanian, L. E. (2001). Are Phillips Curves Useful for Forecasting Inflation? *Federal Reserve Bank of Minneapolis Quarterly Review*, 25(1), pp. 2-11.

[2] Bańbura, M., Giannone, D. & Reichlin, L. (2010). Large Bayesian Vector Auto Regressions. *Journal of Applied Econometrics*, 25(1), pp. 71-92.

[3] Bradley, J. & Untiedt, G. (2009). Analysis of EU Cohesion Policy 2000-2006 using the CSHM: aggregate impacts and inter-country comparisons. *Report to the European Commission (DG REGIO*). Brussels/Dublin.

[4] Bussière, M., Callegari, G., Ghironi, F., Sestieri, G. & Yamano, N. (2013). Estimating Trade Elasticities: Demand Composition and the Trade Collapse of 2008-2009. *ECB Working Paper No. 1568*. Frankfurt: European Central Bank.

[5] Calvo, G. A. & Reinhart, C. M. (2002). Fear of Floating. *Quarterly Journal of Economics*, 117(2), pp. 379-408.

[6] Cogley, T. & Sargent, T. J. (2005). Drifts and Volatilities: Monetary Policies and Outcomes in the Post WWII US. *Review of Economic Dynamics*, 8(2), pp. 262-302.

[7] Diebold, F. X. (2015). Comparing Predictive Accuracy, Twenty Years Later: A Personal Perspective on the Use and Abuse of Diebold–Mariano Tests. *Journal of Business & Economic Statistics*, 33(1), pp. 1-9.

[8] Eurostat (2013). European System of Accounts - ESA 2010. Luxembourg: *Publications Office of the European Union*.

[9] Ganev, K. (2015). A Small Model for Output Gap and Potential Growth Estimation: An Application to Bulgaria. *MPRA Paper* No. 63546. Munich: Munich Personal RePEc Archive.

[10] Goldstein, M. & Khan, M. S. (1985). Income and Price Effects in Foreign Trade. In: Jones, R. W. and Kenen, P. B. (eds.) *Handbook of International Economics*, vol. 2. Amsterdam: Elsevier, pp. 1041-1105.

[11] Grech, A. G., Grech, O., Micallef, B., Rapa, N. & Gatt, W. (2013). A Structural Macro-Econometric Model of the Maltese Economy. *MPRA Paper* No. 46128. Munich: Munich Personal RePEc Archive.

[12] Hooper, P., Johnson, K. & Marquez, J. (2000). Trade Elasticities for the G-7 Countries. *Princeton Studies in International Economics* No. 87. Princeton: Princeton University.

[13] Imbs, J. and Mejean, I. (2015). Elasticity Optimism. *American Economic Journal: Macroeconomics*, 7(3), pp. 43-83.

[14] IMF (2022). Republic of Moldova: 2021 Article IV Consultation. *IMF Country Report* No. 22/1. Washington, DC: International Monetary Fund.

[15] IMF (2023). Republic of Moldova: 2023 Article IV Consultation. *IMF Country Report* No. 23/428. Washington, DC: International Monetary Fund.

[16] IMF (2024). Republic of Moldova: Fifth Reviews under the Extended Credit Facility and Extended Fund Facility Arrangements. *IMF Country Report* No. 24/208. Washington, DC: International Monetary Fund.

[17] Mija, S. (2022). *Using of Statistical and Econometric Methods in Fundamentation of Monetary Policy Oriented to Price Stability.* PhD Dissertation, Academy of Economic Studies of Moldova, Chișinău.

[18] Mija, S., Slobozian, D., Cuhal, R. & Stratan, A. (2013). How Core Inflation Reacts to the Second Round Effects. *Romanian Journal of Economic Forecasting*, 16(1), pp. 98-118.

[19] Naval, E. (2019). Experience of the Input-Output Models Application to the Moldovan Economy. *Economy and Sociology*, (1), pp. 36-52.

[20] NBM (2022). *Financial Stability Report* 2022. Chișinău: National Bank of Moldova.

[21] NBM (2023). *Financial Stability Report* 2023. Chișinău: National Bank of Moldova.

[22] NBS (2025). *Statistical Yearbook of the Republic of Moldova 2024*. Chișinău: National Bureau of Statistics.

[23] Pârțachi, I. & Mija, S. (2013). Monetary Policy Transmission Mechanism Using Econometric Models. Romanian Statistical Review Supplement, 61(4), pp. 148-157.

[24] Pârțachi, I. & Mija, S. (2015a). A Semi-Structural General Equilibrium Analysis of Moldova's Monetary Policy Transmission Mechanism. *Economic Research Guardian*, 5(1), pp. 34-47.
[25] Pârțachi, I. & Mija, S. (2015b). Monetary Policy - Instrument for Macroeconomic Stabilization. *Procedia Economics and Finance*, 20, pp. 485-493
[26] Pârțachi, I. & Mija, S. (2024). Moldova GDP Forecasting Using Bayesian Multivariate Models. *Revista Economica*, 76(1), pp. 85-93.
[27] Stock, J. H. & Watson, M. W. (2007). Why Has U.S. Inflation Become Harder to Forecast? *Journal of Money, Credit and Banking*, 39(s1), pp. 3-33.
[28] Theil, H. (1966). *Applied Economic Forecasting*. Amsterdam: North-Holland.
[29] World Bank (2024). *Moldova Country Economic Memorandum*. Washington, DC: World Bank.
[30] World Bank (2024). *Moldova Economic Update, November 2024*. Washington, DC: World Bank.

Beyond the Screen: Assessing the Role of Smartphone Addiction, Fear of Missing Out (FOMO), and Leisure Boredom on Podcast Consumption

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Abstract: The rapid expansion of smartphone-based media has transformed the way people access, select and consume digital content. Among the many forms of mobile media, podcasts have become increasingly relevant because they combine flexibility, personalization and the possibility of multitasking. This paper examines the relationship between smartphone addiction, fear of missing out (FOMO), leisure boredom and podcast consumption. Drawing on the literature on problematic smartphone use, uses and gratifications theory, FOMO and leisure boredom, the paper argues that podcast consumption should not be understood only as an informational or entertainment practice, but also as part of a broader pattern of digital self-regulation. The study proposes that smartphone addiction may increase podcast consumption directly, by encouraging repeated mobile engagement, and indirectly, through FOMO and leisure boredom. Individuals who experience high levels of FOMO may use podcasts to remain connected to trends, conversations and cultural knowledge, while those experiencing leisure boredom may use podcasts as a convenient way to fill empty time and avoid inactivity. The paper contributes to existing literature by integrating three psychological predictors into a conceptual explanation of podcast consumption. The expected impact of this research lies in improving the understanding of digital media habits and supporting healthier, more intentional forms of smartphone and podcast use.

Keywords: smartphone addiction, fear of missing out, FOMO, leisure boredom, podcast consumption, digital media, mobile media.

1. Introduction

Smartphones have become one of the central infrastructures of everyday life. They are not merely communication devices, but portable gateways to social interaction, entertainment, news, education and self-presentation. In this context, podcasts have gained significant visibility as a flexible form of digital media, accessible through smartphones and compatible with daily routines such as commuting, exercising, working, studying or household activities. Unlike traditional radio, podcasts are on-demand, personalized and often consumed through mobile applications, which makes them particularly relevant for understanding contemporary digital behaviour.

This paper covers the relationship between smartphone addiction, fear of missing out (FOMO), leisure boredom and podcast consumption. More precisely, it investigates whether excessive or compulsive smartphone use may influence how frequently individuals consume podcasts, what role FOMO plays in motivating constant connection to audio or video content, and how leisure boredom encourages individuals to fill idle time with easily accessible digital media. The subject is important because podcast consumption is not only a media preference; it may also reflect deeper psychological and behavioural patterns associated with digital dependency, emotional regulation and the avoidance of boredom.

The relevance of this topic is strengthened by the broader social concern surrounding problematic smartphone use. Research has associated excessive mobile phone use with anxiety, reduced academic performance, sleep disruption and lower well-being (Lepp, Barkley and Karpinski, 2014; Elhai et al., 2017). At the same time, FOMO has been conceptualized as a pervasive apprehension that others may be having rewarding experiences from which one is absent, combined with the desire to remain continually connected (Przybylski et al., 2013). Leisure boredom, in turn, refers to the perception that free time lacks meaning, stimulation or satisfying engagement (Iso-Ahola and Weissinger, 1990). These three constructs are particularly relevant in the smartphone era, where individuals can instantly access podcasts and other digital content whenever they experience uncertainty, social anxiety or boredom.

The paper intends to answer this matter through a theoretical and literature-based analysis. It reviews specialized literature on smartphone addiction, FOMO, leisure boredom and podcast consumption, then proposes a conceptual framework explaining how these factors may interact. The paper does not claim to present original empirical data, but rather to synthesize previous research and formulate a research model that can be tested in future quantitative or mixed-method studies.

The relationship between this paper and the existing specialized literature is therefore integrative. Previous studies have examined smartphone addiction (Kwon et al., 2013), FOMO (Przybylski et al., 2013), leisure boredom (Iso-Ahola and Weissinger, 1990) and podcast motivations (McClung and Johnson, 2010; Perks and Turner, 2019; Tobin and Guadagno, 2022). However, these topics are often discussed separately. This paper contributes by bringing them together and by positioning podcast consumption as a behavioural outcome shaped by both technological accessibility and psychological need. In doing so, it extends the literature on digital media consumption and offers a clearer explanation of why podcasts may become embedded in smartphone-centered lifestyles.

2. Literature Review

2.1 Smartphone Addiction and Problematic Smartphone Use

Smartphone addiction is usually understood as excessive, uncontrolled or compulsive smartphone use that interferes with daily life, productivity, social relationships or psychological well-being. Although the term "addiction" remains debated, many researchers use related concepts such as "problematic smartphone use" or "smartphone dependency" to describe behaviours involving loss of control, withdrawal-like discomfort, overuse and negative consequences (Billieux, 2012; Kwon et al., 2013).

Kwon et al. (2013) contributed significantly to the measurement of smartphone addiction through the development and validation of the Smartphone Addiction Scale. Their work helped establish smartphone addiction as a measurable behavioural phenomenon, especially among younger users. Other studies have shown that frequent mobile phone use can be associated with anxiety and lower life satisfaction (Lepp, Barkley and Karpinski, 2014). Elhai et al. (2017) also linked problematic smartphone use to anxiety and depression, suggesting that smartphone overuse may function as both a cause and consequence of emotional distress.

The addictive potential of smartphones lies partly in their design and affordances. Smartphones provide instant access to social media, entertainment platforms, messaging services, news feeds and audio content. Notifications, algorithmic recommendations and infinite-scroll interfaces encourage repeated checking behavior. This constant availability makes the smartphone not only a tool, but also a default response to discomfort, uncertainty or inactivity.

In relation to podcast consumption, smartphone addiction may increase exposure to podcasts simply because the device is constantly present. Individuals who frequently use smartphones are more likely to discover podcasts through apps, social media recommendations, streaming platforms or algorithmic suggestions. Therefore, podcast consumption may become part of a wider cycle of habitual mobile use.

2.2 Fear of Missing Out

Fear of Missing Out, commonly known as FOMO, was defined by Przybylski et al. (2013) as a pervasive apprehension that others might be having rewarding experiences from which one is absent. FOMO includes both emotional and behavioural dimensions: anxiety about exclusion and the desire to stay continuously connected. It is closely linked with social media use, notification checking and digital engagement.

FOMO is relevant to smartphone addiction because smartphones allow users to monitor social environments in real time. Through messages, stories, posts, podcasts, reels and news updates, individuals can remain connected to social and cultural conversations. However, this constant monitoring may reinforce anxiety rather than reduce it. The more individuals check their devices, the more they become aware of new content, new conversations and new opportunities to miss something.

In the context of podcast consumption, FOMO may operate in several ways. First, users may listen to podcasts in order to stay informed about current events, professional trends, cultural debates or niche communities. Second, users may follow popular podcasts because these programs become part of social conversation. Third, the growth of video podcasts and platform-based recommendations may increase the sense that there is always another episode, another discussion or another expert opinion that should be consumed.

From this perspective, podcast listening may be both enriching and anxiety-driven. A person may listen to a podcast to learn, relax or feel entertained, but also to avoid feeling uninformed, excluded or culturally behind. FOMO therefore provides an important psychological mechanism linking smartphone dependency to repeated podcast consumption.

2.3 Leisure Boredom

Leisure boredom refers to a subjective state in which individuals perceive their free time as insufficiently meaningful, stimulating or satisfying. Iso-Ahola and Weissinger (1990) conceptualized leisure boredom as a specific form of boredom occurring during free time, when individuals have available time but lack engaging activities. This is particularly relevant in contemporary societies, where digital entertainment is abundant, but meaningful leisure may still be difficult to achieve.

Smartphones offer a quick solution to leisure boredom. Instead of tolerating idle moments, individuals can immediately access music, podcasts, videos, games, messages or social feeds. This may provide short-term relief, but it can also reduce the ability to engage in deeper or more intentional leisure activities. In other words, smartphones may transform boredom from a signal for reflection or creativity into a trigger for automatic digital consumption.

Podcasts occupy a special position in this process. They are less visually demanding than many digital media formats and can be consumed while doing other things. This makes them attractive for filling transitional or low-stimulation moments: commuting, walking, cleaning, waiting, cooking or exercising. Podcasts can make empty time feel productive, educational or emotionally comforting.

However, when podcast consumption is primarily driven by boredom avoidance, it may become repetitive and automatic. Users may listen not because they actively choose the content, but because silence, inactivity or mental space feels uncomfortable. Leisure boredom may therefore predict not only podcast consumption frequency, but also passive or compulsive listening patterns.

2.4 Podcast Consumption in the Digital Media Environment

Podcasts are on-demand audio or video programs distributed through digital platforms. They cover a wide range of topics, including news, politics, science, comedy, self-improvement, education, business, health, entertainment and personal storytelling. Their growth reflects the broader shift from scheduled broadcasting to personalized, platform-based media consumption.

Uses and gratifications theory provides a useful framework for understanding podcast consumption. According to Katz, Blumler and Gurevitch (1973), audiences actively select media to satisfy specific needs, such as information, entertainment, social interaction or escape. Ruggiero (2000) later argued that uses and gratifications theory remains particularly relevant in the internet age because digital media increase user control, interactivity and choice.

Studies on podcast users have identified several motivations, including entertainment, information, companionship, time-shifting, habit and multitasking (McClung and Johnson, 2010; Perks and Turner, 2019). Tobin and Guadagno (2022) also explored psychological predictors and outcomes of podcast listening, suggesting that podcast use may relate to curiosity, social engagement and informational needs.

Recent industry data also confirm the increasing importance of podcasts. Edison Research reported that podcast consumption reached record levels in 2025, with 73% of people aged 12+ in the United States having ever consumed a podcast and 55% having consumed one in the last month (Edison Research, 2025). Although such data are market-specific, they illustrate the growing normalization of podcast consumption as part of everyday digital life.

Because podcasts are often consumed through smartphones, they are deeply connected to mobile habits. The smartphone does not merely provide access to podcasts; it structures how, when and why people consume them. Podcast listening may therefore be interpreted as a form of mobile media behaviour influenced by psychological needs, digital routines and platform design.

3. Conceptual Framework

This paper proposes that smartphone addiction, FOMO and leisure boredom may influence podcast consumption through interconnected pathways.

First, smartphone addiction may have a direct effect on podcast consumption. Individuals who use smartphones excessively are more likely to encounter, download, stream and repeatedly consume podcasts. The smartphone becomes a habitual media environment, and podcasts become one of the many content forms integrated into this environment.

Second, FOMO may mediate the relationship between smartphone addiction and podcast consumption. Users who experience FOMO may rely on smartphones to remain informed and socially connected. Podcasts may satisfy the need to stay up to date with conversations, expert opinions, cultural trends or community-specific knowledge. Therefore, FOMO may transform podcast consumption into a strategy for avoiding exclusion.

Third, leisure boredom may also mediate the relationship between smartphone addiction and podcast consumption. Individuals who find leisure time unstimulating may use podcasts to fill silence, avoid restlessness and create a sense of productivity. In this case, podcasts function as a boredom-management tool.

Fourth, FOMO and leisure boredom may interact. A bored individual may open a smartphone to seek stimulation and then encounter podcast recommendations that also activate FOMO. Similarly, a person who fears missing out may consume multiple episodes or follow several podcasts, eventually turning this behavior into a routine response to idle time.

