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Olha Shkrumiak
PhD Student, Department of International Economic Analysis and Finance, Ivan Franko National University of Lviv, Lviv, Ukraine;
e-mail: olha.shkrumiak@lnu.edu.ua
ORCID: 0009-0002-5565-0134
(Corresponding author)

Yuriy Bilenko
Candidate of Economic Sciences, Associate Professor of the Department of International Economic Analysis and Finance, Ivan Franko National University of Lviv, Lviv, Ukraine;
ORCID: 0000-0002-5877-0564

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INNOVATIONS, FINANCIAL MARKETS DEVELOPMENT, CAPITAL INFLOWS, AND ECONOMIC GROWTH DYNAMICS IN EUROPEAN COUNTRIES

ABSTRACT

Factors that affect economic growth have been studied for a long time. At the same time, traditional economic models struggle to explain why, after reaching the economic frontier, it becomes much harder to keep up with other advanced economies solely through traditional factors such as capital accumulation. Although much research argues that human capital and innovation make growth possible after traditional factors lose their influence, there is still insufficient understanding of how innovative capital interacts with other fundamental drivers of economic development. To address this gap, our research seeks to answer the following question: "Why did Europe lose leadership in innovations, growth, and financial development? Why are there significant disparities in these indicators among European Countries, and how can Europe deal with these challenges?" This research examines how the economic growth of European economies is affected by a set of indicators describing the level of financial market development, innovation activity, and the volume of foreign capital. Systematization of the existing approaches suggests that these factors influence economies differently depending on their structural maturity. Our findings, based on a panel fixed-effects model, demonstrate that research and development, as a proxy for innovation, has the greatest impact on economic growth across all groups of countries. Moreover, foreign capital and innovation act as complementary processes that together have the largest impact on economic growth in most EU economies. In the long term, R&D capital consistently supports growth, with stronger effects in countries that invest more in innovation. In the short term, foreign capital – whether foreign direct investment or debt – often amplifies the influence of innovation on GDP. The results may be useful for policymakers and institutions working to strengthen innovation capacity and support sustainable economic growth in Europe.

Keywords: capital-based economy, debt capital, economic convergence, endogenous growth, equity capital, European economic growth, innovation-based economy, Institutional development, Long-term growth, R&D growth

JEL Classification: F21, F43

INTRODUCTION

Despite being advanced economies, European countries found themselves in a period of slow growth or even stagnation, in which they are no longer drivers of global economic development but are increasingly dependent on external economic and political dynamics. Factors such as the aging population, the war in the region, trade tensions between the major economic powers, and energy crises have highlighted Europe's vulnerability and forced Europe to think about the importance of achieving higher economic independence - the state when the economies are capable of sustaining themselves by securing all the necessary resources and materials without a need to make concessions to its partners. To achieve this, European countries have to focus on factors that shape economic growth and eradicate factors that hamper it.

This paper analyses the key drivers of growth for European economies, such as foreign capital, financial market development, and innovation activity, to understand how and why these factors differ across groups with different levels of economic development.

Foreign capital has been associated with economic growth for a long time. However, as the European Debt Crisis demonstrated, it is essential to distinguish between different types of capital investments - debt or equity, short-term or long-term. While capital can be a great source of growth, it can also pose serious risks unless managed responsibly.

Financial Markets play a vital role in connecting those who have money and those who have ideas worth investing in. The development of financial markets contributed significantly to the rapid economic growth in the US in the past, while the underdevelopment of financial markets is believed to be one of the factors that limit the growth capacity of European economies. The issues are further exacerbated by the lack of full integration of EU member states' capital markets and the unfinished reform of the Capital Markets Union.

Innovation-driven economy and human capital are the factors that distinguish advanced economies from developed ones. However, today's innovation landscape is so saturated that, for countries to sustain their growth rates, they must make significant investments in R&D. Although European countries constantly highlight this as their top priority, the R&D expenditure as % of the GDP of the EU (2,27%) is much lower than that of other advanced countries - the USA (3,46%) or Japan (3,65%).