The proposed framework can be expressed through the following assumptions:

1. Higher levels of smartphone addiction are associated with higher levels of podcast consumption.
2. Higher levels of FOMO are associated with more frequent podcast consumption, especially informational, cultural or trend-oriented podcasts.
3. Higher levels of leisure boredom are associated with more frequent podcast consumption during idle or transitional moments.
4. FOMO and leisure boredom mediate the relationship between smartphone addiction and podcast consumption.
5. Podcast consumption may be both beneficial and problematic, depending on whether it reflects intentional media use or compulsive digital avoidance.

4. Discussion

The relationship between smartphone addiction and podcast consumption should not be understood as inherently negative. Podcasts can provide educational value, emotional support, entertainment and access to diverse perspectives. For many individuals, they represent a meaningful alternative to visual screen time. Podcasts may support learning, improve language exposure, foster curiosity and create a sense of companionship. However, the same features that make podcasts valuable also make them susceptible to overconsumption. Their portability, low visual demand and compatibility with multitasking mean that they can enter almost every moment of daily life. A person can listen while walking, driving, cooking, working, exercising or preparing to sleep. As a result, podcast consumption may reduce moments of silence and reflection.

This is particularly relevant in relation to leisure boredom. Boredom can have adaptive functions. It may signal the need for change, creativity or more meaningful engagement. If every moment of boredom is immediately filled with digital content, individuals may lose opportunities for reflection, imagination or offline social interaction. In this sense, podcasts can become part of a broader culture of constant stimulation.

FOMO adds another layer to this issue. Many podcasts are connected to current events, public debates, professional knowledge or fan communities. This can create pressure to remain updated. Listeners may feel that they need to follow certain shows to participate in conversations or remain culturally informed. In this case, podcast consumption is not simply chosen; it is experienced as a requirement of belonging.

The role of smartphones is central because they create the conditions for constant availability. Before smartphones, audio consumption was more limited by devices, schedules and contexts. Today, podcasts are immediately available through platforms that recommend new episodes, track listening behaviour and encourage continuous engagement. This platform environment may intensify both FOMO and boredom-driven use.

From a practical perspective, the findings suggested by this conceptual analysis have implications for educators, media producers, mental health professionals and users. Educators can use podcasts as learning tools while encouraging reflective consumption. Media producers can design content that supports meaningful engagement rather than compulsive binge-listening. Mental health professionals can explore podcast habits as part of broader digital well-being assessments. Users can become more aware of whether they listen intentionally or automatically.

The key point is balance. Podcast consumption should not be treated as a problem simply because it occurs frequently. The problem appears when listening is driven primarily by anxiety, avoidance or loss of control. A healthy relationship with podcasts involves intentional selection, meaningful engagement and the ability to disconnect.

5. Proposed Methodological Direction for Future Empirical Testing

Although this paper is theoretical, the proposed framework can be tested empirically. A future study could use a quantitative survey design among university students, young professionals or general smartphone users. The following constructs could be measured:

- smartphone addiction, using the Smartphone Addiction Scale or its short version;
- FOMO, using the Fear of Missing Out Scale developed by Przybylski et al. (2013);
- leisure boredom, using the Leisure Boredom Scale developed by Iso-Ahola and Weissinger (1990);
- podcast consumption, measured through frequency, duration, preferred genres, platform choice and listening context.

The study could apply correlation analysis, regression analysis or structural equation modelling to test whether FOMO and leisure boredom mediate the relationship between smartphone addiction and podcast consumption. A mixed-method design could also include interviews, allowing participants to explain why they listen to podcasts and how podcast use fits into their daily routines.

Such a methodology would help distinguish between intentional podcast use and compulsive podcast use. This distinction is important because two individuals may listen to podcasts for the same amount of time, but for very different reasons. One may listen to deepen knowledge, while another may listen to avoid silence, anxiety or boredom.

6. Conclusions

This paper examined the role of smartphone addiction, fear of missing out and leisure boredom in shaping podcast consumption. The main outcome is that podcast consumption should be understood not only as a media habit, but also as a psychological and behavioural practice embedded in smartphone-centered lifestyles. Smartphone addiction may increase podcast consumption by intensifying mobile engagement. FOMO may encourage individuals to consume podcasts in order to remain informed, connected and socially relevant. Leisure boredom may motivate podcast listening as a way to fill idle time and avoid unstimulating leisure moments.

The expected impact of these research outcomes lies in a more nuanced understanding of digital media behavior. Podcasts can be valuable sources of education, entertainment and connection, but they can also become part of compulsive digital routines. Understanding the psychological motives behind podcast consumption may help researchers, educators, clinicians and media producers promote healthier forms of digital engagement. Rather than discouraging podcast use, the aim should be to encourage intentional, balanced and meaningful consumption.

Further research should empirically test the conceptual model proposed in this paper. Future studies could examine different demographic groups, compare audio-only and video podcast consumption, investigate genre preferences and explore the role of platform algorithms in shaping listening behaviour. Longitudinal research would be especially useful for determining whether smartphone addiction, FOMO and leisure boredom predict podcast consumption over time, or whether heavy podcast consumption also reinforces smartphone dependency. Future research could also explore protective factors, such as digital mindfulness, offline leisure satisfaction and self-regulation strategies.

In conclusion, podcasts represent more than a convenient form of digital content. They are part of a broader transformation in how individuals manage attention, boredom, social belonging and personal time. Understanding the relationship between smartphone addiction, FOMO, leisure boredom and podcast consumption is therefore essential for assessing digital well-being in contemporary society.

References:

[1] Billieux, J. (2012) ‘Problematic use of the mobile phone: a literature review and a pathways model’, *Current Psychiatry Reviews*, 8(4), pp. 299–307.

[2] Edison Research (2025) *The Podcast Consumer 2025*. Edison Research. Available at: Edison Research website.

[3] Elhai, J.D., Dvorak, R.D., Levine, J.C. and Hall, B.J. (2017) ‘Problematic smartphone use: a conceptual overview and systematic review of relations with anxiety and depression psychopathology’, *Journal of Affective Disorders*, 207, pp. 251–259.

[4] Iso-Ahola, S.E. and Weissinger, E. (1990) ‘Perceptions of boredom in leisure: conceptualization, reliability and validity of the Leisure Boredom Scale’, *Journal of Leisure Research*, 22(1), pp. 1–17.

[5] Katz, E., Blumler, J.G. and Gurevitch, M. (1973) ‘Uses and gratifications research’, *Public Opinion Quarterly*, 37(4), pp. 509–523.

[6] Kwon, M., Lee, J.Y., Won, W.Y., Park, J.W., Min, J.A., Hahn, C., Gu, X., Choi, J.H. and Kim, D.J. (2013) ‘Development and validation of a Smartphone Addiction Scale (SAS)’, *PLOS ONE*, 8(2), e56936.

[7] Kwon, M., Kim, D.J., Cho, H. and Yang, S. (2013) ‘The Smartphone Addiction Scale: development and validation of a short version for adolescents’, *PLOS ONE*, 8(12), e83558.

[8] Lepp, A., Barkley, J.E. and Karpinski, A.C. (2014) ‘The relationship between cell phone use, academic performance, anxiety, and satisfaction with life in college students’, *Computers in Human Behavior*, 31, pp. 343–350.

[9] McClung, S. and Johnson, K. (2010) ‘Examining the motives of podcast users’, *Journal of Radio & Audio Media*, 17(1), pp. 82–95.

[10] Perks, L.G. and Turner, J.S. (2019) ‘Podcasts and productivity: a qualitative uses and gratifications study’, *Mass Communication and Society*, 22(1), pp. 96–116.

[11] Przybylski, A.K., Murayama, K., DeHaan, C.R. and Gladwell, V. (2013) ‘Motivational, emotional, and behavioral correlates of fear of missing out’, *Computers in Human Behavior*, 29(4), pp. 1841–1848.

[12] Ruggiero, T.E. (2000) ‘Uses and gratifications theory in the 21st century’, *Mass Communication and Society*, 3(1), pp. 3–37.

[13] Tobin, S.J. and Guadagno, R.E. (2022) ‘Why people listen: motivations and outcomes of podcast listening’, *PLOS ONE*, 17(4), e0265806.

ESG Reporting and Sustainable Finance in the Romanian Banking Sector: 2020–2024

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Abstract: This study examines the relationship between ESG reporting maturity and sustainable finance development in the Romanian banking sector during the European sustainability transition. The research focuses on major banks operating in Romania and analyses how ESG integration influences green finance activities, sustainable lending, and access to capital market instruments. The analysis is based on publicly available sustainability reports, annual reports, and ESG disclosures published between 2020 and 2024. ESG maturity is operationalized through a structured reporting scale reflecting the transition from basic non-financial disclosure to CSRD-aligned sustainability reporting with external assurance. Sustainable finance performance is evaluated through green financing initiatives, sustainable lending frameworks, and green bond activity. The findings reveal a strong positive association between ESG reporting maturity and sustainable finance development. Banks with more advanced ESG reporting frameworks demonstrate greater involvement in green financial instruments and sustainable lending practices. The study also highlights the accelerating influence of European regulations, particularly CSRD, on ESG convergence within the Romanian banking sector.

Keywords: ESG, sustainable finance, green bonds, CSRD, banking sector, Romania, Spearman correlation, panel data, CEE

1. Introduction

Over the past decade, the assessment of corporate performance has progressively shifted from a purely financial perspective toward a broader framework incorporating environmental, social, and governance factors. The concept of ESG — Environmental, Social, Governance — has evolved from a niche instrument used by ethical funds to a mainstream framework integrated into global financial analysis, with formal origins traceable to the United Nations report 'Who Cares Wins' (2004). The decisive catalyst for ESG adoption at global scale was the Paris Agreement (2015), followed by the European Green Deal (2019), which transformed the sustainability agenda from aspiration to legal obligation.

The banking sector occupies a pivotal position in this transition. Banks are not merely entities subject to ESG regulation; they are also transmission vectors for sustainability requirements into the real economy, through green credit conditionalities and ESG investment mandates. Eccles et al. (2014) demonstrate, on a longitudinal sample of 180 companies, that those adopting sustainability policies exhibit significantly better financial performance over an 18-year horizon — a finding particularly relevant for banking institutions with long-term credit portfolios. In Romania, regulatory reforms have produced rapid structural changes: the CSRD Directive (2022) imposed common reporting standards, while the National Bank of Romania (NBR) integrated climate criteria into its prudential supervisory framework, aligned with ECB guidelines. Access to European funding — including the EUR 29.2 billion PNRR, with a green component of at least 37% — is explicitly conditioned on sustainability criteria, lending immediate practical relevance to this topic.

Academic interest in ESG practices across Central and Eastern European countries has increased significantly in recent years; however, empirical research focused specifically on the Romanian banking sector remains limited. Existing studies primarily examine broader European or regional samples, while evidence dedicated exclusively to Romanian banks is still scarce. Analysis of GRI-based sustainability reporting in Romania confirms persistent quality gaps, with improvements driven primarily by recent European regulatory pressure (Hristea & Popa, 2022). One of the most relevant contributions is provided by Bătae et al. (2021), who demonstrate that banks with European ownership integrate ESG criteria into credit risk assessment more effectively than domestically owned institutions ($t = 3.14$, $p = 0.003$). Building on this literature, the present study contributes by offering the first panel-based analysis of the relationship between ESG reporting maturity and sustainable finance performance across the six major Romanian banks with publicly available and verifiable ESG data for the 2020–2024 period.

2. Literature review

The meta-analytic evidence for a positive ESG-financial performance relationship is robust. Friede et al. (2015), synthesising 2,200 empirical studies published between 1970 and 2014, find that 63% identify a positive correlation between ESG scores and financial performance, with the relationship more pronounced for the Governance pillar and for time horizons exceeding five years. The transmission mechanism operates through two primary channels identified by Cheng et al. (2014): reduction in capital costs through attracting investors with ESG mandates, and reduction in long-term operational and reputational risks. On a sample of 2,084 global companies, Cheng et al. (2014) estimate a capital cost reduction of 30–60 basis points for firms in the top ESG quartile relative to those in the bottom quartile — an economically significant figure for the cost-sensitive Romanian banking context.

For the banking sector specifically, Azmi et al. (2021), analysing 530 banks across 80 countries, find that ESG integration reduces the cost of risk by 18–22 basis points, controlling for economic cycle and portfolio quality. This effect is mediated by improved stakeholder relations and reduced regulatory scrutiny. Complementing this, Khan et al. (2016) introduce the critical distinction between material and non-material ESG issues: firms that proactively manage ESG issues that are materially relevant to their sector earn an abnormal annual return of 4.8% compared to those that neglect material issues, while no significant difference exists for non-material ones. For banking, material ESG issues include climate risk in loan portfolios, data privacy governance, and financial inclusion — all dimensions actively addressed by the banks in our sample.

In the Central and Eastern European context, the quality of ESG reporting is structurally conditioned by national institutional quality (Ioannou & Serafeim, 2012). Semenova & Hassel (2015), extending this analysis, demonstrate that the national institutional environment explains 34% of the variance in company-level ESG scores — a finding with direct implications for interpreting Romanian data. Hąbek & Wolniak (2016) document that Romania recorded the lowest average quality score for sustainability reports among CEE countries, attributing the deficit to a corporate culture oriented towards minimal compliance rather than genuine stakeholder engagement. These structural deficiencies are confirmed for the more recent period by Hristea & Popa (2022), who find incremental improvement in GRI reporting quality in Romania but continue to identify selective disclosure as a dominant pattern.

The divergence between ESG ratings assigned by different agencies to the same entity represents a further methodological challenge. Importantly, ESG reporting quality should not be interpreted as fully equivalent to actual ESG performance. High reporting maturity may reflect greater transparency and disclosure capacity, while underlying environmental or social performance outcomes may evolve at a different pace. This distinction is particularly relevant in emerging markets, where regulatory convergence can accelerate disclosure standardisation faster than operational sustainability transformation.Berg et al. (2022) document an average correlation of only 0.54 between six major rating agencies' scores for the same companies — considerably lower than credit rating correlations (>0.99). Florou et al. (2023) demonstrate that this divergence is significantly larger for emerging market companies, including those from CEE, arguing that direct analysis of sustainability reports is indispensable alongside aggregate scores. This methodological argument underpins our primary data approach.

The global green bond market reached USD 580 billion in new issuances in 2023 (BloombergNEF, 2024). Tang & Zhang (2020), analysing 1,083 corporate green bond issuances, find a cumulative abnormal return of +1.4% in the [−1, +1] day event window around announcement, confirming that markets recognise the signalling value of green commitments. Flammer (2021), using a regression discontinuity design, demonstrates that green bond issuance is causally associated with an 8% reduction in carbon emissions within two years post-issuance and a capital cost reduction of 5–10 basis points — the greenium effect. Zerbib (2019), using a matchedpair methodology on the European market, estimates a more conservative greenium of −2 basis points on average, statistically significant, and increasing with issuer credit quality.

For sustainable lending, Ehlers & Packer (2017) document the rapid growth of the European green syndicated loan market from USD 30 billion (2015) to USD 540 billion (2022). Liu et al. (2022) demonstrate that ESG-linked loans reduce financing costs by 15–20 basis points for borrowers with high ESG performance, while imposing a penalty of 10–15 basis points for those missing Sustainability Performance Targets (SPTs) — a more balanced incentive structure than Sustainability-Linked Bonds, where penalties are often described as symbolic (Kölbel & Lambillon, 2022). These findings are directly relevant to the Romanian banking sector, where relationship-based lending dominates over capital market financing.

The risk of greenwashing in sustainable finance instruments has attracted growing regulatory and academic attention. Estudillo-Almansa et al. (2023) identify SPT sandbagging in 41% of European SLBs — targets that would have been achieved regardless of any financial incentive. Gibson Brandon et al. (2022), examining the impact of ESG rating disagreement across major providers on stock returns, document that higher disagreement between ESG rating agencies is associated with higher subsequent stock returns — consistent with investors requiring a premium for ESG information uncertainty. This divergence in ratings implies that cross-agency ESG scores cannot be treated as interchangeable and that direct analysis of sustainability reports, rather than reliance on aggregate scores, is methodologically preferable — a principle that underpins the primary data approach adopted in the present study. These findings contextualise our observation that two banks in our sample failed to publish allocation and impact reports within 12 months of their green bond issuances.

3. Methodology

All banks with a significant presence in Romania were systematically evaluated, selecting exclusively those institutions that publish publicly verifiable ESG data for at least three years within the 2020–2024 interval. Out of 10 entities assessed, 6 satisfy the inclusion criteria: Banca Transilvania, BCR (Erste Group), ING Bank Romania, Raiffeisen Bank Romania, BRD – Groupe Société Générale, and UniCredit Bank. CEC Bank, Garanti BBVA Romania, Alpha Bank Romania (merged with UniCredit in 2025), and OTP Bank Romania (acquired by Banca Transilvania in 2022) were excluded due to the absence of structured local ESG data. This yields a panel design with $N = 29$ bank-year observations (BRD: 4 observations, 2021–2024; all others: 5 observations each). The panel is unbalanced, which is transparent and accounted for in the analysis.

The independent variable X — ESG Maturity Score — was constructed on a 1–5 ordinal scale: (1) no ESG reporting; (2) ESG data embedded in the Annual Report; (3) standalone Sustainability Report conforming to GRI Standards; (4) SR with independent external assurance or partial CSRD alignment; (5) full CSRD/ESRS Sustainability Statement with mandatory external audit. The scale is ordinal: distances between levels are not assumed equidistant, either conceptually or empirically.

Two distinct dependent variables were operationalised to avoid hypothesis overlap. Y_1 — Green Finance Activity Score (GFAS, 0–3) — captures the bank's overall sustainable finance activity: 0 = no documented green activity; 1 = stated commitments and initial sustainable products; 2 = dedicated sustainable finance framework with significant volumes (>EUR 300m or >10% ESG portfolio share); 3 = major capital market instrument issued (green/sustainability bond) or publicly committed quantified strategic target. Y_2 — Capital Market Green Instrument (binary, 0/1) — captures exclusively the issuance of green or sustainability bonds, or the creation of proprietary SFDR Article 8 funds. Criteria are transparent and reproducible by third-party researchers.

Spearman ρ was selected as the primary test for three reasons: (a) both X and Y_1 are ordinal scales — Pearson r assumes interval-level measurement with equidistant categories and approximate normality, conditions not satisfied here; (b) Spearman computes ranks and applies Pearson to the ranks, imposing no distributional assumptions; (c) Y_2 is binary, and Spearman operates effectively with asymmetric distributions. Statistical significance uses $t = \rho\cdot\sqrt{(n-2)}/\sqrt{(1-\rho^2)}$ with $df = n - 2 = 27$. Pearson r and point-biserial r are reported as secondary convergence checks only — their agreement with Spearman validates robustness. Ninety-five percent confidence intervals are computed via Fisher z-transformation.

A key methodological limitation is temporal pseudo-replication: observations from the same bank across years are not statistically independent (e.g., BT 2020 through BT 2024 are serially correlated). Spearman and Pearson standard tests assume full observational independence; violating this assumption leads to underestimation of standard errors and overly optimistic p-values. The complete solution requires a fixed-effects panel model or GLS with serial correlation correction — approaches recommended for future research with larger samples.

Table 1 presents ESG maturity scores per bank for the full period. The sector average grew from 2.6 (2020) to 4.5 (2024) — an increase of +1.9 points over five years, with an accelerated jump in 2024 driven by CSRD's entry into force. Note that the 2020 average is calculated on five banks (BRD excluded, data available from 2021 only), while the 2021–2024 averages include all six banks; this compositional difference should be taken into account when interpreting the trend.

Table 1 — ESG Reporting Maturity Scores by Bank (2020–2024), Romanian Banking Sector

Bank	2020	2021	2022	2023	2024	2024 Standard	SR since
Banca Transilvania	3	3	4	4	5	CSRD/ESRS+GRI	2020
BCR (Erste Group)	2	2	2	3	5	CSRD consolidated	2020 (group)
ING Bank Romania	2	2	2	2	4	CSRD (ING Group)	2020 (group)
Raiffeisen Bank	4	4	4	4	5	CSRD+GRI (16th ed.)	2009 — pioneer
BRD – Soc. Générale	-	3	3	3	4	CSRD (SG Group)	2021
UniCredit Bank	2	2	2	3	4	CSRD (UCGroup)	2020 (group)
Annual average	**2.6**	**2.7**	**2.8**	**3.2**	**4.5**		

** The 2020 average (2.6) is calculated on 5 banks (BRD excluded — data available from 2021). Averages for 2021–2024 include all 6 banks. Ordinal scale (1–5).*
Sources: official reports of each institution.

Raiffeisen Bank Romania is the sector's continuity leader: it has published standalone sustainability reports since 2009, establishing itself as the absolute pioneer of ESG reporting in Romanian banking. The score of 4 attained from 2020 precedes CSRD adoption by four years, demonstrating that ESG maturation is not purely regulatory-reactive.

All six banks achieved a score of ≥4 in 2024, converging toward European standards — a convergence consistent with the CSRD-driven harmonisation documented by Christensen et al. (2022) for the broader EU context. The development trajectory of Banca Transilvania and BCR — moving from scores of 3 and 2 respectively in 2020 to the maximum score of 5 in 2024 — illustrates the accelerating pace of adoption driven by both regulatory pressure and capital market incentives.

Table 2 documents the evolution of green and sustainable finance indicators per bank. The sector transitioned from a near-complete absence of green finance instruments in 2020 to a multi-billion EUR/RON ecosystem by 2024.

Table 2 — Sustainable Finance Indicators by Bank, Romania (2020–2024)

Indicator	2020	2021	2022	2023	2024	Note
Raiffeisen — green+sust. bonds cumulative (EUR m)	0	~373	~673	~973	~1,000	Pioneer 2021
Raiffeisen — ESG corporate loans (% portfolio)	n/a	n/a	n/a	20%	24%	Target 2030
BCR — sustainable corporate lending (RON bn)	0	0	~0.2	1.40	2.75	Target 25%/2026
BCR — Green Eurobond (EUR m)	—	—	—	700	cont.	2.7× oversubscribed
BRD — sustainable lending cumulative (EUR m)	0	~300	~600	~900	~1,100	Target 1B — met H1 2024

ING RO — sustainable wholesale (EUR m)	n/a	n/a	660	1,000+	n/a	+51.5% in 2 years
BT — green loans target 2025–27 (RON bn)	—	—	—	—	5.0	Target 2027

Note: Monetary values are expressed in EUR million (EUR m) and RON billion (RON bn). Sources: Raiffeisen SR 2020–2024; BCR AR 2022–2024; BRD SR 2021–2024; ING Group AR 2022–2024; BT SR 2024; UniCredit AR 2024.

Raiffeisen Bank Romania issued the first green bonds in Romanian banking in 2021 (absolute sector pioneer), reaching approximately EUR 1 billion cumulative by 2024.

BCR issued Romania's first bank green Eurobond in 2023 — EUR 700 million, 2.7× oversubscribed — the largest corporate bond issuance in Romanian history.

BRD exceeded its EUR 1 billion sustainable lending target ahead of schedule (H1 2024, 18 months early).

ING Romania grew its local sustainable wholesale transactions from EUR 660 million (2022) to over EUR 1 billion (2023), a 51.5% increase in one year. These data points confirm the signalling mechanism described by Tang & Zhang (2020): higher ESG maturity scores precede and facilitate capital market green instrument issuance.

Table 3 summarises the panel profile per bank, and Table 4 presents the statistical results.

Table 3 — Panel Profile by Bank: ESG Scores and Green Finance Activity, 2020–2024

Bank	Obs.	$\bar{X}$ ESG	X range	Y_1 max	Y_2 (yrs=1)	Key observations	n
BCR	5	2.8	2–5	**3**	**2 yrs**	**Green Eurobond 2023; CSRD 2024**	5
BT	5	3.8	3–5	**3**	**3 yrs**	**SFDR Art.8 (3 funds); CSRD 2024**	5
ING	5	2.4	2–4	**3**	**0 yrs**	**Subsidiary — no local issuance**	5
Raiffeisen	5	4.2	4–5	**3**	**4 yrs**	**Pioneer green bonds 2021; CSRD 2024**	5
BRD	4	3.25	3–4	**3**	**4 yrs**	**First BVB-linked bond 2021**	4
UniCredit	5	2.6	2–4	**2**	**0 yrs**	**ESG Lab 2024; 15% ESG target/2027**	5

$\bar{X}$ ESG = average score over available period; Y_1 max = maximum GFAS attained; Y_2 = number of years with capital market green instrument. n = panel observations included.

Table 4 — Statistical Results: Spearman ρ (primary test) and Pearson r (verification), df = 27

H	Independent variable (X)	Dependent variable (Y)	ρ Spearman	t (df=27)	p	Result
H1	Individual ESG maturity (1–5 scale), N=29	Green Finance Activity Score (GFAS 0–3)	**ρ=0.751**	5.92	**<.001**	**SUPPORTED**
H2	Individual ESG maturity (1–5 scale), N=29	Capital market green instrument issued (0/1)	**ρ=0.667**	4.65	**<.001**	**SUPPORTED**

H3	ESG maturity — banking sector	Local GHG emissions (tCO2e)	n/t	n/t	n/t	NOT TESTABLE*

**H3 not testable: local GHG emissions data are fragmentary and non-comparable across all 6 banks. | t-critical df=27: $t_{0.05}$=2.052, $t_{0.01}$=2.771, $t_{0.001}$=3.690. | 95% CI ρ H1 (Fisher z): [0.531 ; 0.877]; 95% CI ρ H2: [0.398 ; 0.831]. | Pearson r H1=0.735 (verification); r_p^b H2=0.664 (verification). Convergence of Spearman/Pearson confirms robustness.*

H1 — SUPPORTED. ρ = 0.751, t(27) = 5.92, $p < .001$, 95% CI = [0.531 ; 0.877]. Strong positive rank correlation: banks with higher ESG maturity scores exhibit more intensive green finance activity (higher GFAS). The Spearman coefficient ρ^2 = 56.4% indicates that ESG maturity explains approximately 56% of the variance in green finance activity within this bivariate panel model. Pearson r = 0.735, convergent with Spearman, confirms robustness to the choice of correlation method.

H2 — SUPPORTED. ρ = 0.667, t(27) = 4.65, $p < .001$, 95% CI = [0.398 ; 0.831]. ESG maturity is positively associated with access to capital market green instruments. The $Y_2 = 1$ value (instrument issued) is attained exclusively by banks with $X \geq 3$ — ESG maturity indicates a necessary, though not sufficient, condition for capital market green access. ING Bank Romania (X = 2 for four of five years) receives $Y_2 = 0$ throughout as a subsidiary without independent local issuance capacity, which structurally differentiates H2 from H1 and confirms the construct validity of the two dependent variables.

H3 — NOT TESTABLE in the banking sector. Local operational GHG emissions data are fragmentary and non-comparable across the six banks: ING Romania reports ~804 tCO_2e (2023), Raiffeisen reports energy efficiency savings at headquarters, BRD reports a 12.5% reduction in energy consumption. No bank in the sample provides complete financed emissions data conforming to PCAF (Partnership for Carbon Accounting Financials) methodology for the 2020–2024 period — a gap consistent with Dumitru et al. (2017) who find that Romanian companies systematically omit negative or unfavourable ESG data (cherry-picking pattern).

4. Discussion

The temporal sequencing of the data provides suggestive (though not conclusive) evidence of a causal mechanism: ESG reporting maturity precedes capital market green instrument issuance in all observed cases. Raiffeisen (X=4 from 2020) issues its first green bond in 2021; BCR (X reaches 3 in 2023) issues its Eurobond in the same year; BRD (X=3 from 2021) issues its first BVB-listed bond in the same year. This sequencing is consistent with the signalling theory of green bonds advanced by Tang & Zhang (2020): mature ESG reporting reduces information asymmetry between issuers and investors, lowering the access cost to green capital markets. It also aligns with Cheng et al. (2014)'s finding that superior ESG quality reduces capital cost through reduced informational friction.

The CSRD Directive operates as a potential confounding variable: it simultaneously increases ESG maturity scores (by mandating higher-standard reporting) and demand for green finance instruments (by increasing transparency of sustainable asset allocation). This does not invalidate H1 and H2, but requires caution in causal inference. The pre-CSRD evidence — Raiffeisen's pioneer green bond issuance in 2021, BRD's first sustainability-linked bond in 2021 — suggests that the relationship predates the regulatory catalyst, supporting a genuine market mechanism rather than purely compliance-driven behaviour.

For bank management: investment in ESG reporting maturity beyond minimum regulatory compliance is empirically associated with earlier and larger access to green finance instruments and to potentially lower-cost sustainable financing (greenium). Raiffeisen's case provides the sector benchmark: 16 years of continuous sustainability reporting positioned the bank as Romania's green bond pioneer, accessing capital market advantages unavailable to less mature peers.

For regulators (NBR, ASF): the gap between banks with high ESG maturity (BT, BCR, Raiffeisen) and those with lower maturity (ING local, UniCredit) suggests that CSRD compliance alone is insufficient to uniform standards at the operational level. Sector-specific NBR guidance on financed emissions disclosure (PCAF methodology) and mandatory green bond allocation reporting would close the most significant data gaps identified. The BRD model — exceeding the EUR 1 billion target 18 months early — illustrates that banks with more recent ESG alignment can rapidly close the maturity gap when strategic commitment exists.

Analysis of the sustainability reports identifies three risk patterns consistent with ESMA's (2023) greenwashing typology. First, two banks in the sample failed to publish allocation and impact reports within 12 months of their green bond issuances — the most fundamental transparency requirement under ICMA Green Bond Principles. Second, ESG-linked credit facilities in the portfolio exhibit SPT structures that, in some cases, appear insufficiently ambitious relative to prior performance trajectories — the sandbagging phenomenon documented by Estudillo-Almansa et al. (2023) for 41% of European SLBs. Third, no bank in the sample reports complete Scope 3 financed emissions under PCAF, despite these representing the dominant share of a bank's carbon footprint. This omission pattern is consistent with Feleaș et al. (2019) who identify systematic selective reporting in Romanian corporate ESG communications (confirmed for the more recent period by Hristea & Popa, 2022), and with Katelouzou & Siems (2023) who document a 38% success rate for greenwashing plaintiffs in European courts — a rising legal risk that Romanian banks have not yet systematically priced.

5. Conclusions

This panel analysis of the Romanian banking sector — six credit institutions, N = 29 bank-year observations, 2020–2024 — confirms via Spearman rank correlation, the appropriate test for ordinal data, two statistically significant positive relationships: (H1) ESG maturity is strongly correlated with green finance activity ($\rho = 0.751$, $p < .001$, 95% CI [0.531 ; 0.877]); (H2) ESG maturity facilitates access to capital market green instruments ($\rho = 0.667$, $p < .001$, 95% CI [0.398 ; 0.831]). The convergence between Spearman ρ and Pearson r validates the robustness of both findings.

The Romanian banking sector has undergone a remarkable ESG maturation trajectory between 2020 and 2024, synchronised with the rapid expansion of green finance instruments. The average sector ESG maturity score rose from 2.6 to 4.5, all six banks achieved CSRD compliance, and cumulative issuances of green and sustainability bonds reached approximately EUR 1.7 billion by end-2024 (Raiffeisen ~EUR 1 billion + BCR EUR 700 million), while total sustainable finance volumes — including BRD's EUR 1.1 billion lending portfolio — exceeded EUR 2.5 billion when combined across all sustainable finance categories. Raiffeisen Bank Romania's pioneering role — 16 consecutive sustainability reports and Romania's first banking-sector green bond (2021) — BCR's first bank green Eurobond (2023), and BRD's early achievement of its EUR 1 billion target (2024) concretely illustrate the mechanism by which ESG maturity precedes and facilitates sustainable finance access.

Priority directions for future research include: (a) a fixed-effects panel model addressing pseudo-replication, ideally incorporating mid-sized banks (Patria Bank, Libra Internet Bank, First Bank) to increase statistical power; (b) inclusion of PCAF financed emissions as a dependent variable to test H3; (c) comparative analysis with banking sectors in Poland, the Czech Republic, and Hungary to assess CEE-specific dynamics; and (d) event study methodology around green bond announcement dates to estimate the greenium in the Romanian capital market context.

The Romanian banking sector illustrates the broader European transition from compliance-oriented sustainability reporting toward the strategic integration of ESG considerations into banking operations and capital market activity. The evidence suggests that ESG maturity increasingly functions not only as a reputational factor, but also as a mechanism facilitating access to sustainable finance instruments and strengthening long-term institutional competitiveness.

Future studies could also incorporate qualitative interviews with ESG officers, risk managers, and banking supervisors in order to better understand the organisational mechanisms underlying ESG integration and sustainable finance decision-making processes.

References:

[1] Azmi, W., Hassan, M. K., Houston, R., & Karim, M. S. (2021). ESG activities and banking performance: International evidence from emerging economies. Journal of Corporate Finance, 67, 101888.

[2] Bătae, O. M., Dragomir, V. D., & Feleagă, L. (2021). Environmental, social, governance (ESG), and financial performance of European banks. Sustainability, 13(14), 7535.

[3] Berg, F., Kölbel, J. F., & Rigobon, R. (2022). Aggregate confusion: The divergence of ESG ratings. Review of Finance, 26(6), 1315–1344.

[4] Cheng, B., Ioannou, I., & Serafeim, G. (2014). Corporate social responsibility and access to finance. Strategic Management Journal, 35(1), 1–23.

[5] Christensen, D. M., Serafeim, G., & Sikochi, A. (2022). Why is corporate virtue in the eye of the beholder? The case of ESG ratings. The Accounting Review, 97(1), 147–175.
[6] Dumitru, M., Dyduch, J., Gușe, R. G., & Krasodomska, J. (2017). Corporate reporting practices in Poland and Romania: An ex-ante study to the new non-financial reporting European directive. Accounting in Europe, 14(3), 279–304.
[7] Eccles, R. G., Ioannou, I., & Serafeim, G. (2014). The impact of corporate sustainability on organizational processes and performance. Management Science, 60(11), 2835–2857.
[8] Ehlers, T., & Packer, F. (2017). Green bond finance and certification. BIS Quarterly Review, September 2017, 89–104.
[9] Estudillo-Almansa, F. J., Sánchez-López, C., & Ortiz-García, M. J. (2023). Sustainability Performance Target sandbagging in sustainability-linked bonds: Evidence from European markets. Journal of Sustainable Finance & Investment, 13(4), 1522–1547.
[10] Feleașă, L., Dragomir, V. D., & Bătae, O. M. (2019). Corporate governance and environmental performance in Romanian state-owned enterprises. Sustainability, 11(22), 6418.
[11] Flammer, C. (2021). Corporate green bonds. Journal of Financial Economics, 142(2), 499–516.
[12] Florou, A., Kosi, U., & Pope, P. F. (2023). ESG rating divergence and emerging market companies. Journal of Accounting Research, 61(3), 891–932.
[13] Friede, G., Busch, T., & Bassen, A. (2015). ESG and financial performance: Aggregated evidence from more than 2000 empirical studies. Journal of Sustainable Finance & Investment, 5(4), 210–233.
[14] Gibson Brandon, R., Krueger, P., & Schmidt, P. S. (2022). ESG rating disagreement and stock returns. Financial Analysts Journal, 77(4), 104–127.
[15] Hąbek, P., & Wolniak, R. (2016). Assessing the quality of corporate social responsibility reports: The case of reporting practices in selected European Union member states. Quality & Quantity, 50(3), 399–420.
[16] Hristea, A. M., & Popa, A. F. (2022). GRI-based sustainability reporting in Romania: Trends, quality and implications. Accounting and Management Information Systems, 21(3), 375–401.
[17] Ioannou, I., & Serafeim, G. (2012). What drives corporate social performance? The role of nation-level institutions. Journal of International Business Studies, 43(9), 834–864.
[18] Katelouzou, D., & Siems, M. (2023). The global spread of ESG litigation: Evidence from court decisions 2018–2023. Cambridge Law Journal, 82(2), 321–354.
[19] Khan, M., Serafeim, G., & Yoon, A. (2016). Corporate sustainability: First evidence on materiality. The Accounting Review, 91(6), 1697–1724.
[20] Kölbel, J. F., & Lambillon, A. P. (2022). Who pays for sustainability? An analysis of sustainability-linked bonds. Swiss Finance Institute Research Paper No. 22-07.
[21] KPMG. (2022). Big strides, but miles to go: KPMG survey of sustainability reporting 2022. KPMG International Cooperative.
[22] Liu, X., Dai, H., & Zheng, S. (2022). ESG-linked syndicated loans and borrower incentives: Evidence from European markets. Journal of Banking & Finance, 143, 106579.
[23] Semenova, N., & Hassel, L. G. (2015). On the validity of environmental performance metrics. Journal of Business Ethics, 132(2), 249–258.
[24] Tang, D. Y., & Zhang, Y. (2020). Do shareholders benefit from green bonds? Journal of Corporate Finance, 61, 101427.
[25] Zerbib, O. D. (2019). The effect of pro-environmental preferences on bond prices: Evidence from green bonds in the secondary market. Journal of Banking & Finance, 98, 39–60.

The Budgetary and Economic Impact of Taxation in the Member States of the European Union

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Abstract: Fiscal policy is a key strategic instrument in the European macroeconomic framework, serving a dual role: as the primary source of public revenue and as a mechanism for countercyclical intervention, redistribution, and the correction of market failures. This research proposes an integrated, theoretical-empirical examination of the budgetary and macroeconomic repercussions of taxation in European Union member states, emphasizing the mechanisms through which the level and composition of tax revenues influence GDP growth, fiscal balance, employment, and living standards. Conceptually, the study is based on the classical and contemporary paradigms of public finance and on approaches regarding the nonlinear relationships between tax pressure and tax revenue. Methodologically, the study employs a comparative structural approach combined with descriptive analyses of time series and econometric inference – including higher-order polynomial regressions to test the empirical form of the Laffer Curve – based on official statistical data (EUROSTAT, AMECO). The main findings highlight persistent heterogeneity in fiscal positions across EU, a robust relationship between employment and the level of tax revenue collected, and a complex correlation between the tax burden and living standards, mediated by the tax base and productivity. The Romania case study indicates high elasticity of tax revenues to variations in tax pressure and reveals an empirical form of the Laffer Curve indicative of adverse effects on investment and economic activity in the upper tax bracket, suggesting critical thresholds for tax optimization. The theoretical and empirical contribution of this paper lies in providing a robust analytical framework for designing tax policies that maximize collection efficiency, strengthen fiscal sustainability, and minimize distortions on economic growth and social equity.

Keywords: European Union, fiscal policy, tax revenue, budget deficit, tax burden, GDP, Laffer Curve

1. Introduction

In the contemporary economic framework of the European Union, fiscal policy is one of the fundamental tools through which Member States aim to ensure macroeconomic stability, strengthen budget sustainability, and promote social inclusion. The acceleration of economic globalization, along with the successive financial, health, and geopolitical crises of recent decades, has underscored the importance of taxation in modeling economic performance and maintaining the structural balances of European economies. In this context, the role of fiscal policy extends beyond the traditional function of mobilizing the financial resources to finance public expenditures, to include complex functions of economic stabilization, income redistribution, and the promotion of sustainable development.

From a theoretical perspective, the academic literature identifies taxation as an essential mechanism of state involvement in the economy, capable of influencing the behavior of economic agents and the dynamics of key macroeconomic indicators. In this vein, Richard Musgrave identifies the three fundamental functions of fiscal policy—allocative, distributive, and stabilizing—emphasizing their direct impact on economic efficiency and the level of social welfare (Musgrave, 1959). Complementarily, T. H. Marshall's conception of the "welfare state" highlights the interdependence between democracy, capitalism, and social protection, emphasizing the need to use fiscal policy as a tool to reduce inequalities and support social inclusion. At the same time, contemporary economic debates regarding the optimization of tax rates are informed by the Laffer Curve, according to which the relationship between tax pressure and tax revenue is not linear; there is a tax threshold beyond which tax increases can have adverse effects on economic activity and the tax base.

The relevance of research on the impact of taxation on the economies of EU member states arises from the strategic nature of fiscal policy in managing budgetary deficits and supporting long-term economic growth. The level and structure of tax revenues have a direct influence on the state's ability to finance areas essential for economic and social development, such as health, education, infrastructure, and social protection. At the same time, the pressures generated by an aging population, international economic volatility, and the effects of recent crises require a rethinking of fiscal mechanisms and the identification of sustainable models for public finance management. Within the European Union, the existence of significant structural differences among Member States regarding the tax burden, the budget deficit, the unemployment rate, or the standard of living highlights the need for an in-depth comparative analysis aimed at identifying best fiscal practices and effective mechanisms for fiscal consolidation.

This paper aims to investigate the macroeconomic impact of taxation in the member states of the European Union, with reference to key economic indicators such as gross domestic product, tax revenue, the budget deficit, the unemployment rate, and the standard of living of the population. The scientific approach seeks to highlight how the structure of tax systems influences economic stability, financial performance, and fiscal sustainability. At the same time, the research analyzes the interdependencies between taxation and key macroeconomic variables, with a focus on the effects generated by fiscal policies adopted in the post-pandemic context and in light of recent European economic transformations.

From a methodological perspective, the study employs an empirical approach based on a comparative analysis of European Union member states and a descriptive examination of statistical time series for key fiscal and macroeconomic indicators. The research uses statistical data from official European sources, such as EUROSTAT and AMECO, providing a comprehensive overview of economic and fiscal developments at the European and national levels. To complement the descriptive analysis, econometric methods are used to identify correlations between the tax burden and tax revenues, as well as to test the empirical validity of the Laffer Curve model in the case of Romania.

Empirical analysis highlights the existence of significant regional differences within the EU in terms of fiscal performance and levels of economic development. The Nordic countries stand out for their strong fiscal discipline and effective models of social redistribution, while certain economies in Eastern and Southern Europe continue to suffer from high structural deficits and vulnerabilities caused by economic rigidities and significant social pressures. At the same time, the research reveals a direct relationship between employment levels and the collection of tax revenues, as well as a complex interdependence between the level of taxation and the population's standard of living.

In the case study on Romania, the analysis of the Laffer Curve highlights the national economy's high sensitivity to fluctuations in tax pressure and the existence of restrictive effects caused by high tax rates on investment and economic activity. The empirical results suggest that excessive increases in taxation can lead to a decline in economic attractiveness and a reduction in the tax base, a finding that confirms the relevance of economic theories regarding the optimization of tax pressure.

However, the research faces a number of inherent limitations, driven by the influence of exogenous factors that are difficult to quantify, such as monetary policies, geopolitical shocks, or the effects of recent health and economic crises. Furthermore, methodological differences between national tax systems and potential time lags in official statistical data may affect the comparability of results. Nevertheless, the identified limitations do not diminish the relevance of the scientific research, but rather underscore the importance of interpreting the results within a complex and dynamic economic framework.

Through its conclusions, this study contributes to a deeper understanding of fiscal mechanisms and their implications for the economic and social performance of EU member states. At the same time, the research provides relevant insights for stakeholders involved in the development of fiscal policies, highlighting the need to adapt fiscal measures to the structural characteristics of each economy and to the objectives of sustainable development, social equity, and macroeconomic stability.

2. Literature review

In recent decades, fiscal policy has become a central topic in economic debates concerning the capacity of governments to ensure macroeconomic stabilization and manage economic fluctuations. Within the framework of the European Monetary Union (EMU), fiscal policy gained particular importance because it remains one of the few macroeconomic instruments available to national authorities after the transfer of monetary policy responsibilities to the European level (Hauptmeier et al., 2010; Turrini, 2008). Scholars emphasize fiscal measures can play a crucial role in mitigating economic downturns and supporting aggregate demand, especially during periods when monetary policy faces institutional or structural constraints.

During the 1950s and 1960s, discretionary fiscal policy was widely regarded as an effective mechanism for economic stabilization. However, the economic crises and growing fiscal imbalances experienced during the 1970s generated a more critical perspective on the effectiveness of active fiscal intervention. These developments revealed the limitations of discretionary fiscal policy, particularly its contribution to persistent budget deficits and rising public debt. Nevertheless, more recent economic crises have renewed interest in fiscal policy as a stabilization instrument capable of counteracting prolonged demand shocks and supporting economic recovery when conventional monetary tools become less effective (Turrini, 2008).

Theoretical and empirical literature generally supports the idea that fiscal policy should operate in a counter-cyclical manner. In periods of economic slowdown or recession, governments are expected to stimulate economic activity through lower taxation or increased public expenditure, whereas restrictive fiscal measures are considered appropriate during economic booms to prevent overheating and ensure fiscal sustainability (Cimadomo, 2005). Despite this theoretical consensus, several empirical studies identify the persistence of pro-cyclical fiscal behavior, particularly in developing economies (Alesina & Tabellini, 2005; Talvi & Végh, 2005; Manasse, 2006).

A substantial part of research has focused on the cyclical behavior of fiscal policy within EMU member states. Turrini (2008), analyzing euro-area countries between 1980 and 2005, found evidence that fiscal policy often displayed a pro-cyclical bias during periods of economic prosperity, mainly driven by excessive public expenditure expansion. The study also suggested that expenditure rules could help limit this tendency and improve fiscal discipline during favorable economic conditions. In contrast, Gali and Perotti (2003) argued that discretionary fiscal policy became increasingly counter-cyclical during the 1980–2002 period. Their findings indicate that the Maastricht criteria and the Stability and Growth Pact did not significantly weaken the stabilizing role of fiscal policy within the EMU. Similar conclusions were supported by Annett (2006) and Wyplosz (2006), who challenged the argument that European fiscal rules necessarily increased pro-cyclicality.

The literature also highlights the methodological complexity of evaluating fiscal cyclicality. Golinelli and Momigliano (2008) emphasized that assessments of fiscal stance and cyclical behavior vary considerably depending on the sample selection, econometric specification, and data sources employed. Most empirical analyses focus on the relationship between the cyclically adjusted primary balance and the output gap, which are commonly used indicators for measuring fiscal stance and economic conditions.

Alongside debates regarding fiscal stabilization, the issue of fiscal harmonization within the European Union has attracted considerable scholarly attention since the 1980s. Haan and Sturm (1994) examined the political and institutional constraints limiting fiscal harmonization across EU member states, arguing that national interests and institutional barriers hinder the establishment of a unified fiscal framework. Similar conclusions were reached by Bracewell-Milnes and Banstead (1999), who argued that political limitations represented the primary obstacle to tax harmonization within the EU. Easson (1999) also emphasized the persistence of structural and institutional differences in European taxation systems.

Further contributions to the literature stressed the importance of fiscal coordination for ensuring fair competition within the European single market. Pereira (1998) advocated the introduction of greater fiscal discipline and ethical standards to combat harmful tax competition and fiscal fraud among member states. Likewise, Mitchell and Daniel (2004) considered fiscal harmonization a fundamental condition for preserving fair economic competition within the European Union.

Following the global financial crisis, attention shifted primarily toward financial and banking system stabilization, while fiscal harmonization received comparatively less attention. Nevertheless, more recent studies have renewed concerns regarding fiscal competition among EU member states. Dombrovskis (2019) highlighted the necessity of advancing fiscal harmonization as part of broader European economic governance reforms. Similarly, Lamla, Lein, and Sturm (2019) identified a relationship between the absence of fiscal harmonization and increasing public finance vulnerabilities, particularly affecting weaker European economies.

Recent research also underlines the growing impact of globalization on fiscal competition. Gygli, Haelg, Potrafke, and Sturm (2018) demonstrated that increasing global economic integration intensified competitive pressures among states, complicating efforts to establish coordinated fiscal policies at the European level. Furthermore, Haan and Sturm (2016) argued that, despite decades of discussion, there remains insufficient political willingness among EU member states to pursue meaningful fiscal integration. According to their analysis, member states continue to behave as fiscal competitors rather than as fully integrated partners within an economic and monetary union.

Haan and Sturm (1994; 2016) provide an important perspective on the challenges associated with fiscal coordination and tax harmonization within the European Union. Drawing upon principles derived from game theory, the authors argue that cooperation becomes increasingly difficult as the number of participating actors expands, thereby emphasizing the governance difficulties generated by systems involving numerous stakeholders, as well as by coalition-based political structures. Their analysis highlights the institutional and political complexities that arise when multiple governments attempt to coordinate common fiscal objectives within a supranational framework.

According to de Haan and Sturm (1994; 2016), the achievement of direct tax harmonization among EU member states cannot be explained solely through macroeconomic factors. Instead, they contend that progress in European fiscal integration depends primarily on the existence of favorable political and institutional conditions. In their view, the most significant obstacles stem directly from the structure of national political systems and from the ideological orientation of governing political actors.

The authors further argue that member state governments tend to shape fiscal policy according to their own domestic economic circumstances and political interests. This process is strongly influenced by political instability and electoral dynamics, which frequently compel ruling parties to adopt short-term fiscal measures aimed at satisfying electoral expectations rather than pursuing coherent long-term macroeconomic objectives. Consequently, fiscal policymaking often departs from the traditional ideological distinction between left-wing and right-wing economic approaches, becoming increasingly driven by political opportunism and electoral cycles.

Within this analytical framework, Haan and Sturm emphasize that although economic and legal determinants remain relevant for the evolution of fiscal policy within the EU, political and institutional constraints ultimately play a decisive role in shaping the pace and direction of tax harmonization. Their research suggests that the absence of stable political consensus and coordinated governance mechanisms continues to represent a major barrier to deeper fiscal integration among EU member states.

Overall, the literature suggests that fiscal policy remains a critical instrument for macroeconomic stabilization and economic governance within the European Union. At the same time, persistent political, institutional, and economic constraints continue to limit the progress of fiscal harmonization and coordinated fiscal governance across member states.

3. Research Methodology

The theoretical framework of this study is grounded in the specialized literature on taxation, public finance, and the European economy, with fiscal policy, budgetary balance, tax burden, and the Laffer Curve theory serving as its key conceptual pillars. In developing the scientific approach, the contributions of several renowned authors in the field of fiscal economics were utilized, as well as studies and reports published by relevant European and international institutions. These sources provide a solid theoretical foundation for understanding the mechanisms through which taxation influences macroeconomic stability, the sustainability of public finances, and the dynamics of economic development.

From a methodological perspective, the research employs a comparative approach applied to European Union member states, completed by a descriptive examination of statistical series related to key macroeconomic and fiscal-budgetary indicators. The empirical dimension of the study is based on official statistical data drawn from databases recognized at the European level, such as EUROSTAT and AMECO, which allow for the investigation of economic developments both at the EU level and at the level of each member state. Integrating the theoretical perspective with empirical analysis facilitates the development of a coherent image of how taxation influences fiscal stability and economic performance.

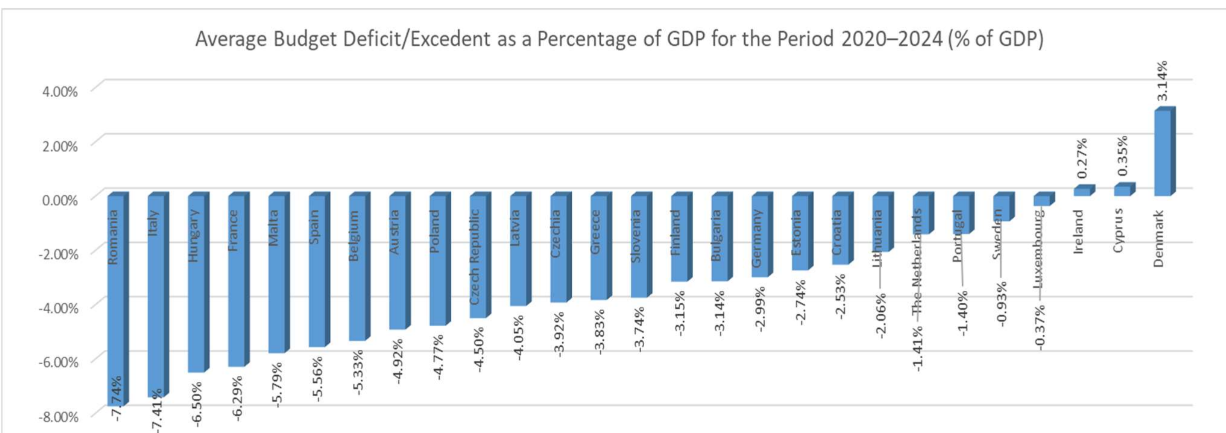
This research effort faces a number of limitations inherent to comparative economic analysis. The impact of taxation on the economy is influenced not only by the macroeconomic variables analyzed, but also by exogenous factors such as monetary policies, international economic developments, geopolitical tensions, or health crises—elements that cannot be fully incorporated into the descriptive analysis. Furthermore, although the databases used provide rigorous and standardized information, they may contain time lags in the statistical updating process. In addition, the diversity of national tax systems and differences in the fiscal policies adopted by member states complicate the process of methodological harmonization and the full comparability of results. Nevertheless, the identified limitations do not diminish the relevance of the research but require the interpretation of the results within an objective and realistic analytical framework.

From a conceptual perspective, the study contributes to a deeper understanding of taxation as a tool able to stimulate or hinder economic growth, depending on the intensity and structure of the tax burden. From an empirical perspective, the comparative analysis highlights the differences and similarities among EU member states regarding the level of tax burden, fiscal position, and implications for living standards. At the same time, the research findings allow for the identification of correlations between the level of taxation and the dynamics of tax revenues in the European context. In this regard, the Laffer Curve serves as a relevant tool for assessing the relationship between taxation and economic performance, through statistical testing of the model's validity and its consistency with the hypotheses formulated in the specialized economic literature. Through its conclusions, this paper offers useful insights for policymakers involved in the development and adaptation of fiscal policies, contributing to a deeper understanding of fiscal-budgetary mechanisms and their implications for the economy.

4. Empirical results

The budget deficit is one of the most relevant indicators of fiscal policy, reflecting both governments' ability to manage public resources and the strategies used to correct budgetary imbalances. The evolution of this indicator provides important information regarding the sustainability of public finances and the effects of fiscal policies on key macroeconomic indicators.

Figure no. 1



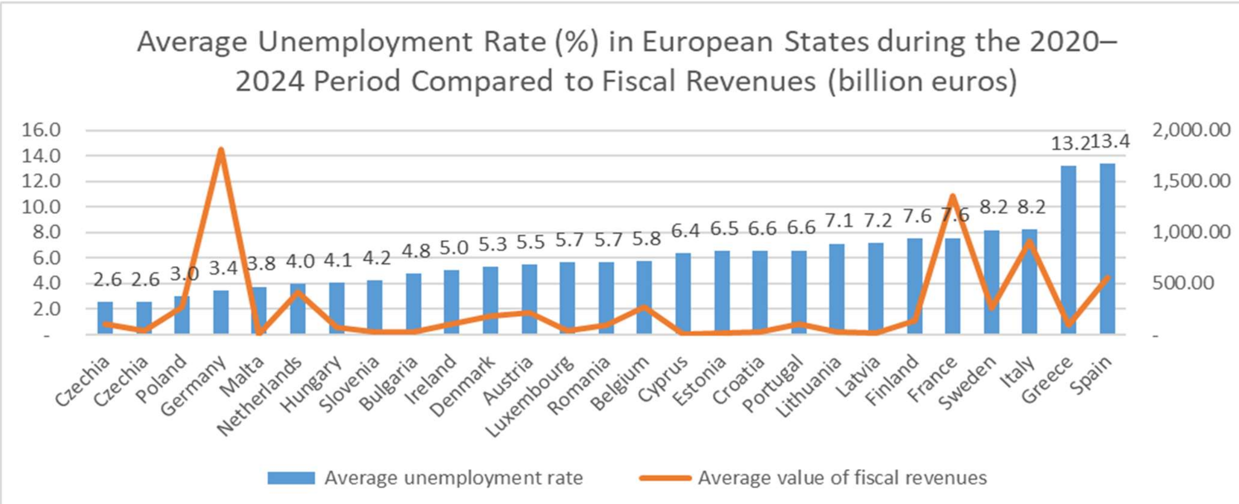
Source: Database colected from https://dashboard.tech.ec.europa.eu/qs_digit_dashboard_mt/public/sense/app/667e9fba-eea7-4d17-abf0-ef20f6994336/sheet/f38b3b42-402c-44a8-9264-9d422233add2/state/analysis/ on 03.08.2025

Figure 1 shows the average level of the budget deficit as a percentage of GDP in EU member states for the period 2020–2024, a period heavily influenced by the economic effects of the COVID-19 pandemic. The figure reveals significant differences among member states in terms of their fiscal positions. Thus, countries such as Romania, Italy, Hungary, France, Malta, Spain, and Belgium recorded high budget deficits, exceeding the threshold of 5% of GDP. Romania stands out with the highest budget deficit, at 7.74% of GDP, reflecting significant pressures on public finances and heightened fiscal vulnerability.

These economies share high levels of public expenditures and the necessity to support extensive social and economic measures in the context of recent crises. Large budget deficits indicate the presence of persistent structural imbalances and increased reliance on external financing sources, factors that may affect long-term fiscal sustainability and macroeconomic stability.

At the same time, countries such as Austria, Poland, Slovakia, Latvia, the Czech Republic, Greece, and Slovenia recorded moderate budget deficits, ranging from 3% to 5% of GDP. Although these economies were significantly affected by the pandemic, they managed to maintain a relatively higher degree of fiscal discipline by implementing economic support measures coupled with fiscal consolidation policies. These results indicate more efficient fiscal mechanisms and a greater capacity to adapt to external economic shocks.

Figure no. 2



Source: Database collected from https://dashboard.tech.ec.europa.eu/qs_digit_dashboard_mt/public/sense/app/667e9fba-eea7-4d17-abf0-ef20f6994336/sheet/f38b3b42-402c-44a8-9264-9d422233add2/state/analysis/ on 03.08.2025

Figure 2 highlights the disparities among EU Member States regarding the average unemployment rate for the 2020–2024 period—a timeframe heavily influenced by the economic consequences of the COVID-19 pandemic—and the relationship between this indicator and tax revenue levels. The identified differences have significant implications for tax collection capacity, the scale of public spending, and, consequently, the macroeconomic stability of each Member State.

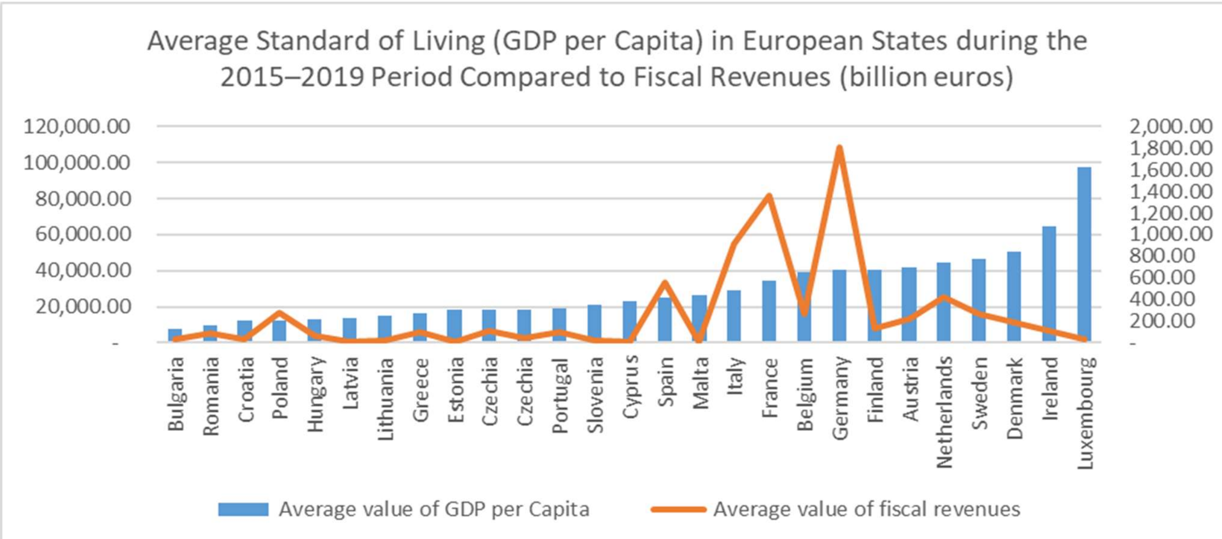
The countries with the lowest unemployment rates, ranging from 2.6% to 4.2%, are the Czech Republic, Poland, Germany, Malta, the Netherlands, and Hungary. These economies are characterized by relatively stable labor markets, high labor absorption rates, and diversified economic structures that are largely export-oriented. Their ability to mitigate the negative effects of the pandemic crisis has helped keep pressure on public budgets at a low level, particularly regarding social spending related to unemployment benefits and social support measures.

A moderate unemployment rate, ranging from 4.8% to 7.0%, is found in countries such as Slovenia, Bulgaria, Ireland, Denmark, Austria, Luxembourg, Romania, Belgium, Slovakia, Cyprus, Estonia, and Croatia. Although these countries differ significantly in terms of economic structure and level of development, they have managed to maintain relative labor market stability amid recent economic uncertainties. This situation suggests the existence of institutional and fiscal mechanisms capable of limiting employment volatility. In contrast, countries such as Lithuania, Latvia, Finland, France, Sweden, and Italy have higher unemployment rates, ranging from 7.1% to 8.2%. This group of economies is characterized by structural rigidities in the labor market, a phenomenon particularly evident in France and Italy. High unemployment places additional pressure on public finances by increasing social spending and reducing revenue from employment-related contributions and taxes. During economic slowdowns, these effects lead to a narrowing of available fiscal space and require the implementation of fiscal and economic policies aimed at stimulating economic activity and reducing unemployment, in order to restore macroeconomic balance and fiscal sustainability.

Figure 3 illustrates the relationship between GDP per capita and the level of tax revenue in the Member States of the European Union, highlighting the interdependence between the population's standard of living and the fiscal capacity of national economies. A comparative analysis of these macroeconomic indicators reveals significant structural differences among member states, reflecting distinct levels of economic development, productivity, and the efficiency of tax systems.

Countries such as Bulgaria, Romania, Croatia, Poland, Hungary, Latvia, Lithuania, and Slovakia are characterized by low GDP per capita and low levels of tax revenue. These economies have narrower tax bases, driven mainly by low wage levels and relatively low labor productivity. Consequently, the state's ability to mobilize tax revenue is limited, which can affect the financing of public investments and the sustainability of social systems.

Figure no. 3



Source: Database collected from
https://dashboard.tech.ec.europa.eu/qs_digit_dashboard_mt/public/sense/app/667e9fba-eea7-4d17-abf0-ef20f6994336/sheet/f38b3b42-402c-44a8-9264-9d422233add2/state/analysis/ on 03.08.2025

An intermediate level of these indicators is found in countries such as the Czech Republic, Estonia, Portugal, Slovenia, Cyprus, Spain, Malta, and Italy. These economies have living standards close to the EU average and a moderate level of tax revenue collected. In this context, a relative balance can be observed between the tax burden on taxpayers and the ability of tax administrations to collect public revenue efficiently.

The category of the most highly developed economies includes Belgium, Germany, France, Austria, the Netherlands, Sweden, Denmark, Ireland, and Luxembourg. The Nordic and Western European countries benefit from robust tax systems, supported by broad tax bases, high wage levels, and superior labor productivity. These characteristics enable the collection of substantial tax revenues, which facilitate the financing of well-developed public systems, including in areas such as health, education, and social protection. In the case of the Nordic models, high taxation is associated with a high level of social welfare and an efficient redistribution of resources, thereby contributing to the strengthening of economic and social cohesion.

6. The Laffer Curve and the tax burden in Romania

The Laffer Curve is a fundamental tool for justifying and evaluating the fiscal policies adopted by European Union member states, providing a relevant analytical framework for examining the relationship between the level of taxation and economic performance. According to this concept, there is an optimal level of tax burden at which public revenues are maximized without generating significant negative effects on economic activity. In this regard, adjustments to tax rates can directly influence the state's ability to collect tax revenues, the level of investment, and the pace of economic growth.

Applying the principles associated with the Laffer Curve allows for the evaluation of the efficiency of EU member states' national tax systems and the identification of circumstances in which the level of taxation can stimulate or, conversely, inhibit economic activity. Thus, analyzing the relationship between the tax burden and tax revenue helps formulate sustainable fiscal policies aimed at fiscal consolidation and macroeconomic balances.

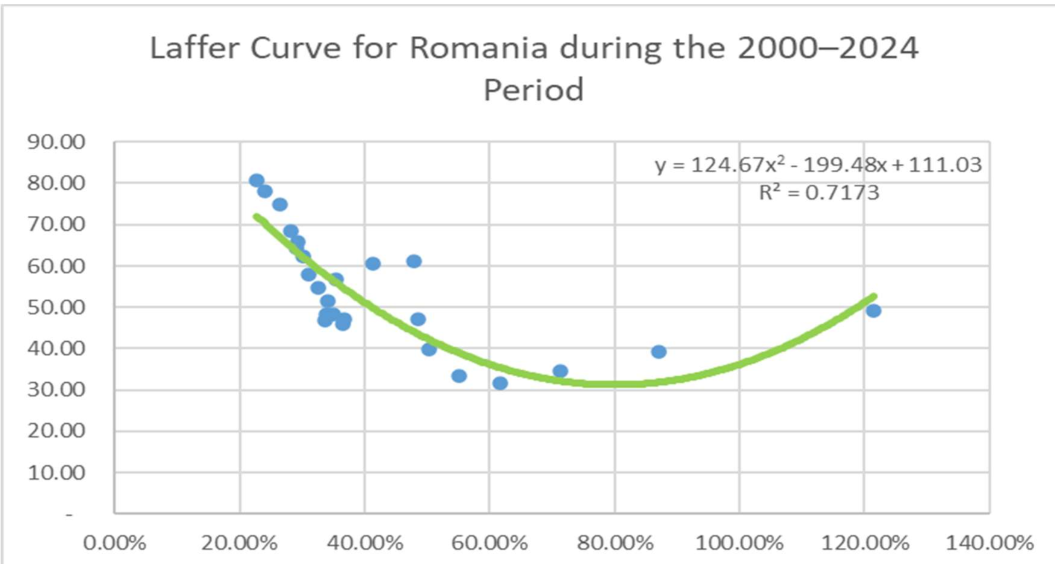
The empirical component of the study utilizes statistical data from the AMECO database for the period 2000–2024, analyzing relevant macroeconomic variables such as nominal tax revenue, the consumer price index (CPI) with a base year of 2015, real tax revenue, real GDP, and the level of gross tax burden. Within the econometric model, the gross tax burden is considered as an independent variable, plotted on the X-axis, while real tax revenues constitute the dependent variable, plotted on the Y-axis.

From an econometric perspective, Figure 4 presents a second-order polynomial regression with an equation in the form $y = 124.67x^2 - 199.48x + 111.03$, having a coefficient of determination R^2 of 0.7173:

y=124.67x^2-199.48x+111.03

This result indicates that approximately 71.73% of the variation in actual tax revenues can be explained by changes in the level of the tax burden. In the economic literature, a coefficient of determination above the threshold of 0.7 is considered relevant and suggests a high explanatory capacity of the econometric model used.

Figure no. 4



Source: Data Base from https://dashboard.tech.ec.europa.eu/qs_digit_dashboard_mt/public/sense/app/667e9fba-eea7-4d17-abf0-ef20f6994336/sheet/f38b3b42-402c-44a8-9264-9d422233add2/state/analysis/ on pe 03.08.2025

The U-shaped curve indicates the existence of a minimum point for real tax revenue associated with a certain intermediate level of taxation. This configuration highlights the complex and nonlinear nature of the relationship between taxation and economic performance, confirming the hypothesis that excessive variations in the tax burden can have adverse effects on the tax base and on the efficiency of public revenue collection.

From a mathematical perspective, the derivative of the equation allows for the identification of a theoretical optimal point of taxation:

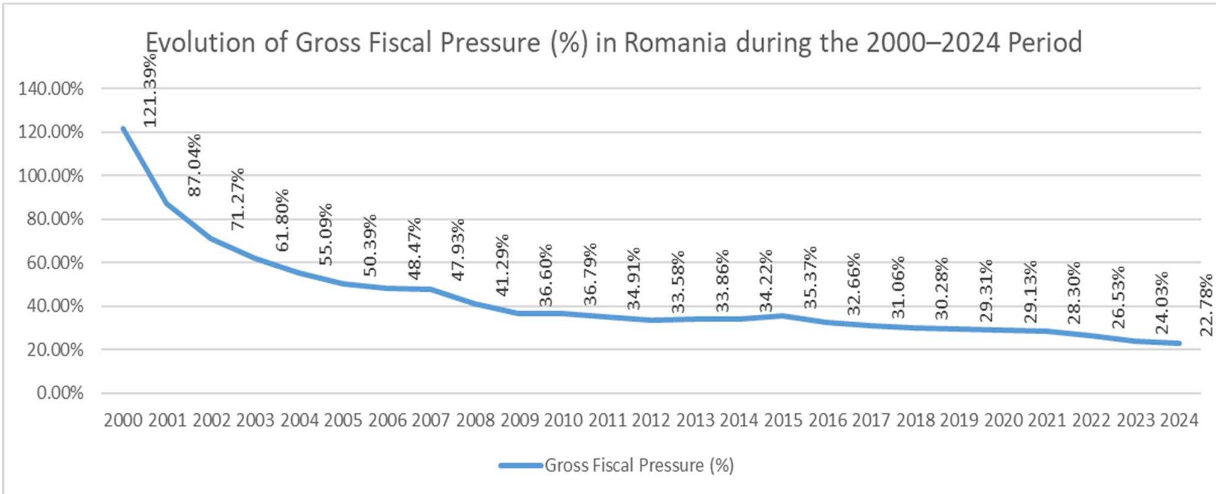
x optimal = 199.48 / (2 * 124.67) = 0.80 or 80%

Thus, the model suggests that actual tax revenues are minimal around a tax rate of approximately 80%, and above this level they theoretically begin to increase. However, the coefficient of the linear term—199.48—is negative, which is consistent with the theory that excessive tax increases can reduce the tax base. From a fiscal-budgetary perspective, the graph shows that tax revenues are high at low tax rates of 20–35%. As the tax rate increases within the 40–70% range, revenues appear to decline because the economic attractiveness for those investing in Romania decreases.

Figure 5 illustrates the downward trend in gross tax burden in Romania over the 2000–2024 period, reflecting the structural reforms of fiscal policy and the country's economy in the context of the European integration process and successive macroeconomic adjustments. The evolution of this macroeconomic indicator is characterized by a significant reduction in the first part of the analyzed period, followed by a period of relative stabilization after 2010.

Between 2000 and 2004, there was a sharp decline in the gross tax burden, from approximately 121% to 56%, a trend related to the post-transition economic restructuring process and the tax reforms implemented following the economic difficulties of the 1990s. The significant reduction in taxation was also influenced by the adjustments implemented in view of Romania's acceding to the European Union, a process that required the harmonization of the tax framework and the implementation of policies aimed at stimulating economic competitiveness and attracting investment.

Figure no. 5



Source: Data Base from https://dashboard.tech.ec.europa.eu/qs_digit_dashboard_mt/public/sense/app/667e9fba-eea7-4d17-abf0-ef20f6994336/sheet/f38b3b42-402c-44a8-9264-9d422233add2/state/analysis/ on 03.08.2025

Between 2005 and 2009, the gross tax burden continued to decline, although at a more moderate pace, from approximately 55% to 36%. This trend can be attributed both to the fiscal relaxation measures implemented in the pre-accession period and to improved tax compliance and the strengthening of administrative collection mechanisms.

Between 2010 and 2014, the gross tax burden stabilized at levels ranging from 33% to 36%, against the backdrop of economic recovery and the implementation of fiscal consolidation measures adopted following the global financial crisis. Subsequently, the 2015–2024 period is characterized by the maintenance of relative fiscal stability, accompanied by a slight downward trend, driven mainly by fiscal easing policies and measures aimed at supporting the business environment and stimulating domestic consumption.

From a fiscal-budgetary perspective, the reduction in gross fiscal pressure was associated with a decrease in the share of tax revenues relative to the government's financing needs. In this context, public authorities have been forced to increasingly resort to alternative financing mechanisms, such as increasing the budget deficit, raising public debt, and intensifying the use of external borrowing. This development highlights the complex relationship between the tax burden, the sustainability of public finances, and the government's ability to maintain macroeconomic stability in the long term.

7. Conclusions

This study highlights the fundamental role of fiscal policy in ensuring macroeconomic stability, fiscal sustainability, and long-term economic development within the European Union. The comparative and empirical analysis of member states demonstrates that taxation is not only a mechanism for raising public revenue but also a strategic tool able to influence investment dynamics, labor market performance, social cohesion, and overall economic resilience. In the contemporary European context, marked by a succession of financial, health, and geopolitical crises, fiscal policy has become a key factor in reducing economic vulnerabilities and supporting sustainable economic growth.

The research findings highlight the existence of persistent structural disparities among European economies in terms of budget balance, unemployment rates, tax compliance rates, and living standards. Northern and Western European countries are characterized by strong fiscal discipline, high levels of productivity, and efficient redistribution mechanisms, which allow for the financing of extensive social systems while maintaining macroeconomic stability. In contrast, many economies in Eastern and Southern Europe continue to experience high structural deficits, low tax compliance rates, and a heavy reliance on external financing mechanisms. These differences confirm that the effectiveness of fiscal policy is directly conditioned by institutional quality, the structure of the economy, and the capacity of public administrations to implement coherent and sustainable fiscal policies.

An analysis of the relationship between the unemployment rate and tax revenue confirms the existence of a strong interdependence between employment and the sustainability of public finances. Economies characterized by stable labor markets and low unemployment rates benefit from greater tax collection capacity and less pressure on social spending. In contrast, countries affected by structural labor market rigidities and high unemployment face declining tax revenues and increased difficulties in maintaining budgetary balances. These findings underscore the importance of implementing integrated fiscal and economic policies aimed both at stimulating employment, increasing productivity, and strengthening public revenues.

At the same time, research confirms the existence of a complex relationship between the level of taxation and the population's living standard. Countries with broad tax bases, high wage levels, and superior productivity are able to sustain efficient tax systems and generate substantial public revenues, which enable major investments in education, health care, and infrastructure. In this regard, the experience of the Nordic countries demonstrates that high tax rates can coexist with strong economic performance and a high level of social welfare when the collected resources are managed efficiently and redistributed fairly.

A central focus of this research is the empirical validation of the Laffer Curve in Romania. The econometric results indicate the existence of a nonlinear relationship between the tax burden and real tax revenues, confirming the hypothesis that excessive increases in taxation can have negative effects on the tax base, investment, and economic attractiveness. The high coefficient of determination of the econometric model highlights the statistical significance of the analyzed relationship and suggests that the Romanian economy is highly sensitive to changes in fiscal policy. At the same time, the downward trend in the gross tax burden between 2000 and 2024 reflects the structural transformations of the Romanian economy and the process of adapting to the requirements of European integration. However, the reduction in the tax burden was not without budgetary costs. The decline in tax revenues relative to the government's financing needs led to a widening of the budget deficit, an increase in public debt, and a rise in external borrowing. This situation highlights the need to strike an optimal balance between stimulating economic activity and ensuring the sustainability of public finances. In the absence of appropriate fiscal policy calibration, excessive tax relaxation can lead to structural vulnerabilities and a decline in long-term macroeconomic stability.

From a theoretical perspective, this study demonstrates that the effects of fiscal policy cannot be analyzed strictly in terms of the level of taxation, but must also be considered in relation to the structure of the economy, institutional efficiency, the political context, and the degree of economic development. At the same time, the results confirm the relevance of classical and contemporary theories of public finance, particularly regarding the stabilizing function of fiscal policy and the nonlinear nature of the relationship between taxation and public revenues.

In practical terms, the study's conclusions provide important guidelines for policymakers involved in the elaboration of fiscal and budgetary policies at the European and national levels. The research underscores the importance of adopting flexible fiscal policies, tailored to the structural characteristics of each economy and aimed at stimulating investment, strengthening the tax base, and maintaining fiscal sustainability. Furthermore, the results highlight the importance of fiscal coordination within the EU to reduce economic imbalances and limit the negative effects generated by excessive tax competition among member states.

In conclusion, fiscal policy remains one of the most significant instruments of economic governance within the EU, with direct implications for financial stability, economic growth, and social cohesion. In a global economic environment marked by uncertainty and high volatility, the effectiveness of fiscal policies will increasingly depend on the ability of member states to strike a sustainable balance between the need to finance public spending and maintaining economic competitiveness. Thus, the future of European fiscal consolidation requires not only the adoption of prudent budgetary policies but also the development of institutional mechanisms capable of supporting economic convergence, fiscal solidarity, and the long-term resilience of European economies.

References:

[1] Alesina, A., & Tabellini, G. (2005). Why is Fiscal Policy Often Procyclical? NBER Working Papers, No. 11600, National Bureau of Economic Research, Inc.

[2] Annett, A. (2006). Enforcement and the Stability and Growth Pact: How Fiscal Policy Did and Did Not Change under Europe's Fiscal Framework. IMF Working Paper, No. 06/116, IMF, Washington (D.C.).
[3] Cimadomo, J. (2005). Has the Stability and Growth Pact Made Fiscal Policy More Pro-Cyclical? La Lettre du CEPII, Vol. 24, CEPII Research Center. Available from internet: http://ideas.repec.org/s/cii/cepill.html
[4] Dombrovskis, V. (2019). Challenges and Impacts of Implementing BASE III. Bruxelles. Available: https://ec.europa.eu/commission/presscorner/detail/en/SPEECH_19_6269
[5] Easson, A. J. (1993). Taxation in European Community. The Athlone Press, London.
[6] Gali, J., & Perotti, R. (2003). Fiscal Policy and Monetary Integration in Europe. Economic Policy, 18(37), 533–572. http://dx.doi.org/10.1111/1468-0327.00115_1
[7] Golinelli, R., & Momigliano, S. (2008). The Cyclical Response of Fiscal Policies in the Euro Area – Why Do Results of Empirical Research Differ so Strongly? Working Paper, No. 654, Banca D'Italia.
[8] Gygli, S., Haelg, F., Potrafke, N., & Sturm, J. (2018). The KOF Globalisation Index – Revisited. Working Paper Series 7430, CESifo Group Munich.
[9] Haan, J., & Sturm, J. (1994). The Political and Institutional Constraints of Fiscal Policy in the European Union. Public Choice Review, 80(1–2), 157–172. ISSN: 0048-5829 / 1573-7101.
[10] Haan, J., & Sturm, J. (2016). Finance and Income Inequality: A Review and New Evidence. DNB Working Papers 530, Netherlands Central Bank, Research Department.
[11] Hauptmeier, S., Fuentes, J. S., & Schuknecht, L. (2010). Towards Expenditures Rules and Fiscal Sanity in the Euro Area. Working Paper, No. 1266, Frankfurt: ECB.
[12] Lamla, M. & Lein, S. & Sturm, J. (2018) Media Reporting and Business Cycles: Empirical Evidence based on News Data. Working papers 2019/05, Faculty of Business and Economics - University of Basel.Manasse, P. (2006). Pro-Cyclical Fiscal Policy: Shocks, Rules and Institutions – A View from MARS. IMF Working Paper, No. 06/27.
[13] Mitchell, D. J. (2004). The Economics of Tax Competition: Harmonization vs. Liberalization. Index of Economic Freedom, p. 25. Available: http://down.cenet.org.cn/upfile/58/200615194647182.pdf
[14] Musgrave, R. A. (1959). The Theory of Public Finance. McGraw-Hill, New York.
[15] Pereira, F. (1998). Fiscalidade das Empresas e Harmonização Fiscal Comunitária – Balanço e Perspectivas. Lisboa: CEF.
[16] Talvi, E., & Végh, C. (2005). Tax Base Variability and the Pro-Cyclicality of Fiscal Policy in Developing Countries. Journal of Development Economics, 78, 156–190. http://dx.doi.org/10.1016/j.jdeveco.2004.07.002
[17] Turrini, A. (2008). Fiscal Policy and the Cycle in the Euro Area: The Role of Government Revenue and Expenditure. European Economy Economic Papers, No. 323, European Commission.
[18] Wyplosz, C. (2006). European Monetary Union: The Dark Sides of a Major Success. Economic Policy, 21, 207–261. http://dx.doi.org/10.1111/j.1468-0327.2006.00158.x
[19] https://ec.europa.eu/taxation_customs/tedb/#/advanced-search
[20] https://www.researchgate.net/publication/260012529_Fiscal_Policy_Stance_in_the_European_Union_The_Impact_of_the_Euro
[21] https://www.researchgate.net/publication/362068583_04_Free-Competition-and-Fiscal-Policy-in-European-Union
[22] https://www.researchgate.net/publication/392822603_Taxation_and_Investor_Behavior_Analyzing_Portfolio_Adjustments_Risk_Preferences_and_Capital_Market_Reactions_to_Fiscal_Policy_Changes
[23] https://www.researchgate.net/publication/231957366_Citizenship_and_Social_Policy_T_H_Marshall_and_Poverty

The Role of Nostalgia in Advertising: Effects on Emotional Engagement and Purchase Intention

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Abstract: Nostalgia has become an increasingly important persuasive strategy in contemporary advertising, especially in a media environment marked by emotional saturation, fragmented attention and intense brand competition. This paper examines the role of nostalgia in advertising and its effects on emotional engagement and purchase intention. Drawing on specialized literature in consumer psychology, advertising and branding, the article argues that nostalgic appeals can strengthen consumer responses by activating autobiographical memory, positive affect, perceived authenticity and emotional connection with the brand. The paper also discusses real campaigns from brands such as Coca-Cola, Nintendo, Microsoft, Barbie and Spotify, showing how nostalgia can be used through retro aesthetics, childhood references, product relaunches, personalized memories and cultural symbols. A conceptual model is proposed in which nostalgia appeal influences emotional engagement, which in turn affects purchase intention. The paper also considers brand authenticity and consumer nostalgia proneness as moderating variables. The findings suggest that nostalgia can be highly effective when it is emotionally meaningful, culturally recognizable and consistent with brand identity. However, nostalgia may become ineffective or even counterproductive when used superficially or when it appears disconnected from the consumer’s lived experience. The article concludes that nostalgia advertising is not simply a return to the past, but a strategic reconstruction of memory designed to create emotional relevance in the present.

Keywords: nostalgia advertising, emotional engagement, purchase intention, brand authenticity, consumer memory, retro marketing, advertising effectiveness.

1. Introduction

Advertising has always relied on emotion, but in the contemporary digital environment emotional differentiation has become even more important. Consumers are exposed to a constant flow of messages across social media, video platforms, search engines, streaming services, retail websites and mobile applications. In this context, brands increasingly seek communication strategies capable of creating immediate recognition, emotional resonance and long-term memorability. Nostalgia is one of these strategies.

This paper covers the role of nostalgia in advertising, with a specific focus on its effects on emotional engagement and purchase intention. Nostalgia is understood as a sentimental longing for the past, often connected to personal memories, childhood experiences, collective symbols, cultural moments or earlier stages in a consumer’s life. In advertising, nostalgia can be activated through music, colors, packaging, slogans, celebrities, retro design, product relaunches, storytelling or references to previous decades.

The studied matter is important because nostalgia can transform advertising from a purely informational message into an emotionally charged experience. Consumers do not respond only to product attributes, price or functionality. They also respond to the feelings, identities and memories associated with brands. A nostalgic advertisement may remind consumers of family moments, childhood routines, past friendships, cultural icons or earlier media experiences. These emotional associations can increase attention, deepen engagement and strengthen purchase intention.

The author intends to answer this matter through a theoretical and applied analysis. The paper reviews specialized literature on nostalgia, emotional engagement and purchase intention, then integrates several real campaign examples. These examples are not treated as isolated marketing anecdotes, but as practical illustrations of how nostalgia works in advertising. The paper also proposes a conceptual research model that can be tested empirically through surveys, experiments or structural equation modelling.

This article is related to existing specialized literature on nostalgia marketing, advertising effectiveness and consumer behavior. Previous studies have shown that nostalgia can influence attitudes toward advertisements, brand attitudes and purchase intentions (Muehling and Sprott, 2004; Merchant and Rose, 2013; Özhan and Akkaya, 2020). Research also suggests that nostalgic advertising may be particularly effective because it activates positive emotions, social connectedness and autobiographical memory. However, this paper contributes by linking nostalgia appeal, emotional engagement and purchase intention into a clear conceptual framework, while also discussing contemporary brand examples such as Coca-Cola's "Share a Coke", Nintendo's NES Classic Edition, Microsoft's "Child of the 90s", Barbie's 2023 marketing campaign and Spotify Wrapped.

2. Nostalgia as an Advertising Appeal

Theoretical perspectives suggest that nostalgia serves important psychological functions beyond simple remembrance. According to Davis (1979), nostalgia helps individuals maintain a sense of identity and continuity by connecting present experiences with meaningful elements of the past. Similarly, Wildschut et al. (2006) argue that nostalgia is a predominantly positive emotion that reinforces social connectedness, self-esteem and existential meaning. These functions help explain why nostalgia has become an effective advertising appeal. By activating personally or culturally significant memories, nostalgic advertisements can create an immediate sense of familiarity and relevance, allowing brands to establish emotional resonance more easily than purely informational messages.

Nostalgia is often described as a bittersweet emotional experience. It involves longing for the past, but not necessarily sadness. In many cases, nostalgia produces warmth, comfort, continuity and emotional security. In consumer behavior, nostalgia can be personal, referring to an individual's own past, or historical, referring to a period the consumer did not personally experience but perceives as culturally meaningful.

Advertising uses nostalgia by reconstructing the past in a selective and emotionally appealing manner. The past presented in advertising is rarely realistic in full detail. It is usually simplified, aestheticized and emotionally edited. Brands emphasize what is comforting, recognizable and desirable: childhood joy, family rituals, old music, retro packaging, familiar characters or cultural references. This perspective is consistent with Stern's (1992) distinction between personal nostalgia and historical nostalgia. Personal nostalgia refers to memories derived from an individual's direct experiences, while historical nostalgia involves longing for a period that may not have been personally experienced but is perceived as culturally desirable. Both forms can be strategically employed in advertising, depending on the characteristics of the target audience and the symbolic associations that brands seek to activate.

Nostalgia advertising may operate through several mechanisms. First, it captures attention because familiar symbols are easier to recognize and process. Second, it activates memory and emotion, making the advertisement more personally relevant. Third, it strengthens brand authenticity, especially when the brand has a long history or a recognizable heritage. Fourth, it may reduce perceived risk because consumers associate familiar brands or products with previous positive experiences.

For example, Coca-Cola has repeatedly used nostalgia through Christmas imagery, classic bottle design, sharing rituals and emotional storytelling. Its "Share a Coke" campaign replaced the Coca-Cola logo on bottles and cans with personal names or nicknames, encouraging people to create personal and social connections through a familiar product. Coca-Cola officially relaunched "Share a Coke" globally in 2025, explicitly connecting the campaign with Gen Z's search for authentic connection and the nostalgia of personalized cans.

This illustrates an important feature of nostalgia advertising: it does not always mean returning unchanged to the past. Instead, brands often update nostalgic concepts for a new generation. In Coca-Cola's case, a previously successful personalization campaign is reintroduced with digital tools, QR codes and shareable content, blending memory with contemporary media behavior.

3. Emotional Engagement in Nostalgia Advertising

Emotional engagement refers to the degree to which consumers feel emotionally involved, interested or connected with an advertisement or brand. It goes beyond simple attention. A consumer may notice an advertisement without being emotionally engaged. Nostalgia increases the probability of emotional engagement because it connects the brand message with personally or culturally meaningful memories.

The role of emotional engagement in advertising can be understood through engagement theory, which views consumer engagement as a multidimensional construct encompassing cognitive, emotional and behavioral dimensions (Brodie et al., 2011). Within this framework, emotional engagement reflects the degree to which consumers experience affective involvement with a brand message. Advertising campaigns that evoke strong emotions are more likely to attract attention, generate favorable evaluations and stimulate subsequent behavioral responses.

When consumers encounter nostalgic advertising, they may experience warmth, happiness, comfort, longing, amusement or identification. These emotions can increase the time spent with the message, the likelihood of sharing it and the depth of brand processing. In digital environments, emotional engagement may appear through likes, comments, shares, saves, user-generated content, participation in challenges or conversations around the campaign.

The relationship between nostalgia and emotional engagement can also be explained through autobiographical memory theory. According to Holak and Havlena (1998), nostalgic experiences are strongly linked to emotionally significant memories and personal life narratives. When advertising activates these memories, consumers become more immersed in the message because the communication acquires personal relevance. As a result, nostalgic advertising often generates deeper emotional processing than messages focused exclusively on functional product attributes.

Microsoft's "Child of the 90s" campaign for Internet Explorer is a relevant example. The campaign targeted millennials by using objects and references from the 1990s, such as old toys, school supplies and early internet culture. Its objective was to reconnect users emotionally with a browser many had used earlier in life, at a time when Internet Explorer was losing relevance. The campaign attempted to transform an outdated product perception into a nostalgic identity cue: users were not only invited to reconsider a browser, but to remember who they were when they first used the internet.

The emotional logic of this campaign is important. Microsoft did not focus only on technical product features. Instead, it used generational memory as the persuasive hook. For consumers who grew up in the 1990s, the advertisement created recognition and emotional intimacy. The product became a symbol of personal history rather than merely a technological tool.

A similar mechanism can be observed in the Barbie movie marketing campaign. The 2023 campaign transformed Barbie into a cultural event by using nostalgia, pink visual identity, immersive experiences and broad brand partnerships. The campaign tapped into childhood memories while simultaneously repositioning Barbie as a contemporary cultural symbol. The Shorty Awards description of the campaign notes that it unfolded over an eight-month period and "tapped into nostalgia" while making Barbie omnipresent across physical and digital spaces.

Barbie demonstrates that nostalgia can work across generations. Older audiences may associate Barbie with childhood memories, while younger audiences may engage with the brand through memes, fashion, social media aesthetics and contemporary identity debates. Thus, nostalgia does not only preserve the past; it can reactivate a heritage brand within present cultural conversations.

From a psychological perspective, nostalgic advertising may also strengthen emotional engagement by fostering a sense of self-continuity. Belk (1990) suggests that possessions, brands and consumption experiences often become part of an individual's extended self. Consequently, brands associated with meaningful memories may evoke stronger emotional responses because they are perceived not merely as market offerings but as symbolic components of personal identity.

4. Nostalgia and Purchase Intention

Purchase intention refers to the consumer's likelihood or willingness to buy a product or service. In advertising research, purchase intention is often influenced by attitudes toward the advertisement, attitudes toward the brand, perceived value, trust, emotional response and social influence. Nostalgia may affect purchase intention by improving emotional attitude toward the advertisement and by strengthening the perceived bond with the brand.

The relationship between emotions and purchase intention has long been recognized in consumer behavior research. Rather than relying solely on rational evaluations, consumers frequently use emotional cues as heuristics when making purchase decisions. This perspective is reflected in the Affect Transfer Hypothesis, which proposes that positive emotions generated by an advertisement can be transferred to evaluations of the advertised brand (Batra and Ray, 1986; MacKenzie et al., 1986). Consequently, advertisements that evoke nostalgic emotions may indirectly increase consumers' willingness to purchase by creating more favorable affective responses toward the brand.

The relationship between nostalgia and purchase intention can be explained through emotional transfer. When an advertisement evokes positive nostalgic feelings, those feelings may transfer to the advertised brand or product. Consumers may not only like the advertisement; they may also perceive the brand as warmer, more familiar and more trustworthy. This can increase the likelihood of purchase, especially when the product is connected to personal memory or cultural heritage.

Nintendo's NES Classic Edition is a strong example of nostalgia translated into purchase behavior. The product was a modern miniature version of the classic Nintendo Entertainment System, designed to evoke the collective memories of earlier gaming experiences. Research discussing Nintendo's nostalgic visual strategy notes that the NES Classic Edition Mini used the iconic symbol of the classic NES and tapped into gamers' collective memories.

In this case, nostalgia was not only an advertising appeal; it was embedded into the product itself. The design, games and user experience were all connected to memory. Consumers were invited to purchase not simply a gaming console, but a renewed access point to childhood or early gaming culture. This illustrates how nostalgia can increase purchase intention when the product offers an emotionally credible link to the past.

This mechanism is also consistent with the Stimulus–Organism–Response (S–O–R) framework proposed by Mehrabian and Russell (1974). Within this model, nostalgia appeal represents an external stimulus that influences the consumer's internal emotional state, which subsequently affects behavioral outcomes such as purchase intention. Emotional engagement therefore acts as an intermediary psychological process through which nostalgic advertising exerts its persuasive influence.

Nostalgia may also influence purchase intention by reducing uncertainty. Familiar brands and retro products may be perceived as safer or more trustworthy because they are connected to previous positive experiences. This is particularly relevant in markets where consumers face too many choices. A nostalgic product can stand out because it already carries emotional meaning.

However, nostalgia does not automatically generate purchase intention. Its effectiveness depends on authenticity, target audience and brand fit. If the nostalgic reference feels artificial, opportunistic or irrelevant, consumers may reject it. Nostalgia must therefore be strategically aligned with the brand's history, product category and consumer expectations.

Previous empirical studies support this relationship. Muehling and Sprott (2004) found that nostalgia-based advertisements generate more favorable attitudes toward advertisements and brands, while Özhan and Akkaya (2020) reported that nostalgia proneness positively influences ad-evoked nostalgia, brand evaluations and purchase intention. These findings suggest that nostalgia can contribute to consumer decision-making not only through memory activation but also through the creation of positive affective associations that enhance brand attractiveness.

5. Brand Examples and Campaign Analysis

5.1 Coca-Cola: Personal Memory and Shared Rituals

Coca-Cola's use of nostalgia is deeply connected to rituals of sharing, family, friendship and celebration. The "Share a Coke" campaign personalized packaging by replacing the logo with names and nicknames. This strategy transformed a mass product into a personal object. Consumers were encouraged to search for their own names or the names of friends and family members, turning purchase into a social and emotional act.

The relaunch of "Share a Coke" in 2025 shows how nostalgia can be adapted to a digital generation. Coca-Cola described the campaign as a way for Gen Z to tap into the nostalgia of personalizing a can and to create authentic connection in a digital world. This demonstrates that nostalgia advertising can combine old emotional mechanisms with new technologies of sharing.

5.2 Nintendo: Retro Product Design and Collective Gaming Memory

Nintendo's NES Classic Edition illustrates product-based nostalgia. Instead of only using nostalgic imagery in advertising, Nintendo relaunched a product format strongly associated with earlier gaming culture.

This strategy appealed both to older consumers who had direct memories of the original console and younger consumers attracted by retro gaming aesthetics.

The nostalgic appeal was strengthened by the physical design of the console, the preloaded classic games and the symbolic value of Nintendo's heritage. In this case, emotional engagement was likely generated by memory, playfulness and identity: purchasing the console meant reconnecting with a formative entertainment experience.

5.3 Microsoft: Generational Nostalgia and Brand Reconsideration

Microsoft's "Child of the 90s" campaign used nostalgia as a repositioning tool. Internet Explorer had become associated with outdated technology, but the campaign tried to reframe it as part of the emotional history of the millennial generation. By showing familiar 1990s objects and cultural references, the campaign aimed to create warmth around a brand that had lost cultural relevance.

This example shows that nostalgia can be used not only to sell products, but also to repair or soften brand perception. However, nostalgia alone may not be enough if the product experience does not meet contemporary expectations. Emotional engagement can open the door, but product performance remains essential for long-term conversion.

5.4 Barbie: Nostalgia, Cultural Relevance and Omnichannel Engagement

The Barbie movie campaign represents a large-scale example of nostalgia integrated with contemporary cultural marketing. The campaign used the historical familiarity of Barbie while expanding the brand into fashion, entertainment, social media, immersive spaces and partnerships. Its visual identity, especially the use of pink, acted as an immediate nostalgic and cultural signal.

The campaign's success was partly based on the fact that Barbie already had strong memory associations. Many consumers had personal childhood experiences with the brand. The marketing strategy reactivated these memories while also making Barbie relevant to contemporary debates about identity, femininity and popular culture. The campaign's official awards description emphasizes both nostalgia and the ambition to make Barbie omnipresent across digital and physical spaces.

5.5 Spotify Wrapped: Personalized Nostalgia and Digital Self-Memory

Spotify Wrapped is not traditional nostalgia advertising in the retro sense, but it uses a contemporary form of personal nostalgia. Each year, users receive a personalized summary of their listening habits, transforming recent consumption data into emotional memory. The campaign encourages users to reflect on who they were during the past year through music and audio choices.

Spotify Wrapped shows that nostalgia does not always refer to distant decades. It can also refer to the recent personal past. The emotional power comes from self-recognition: users see their tastes, moods and routines transformed into shareable identity content. Marketing analyses frequently describe Wrapped as effective because it combines personalization, emotional connection and social sharing.

6. Proposed Conceptual Model

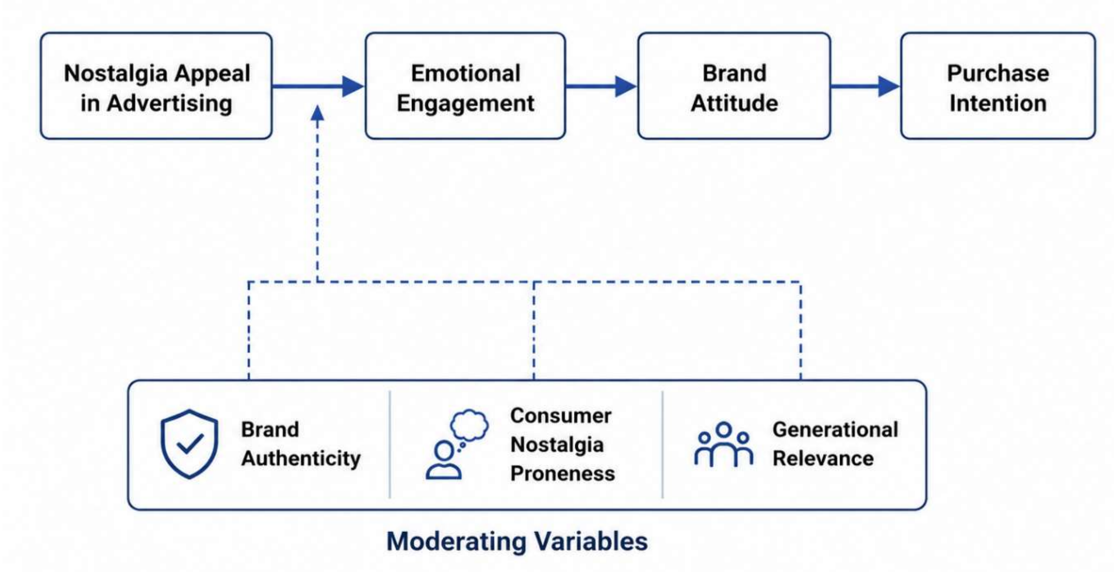
Based on the literature reviewed and the practical examples discussed throughout this paper, a conceptual model is proposed to explain the mechanism through which nostalgia advertising influences consumer behavior. The model positions nostalgia appeal in advertising as the independent variable, emotional engagement and brand attitude as the mediating variables, and purchase intention as the dependent variable. In addition, the model incorporates brand authenticity, consumer nostalgia proneness, product-brand fit, and generational relevance as moderating variables that may strengthen or weaken the proposed relationships. The moderating variables could play a role on the following relations:

- Brand Authenticity influences the relation Nostalgia Appeal → Emotional Engagement.
- Consumer Nostalgia Proneness influences the relation Nostalgia Appeal → Emotional Engagement.
- Generational Relevance influences the relation Nostalgia Appeal → Emotional Engagement.
- Product-Brand Fit influences the relation Nostalgia Appeal → Purchase Intention.

The logic of the model is grounded in the broader tradition of advertising effectiveness research, particularly the Stimulus–Organism–Response (S–O–R) framework developed by Mehrabian and Russell (1974). According to this perspective, marketing stimuli influence consumers' internal cognitive and emotional states, which subsequently shape behavioral responses. Within the context of nostalgia advertising, the nostalgic appeal functions as the stimulus, emotional engagement represents the internal emotional state of the consumer, and purchase intention constitutes the behavioral outcome. This theoretical lens suggests that consumers do not respond directly to nostalgic cues merely because they recognize them; rather, such cues first activate emotional processes that influence subsequent consumption-related decisions.

The proposed model is also consistent with the Affect Transfer Hypothesis, which argues that emotions generated by an advertisement can be transferred to the advertised brand, thereby influencing consumer attitudes and behavioral intentions. When nostalgic advertising evokes feelings such as warmth, comfort, belonging, happiness, or sentimental reflection, these emotions may become associated with the brand itself. As a result, consumers may evaluate the brand more positively and become more inclined to purchase its products or services.

Figure 1. The proposed conceptual model



The model can be translated into the following hypotheses:

H1: Nostalgia appeal in advertising has a positive effect on emotional engagement.
H2: Emotional engagement has a positive effect on brand attitude.
H3: Brand attitude has a positive effect on purchase intention.
H4: Emotional engagement mediates the relationship between nostalgia appeal and brand attitude.
H5: Brand attitude mediates the relationship between emotional engagement and purchase intention.
H6: Emotional engagement and brand attitude jointly mediate the relationship between nostalgia appeal and purchase intention.
H7: Brand authenticity positively moderates the relationship between nostalgia appeal and emotional engagement, such that the relationship is stronger when perceived brand authenticity is high.
H8: Consumer nostalgia proneness positively moderates the relationship between nostalgia appeal and emotional engagement, such that the relationship is stronger for consumers with higher levels of nostalgia proneness.
H9: Product-brand fit positively moderates the relationship between nostalgia appeal and purchase intention, such that the relationship is stronger when consumers perceive a high degree of fit between the nostalgic appeal and the advertised product or brand.
H10: Generational relevance positively moderates the relationship between nostalgia appeal and emotional engagement, such that the relationship is stronger when the nostalgic cues are perceived as relevant to the consumer's generational experiences.

At the center of the model lies the assumption that nostalgia appeal positively influences emotional engagement. Consumers exposed to nostalgic advertising are more likely to feel emotionally connected to the advertisement and the brand. Emotional engagement then increases purchase intention by strengthening positive attitudes, perceived familiarity and emotional attachment. This relationship is supported by research indicating that nostalgic memories are emotionally rich and often connected to personally meaningful experiences, social relationships, and identity construction (Wildschut et al., 2006). Nostalgic advertisements activate autobiographical memories and encourage consumers to mentally revisit significant moments from their past.

Such memory activation increases the personal relevance of the advertising message, making consumers more emotionally involved in the communication process. Rather than processing the advertisement solely as commercial information, consumers experience it as a symbolic reminder of meaningful life experiences.

The mediating role of emotional engagement is particularly important because nostalgia alone may not be sufficient to influence behavioral outcomes. Exposure to nostalgic elements does not automatically generate purchase intentions unless consumers become emotionally connected to the message. Emotional engagement serves as the psychological mechanism through which nostalgic stimuli are translated into consumer responses. This perspective aligns with contemporary engagement theory, which views emotional involvement as a critical antecedent of brand relationships, consumer loyalty, and purchase behavior. Highly engaged consumers tend to pay greater attention to marketing communications, develop stronger attitudes toward brands, and demonstrate increased willingness to support brands through purchasing and advocacy behaviors.

Brand attitude is an additional mediator because many nostalgia advertising studies (e.g., Muehling & Sprott, 2004; Merchant & Rose, 2013) show that nostalgia first improves attitudes toward the advertisement and the brand, which then influence purchase intention.

The relationship between emotional engagement and purchase intention can also be explained through theories of emotional decision-making. Consumer decisions are rarely based exclusively on rational evaluations of product attributes. Instead, emotional experiences frequently influence judgments of value, trust, and desirability. When nostalgia generates positive emotional engagement, consumers may perceive the advertised brand as more familiar, authentic, and psychologically comforting. These perceptions reduce emotional distance between the consumer and the brand, thereby increasing the likelihood of purchase.

The model further proposes that brand authenticity moderates the relationship between nostalgia appeal and emotional engagement. Nostalgia is more effective when consumers believe the brand has a legitimate connection to the past it references. Authenticity has become an increasingly important concept in branding literature because consumers are often skeptical of persuasive communication attempts. Nostalgic appeals are likely to be more effective when consumers perceive the brand as having a legitimate historical connection to the memories, traditions, or cultural symbols being referenced. Heritage brands such as Coca-Cola, Nintendo, or LEGO possess an established history that allows nostalgic narratives to appear credible and meaningful. Conversely, when a brand adopts nostalgic themes without a genuine connection to the referenced past, consumers may perceive the appeal as opportunistic or manipulative, reducing its emotional effectiveness.

Another important moderator is consumer nostalgia proneness, defined as an individual's tendency to experience nostalgic feelings and derive psychological satisfaction from reminiscing about the past. Research has consistently demonstrated that individuals differ in their susceptibility to nostalgic experiences (Muehling and Sprott, 2004; Özhan and Akkaya, 2020). Consumers with high nostalgia proneness are more likely to engage emotionally with nostalgic advertising because they naturally enjoy recalling personal memories and reflecting on previous life stages. For these consumers, nostalgic cues may trigger stronger emotional reactions and deeper psychological involvement than for individuals who are less nostalgic by nature.

The model also incorporates product-brand fit as a moderator influencing the relationship between nostalgia appeal and purchase intention. Product-brand fit refers to the perceived consistency between the nostalgic message and the characteristics of the advertised product or brand. The effectiveness of nostalgia depends not only on the emotional power of the appeal but also on its perceived relevance. Certain product categories, such as food, beverages, toys, entertainment products, fashion items, and heritage brands, possess natural connections to memory and personal experience. In these contexts, nostalgia may strengthen purchase intention because consumers perceive a logical and meaningful relationship between the past-oriented message and the product itself. When such fit is absent, consumers may struggle to understand the relevance of nostalgic references, reducing the persuasive impact of the advertisement.

Finally, the model recognizes the moderating role of generational relevance. Nostalgia is inherently linked to temporal experience, meaning that different generations associate nostalgia with different cultural symbols, technologies, media experiences, and social contexts. A campaign built around 1990s popular culture may evoke strong emotional reactions among millennials but may have limited impact on younger consumers who lack direct experience with that period. Similarly, Generation Z may respond more positively to references associated with early social media platforms, childhood digital experiences, or cultural phenomena from the 2000s and early 2010s. Generational relevance therefore influences the extent to which nostalgic cues are recognized, interpreted, and emotionally experienced.

Taken together, the proposed conceptual model suggests that nostalgia advertising operates primarily through emotional mechanisms rather than purely cognitive evaluations. The model extends previous research by integrating nostalgia appeal, emotional engagement, and purchase intention within a single explanatory framework while acknowledging the boundary conditions that determine advertising effectiveness. By incorporating moderators related to authenticity, individual predispositions, brand-product congruence, and generational experience, the model recognizes that nostalgic advertising does not affect all consumers equally. Instead, its effectiveness depends on a complex interaction between advertising content, brand characteristics, and consumer-specific factors.

The proposed framework provides a foundation for future empirical investigation and offers opportunities for testing both direct and indirect effects through structural equation modelling. Such an approach would contribute to a deeper understanding of how nostalgia functions as a strategic advertising tool in contemporary consumer markets and under which conditions it is most likely to generate meaningful behavioral outcomes.

7. Methodological Direction for Future Research

Future empirical research could test this model through an experimental design. Participants could be exposed to two types of advertisements: one nostalgic and one non-nostalgic. After exposure, they could complete a questionnaire measuring emotional engagement, attitude toward the advertisement, attitude toward the brand, perceived authenticity and purchase intention.

A second possible method would be a survey-based study. Respondents could be asked to evaluate real nostalgic campaigns such as Coca-Cola's "Share a Coke", Nintendo's NES Classic Edition, Microsoft's "Child of the 90s" or Barbie's 2023 campaign. The survey could measure nostalgia intensity, emotional engagement, brand authenticity, purchase intention and demographic variables such as age and generational cohort.

Structural equation modelling could be used to test the mediating role of emotional engagement and the moderating effects of brand authenticity and nostalgia proneness. Qualitative interviews could also provide insight into how consumers interpret nostalgic symbols and whether they perceive them as authentic or manipulative.

This methodological approach would allow researchers to move beyond the assumption that nostalgia "works" and instead identify when, why and for whom nostalgia advertising is effective.

8. Discussion

The analysis suggests that nostalgia advertising is powerful because it connects brands with memory, identity and emotion. In an advertising environment dominated by speed, novelty and algorithmic targeting, nostalgia offers a different kind of value: emotional continuity. It reminds consumers of who they were, what they loved and which brands accompanied meaningful moments in their lives.

However, nostalgia advertising must be used carefully. The most effective nostalgic campaigns are not simple copies of the past. They reinterpret the past for the present. Coca-Cola updates personalization through digital sharing. Nintendo reintroduces classic gaming through a modern compact device. Barbie transforms childhood brand memory into a contemporary cultural event. Spotify turns personal data into yearly emotional reflection.

The danger of nostalgia advertising lies in superficiality. Retro colors, old logos or vintage music are not enough if the campaign lacks emotional relevance. Consumers can recognize when nostalgia is used as a decorative trend rather than as a meaningful brand strategy. This is why authenticity and product-brand fit are essential.

Another important aspect is generational targeting. Nostalgia is not universal. Different generations are nostalgic for different symbols, media, objects and cultural moments. Millennials may respond strongly to 1990s references, while Gen Z may feel nostalgia for early social media, childhood games, YouTube culture or 2000s aesthetics. Brands must therefore understand not only the past, but the consumer's relationship to that past.

Finally, nostalgia advertising can influence purchase intention because it reduces emotional distance between consumer and brand. A nostalgic advertisement can make a product feel familiar before it is bought. It can also make the act of purchase feel like participation in a memory, a community or a personal story.

In addition, nostalgia advertising can also function as a mechanism of differentiation in an increasingly saturated competitive environment, where many brands communicate similar messages focused on innovation and performance. By activating autobiographical memory, brands are able to create a deeper connection than simple exposure to an advertising message, as consumers do not merely process information but relate it to their own lived experiences. This reactivation of personal memory can increase both attention and message retention, thereby enhancing the long-term effectiveness of the campaign. At the same time, this type of communication can contribute to strengthening brand loyalty, as consumers tend to associate nostalgic brands with stability, continuity, and trust in a world perceived as rapidly changing.

9. Conclusions

This paper examined the role of nostalgia in advertising and its effects on emotional engagement and purchase intention. The main outcome is that nostalgia can be a highly effective advertising appeal when it activates meaningful memories, creates emotional engagement and reinforces brand authenticity. Nostalgic campaigns can increase purchase intention by making brands feel familiar, emotionally relevant and culturally significant.

The expected impact of this research is both theoretical and practical. Theoretically, the paper contributes to advertising and consumer behavior literature by proposing a model in which emotional engagement mediates the relationship between nostalgia appeal and purchase intention. Practically, the paper suggests that brands can use nostalgia to build emotional connection, but only when nostalgic elements are authentic, audience-relevant and consistent with the brand's identity.

Further research should empirically test the proposed model across different product categories, generations and cultural contexts. Future studies could compare personal nostalgia with collective nostalgia, examine differences between retro packaging and nostalgic storytelling, and investigate how digital platforms transform nostalgia into shareable content. More research is also needed on the risks of nostalgia advertising, especially when consumers perceive campaigns as manipulative, outdated or culturally insensitive.

In conclusion, nostalgia in advertising is not simply about looking backward. It is about using the emotional power of memory to create relevance in the present. When used strategically, nostalgia can transform advertising into a bridge between past experience, present emotion and future purchase behavior.

References:

[1] Batra, R. and Ray, M.L. (1986). 'Affective responses mediating acceptance of advertising', Journal of Consumer Research, 13(2), pp. 234–249.

[2] Belk, R.W. (1990) 'The role of possessions in constructing and maintaining a sense of past', *Advances in Consumer Research*, 17, pp. 669–676.

[3] Brodie, R.J., Hollebeek, L.D., Juric, B. and Ilić, A. (2011). 'Customer engagement: Conceptual domain, fundamental propositions, and implications for research', Journal of Service Research, 14(3), pp. 252–271.

[4] Coca-Cola Company (2025) 'Iconic "Share a Coke" is back for a new generation'.

[5] Coca-Cola Europacific Partners (2025) 'Get to know Coca-Cola's iconic Share a Coke campaign'.

[6] Davis, F. (1979) *Yearning for Yesterday: A Sociology of Nostalgia*. New York: Free Press.

[7] Holak, S.L. and Havlena, W.J. (1998) 'Feelings, fantasies, and memories: an examination of the emotional components of nostalgia', *Journal of Business Research*, 42(3), pp. 217–226.

[8] Hollebeek, L.D. (2011). 'Demystifying customer brand engagement: Exploring the loyalty nexus', Journal of Marketing Management, 27(7–8), pp. 785–807.

[9] MacKenzie, S.B., Lutz, R.J. and Belch, G.E. (1986). 'The role of attitude toward the ad as a mediator of advertising effectiveness: A test of competing explanations', Journal of Marketing Research, 23(2), pp. 130–143.

[10] Merchant, A. and Rose, G.M. (2013) 'Effects of advertising-evoked vicarious nostalgia on brand heritage', *Journal of Business Research*, 66(12), pp. 2619–2625.

[11] Mehrabian, A. and Russell, J.A. (1974). An Approach to Environmental Psychology. Cambridge, MA: MIT Press.

[12] Muehling, D.D. and Sprott, D.E. (2004) 'The power of reflection: an empirical examination of nostalgia advertising effects', *Journal of Advertising*, 33(3), pp. 25–35.

[13] Özhan, Ş. and Akkaya, D.T. (2020) 'The effect of nostalgia proneness on ad-evoked nostalgia, attitude and purchase intention', *İşletme Araştırmaları Dergisi / Journal of Business Research-Turk*, 12(4), pp. 380–390.

[14] Stern, B.B. (1992) 'Historical and personal nostalgia in advertising text: the fin de siècle effect', *Journal of Advertising*, 21(4), pp. 11–22.

[15] The Shorty Awards (2024) 'Barbie The Movie Marketing Campaign'.

[16] Wildschut, T., Sedikides, C., Arndt, J. and Routledge, C. (2006) 'Nostalgia: content, triggers, functions', *Journal of Personality and Social Psychology*, 91(5), pp. 975–993.