All factors listed above are believed to significantly influence the economic growth of European economies. In this paper, our primary objective is to explore the causal relationships between Innovations, Financial Markets, Foreign Capital, and Economic Growth across different groups of European Countries both in the short- and long-run.

LITERATURE REVIEW

Endogenous models of economic growth

Since the second half of the 20th century, the most popular and convincing economic models have been endogenous. Their popularity can be explained by the limitations of earlier theories, such as the Solow-Swan model, which could not define the source of technological progress, assumed a diminishing rate of return of capital, and did not consider the role of human capital. Endogenous models instead explain the key drivers of growth by the economic activity within the model.

The AK model is an example of the early, simplistic endogenous model. It rejects the diminishing rate of return of capital and the exogenous nature of technological progress, while still highlighting the importance of capital accumulation. The simplicity of the model and its inability to explain differences in economic growth across countries with the same level of capital accumulation led to the development of more advanced economic models that emphasize the importance of factors such as innovation, human capital, and institutions.

The development of the creative destruction concept (Schumpeter, 1942) made its author the pioneer in innovation-led economic models. His theory highlights the endogenous nature of technological progress while emphasizing the stochastic nature of innovation, which cannot be perfectly predicted but can be influenced by factors such as market conditions and institutional development. According to Schumpeter, the dynamic process of creative destruction is crucial for long-term economic growth.

P. Romer presented another groundbreaking endogenous growth theory in "Endogenous Technological Change" (Romer, 1990). Romer's definition of an idea as a "non-rivalry good" implies that once an idea is created, it can be used by many entities without being depleted, enabling increasing returns to scale in production. The knowledge produced by one company can be "spilled over" to another company, increasing overall productivity.

Additionally, D. Acemoglu (D. Acemoglu et al., 2005) complemented endogenous models with a detailed analysis of institutions as another key driver of economic development. Based on the argument developed by North (North, 1990) that institutions "are the humanly devised constraints that shape human interaction", Acemoglu et al. (2005) state that differences in economic institutions are the main reason for the differences in economic growth and prosperity. Authors argue that institutions are endogenous factors, resulting from society's collective voice.

Taking into account these models, a unifying framework that combines different endogenous growth theories - the ones that highlight capital accumulation as the driver of economic growth and those focusing on innovation - was developed (Aghion et al., 2005). According to the unifying framework, for a country to catch up with the technological frontier (Romer, 1989), it is important to have developed institutions, sufficient savings, and a favorable local investment climate (including

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macroeconomic stability, developed infrastructure, and social peace). However, as a country approaches the technological frontier, an implementation-based economic approach cannot provide sufficient growth to compete with technological leaders. To compete with leaders, countries have to focus on innovation-led policy that consists of 3 pillars: competition and entry policy, education, and sound macroeconomic policy. In our research, we adhere to this theory, considering the factors defined by Aghion et al. (2005) as the reasons why the EU's most developed countries are still lagging behind the US (even despite the well-developed institutions, infrastructure, and high savings rate).

Capital and economic growth

There is no consensus among economists on how financial leverage (private credit-to-GDP ratio) affects economic growth. According to research (Zhu et al., 2020), countries with higher levels of financial leverage (with a threshold defined to be 60%) have low or insignificant impacts of innovation on economic development. Among the reasons for such a situation are resource misallocation (both physical and human capital are lured into less productive sectors with higher profitability) and weaker credit constraints that make it easier for less efficient companies to stay in the market, thereby preventing new innovators from entering.

In contrast, another study (Bhattarai, 2015) states that empirical research shows the positive impact of bank credits on economic development. According to Bhattarai, higher corporate financial leverage promotes additional financing of investment or current expenditures, leading to increases in both aggregate supply and aggregate demand in the country.

It is also unclear how differences in capital structure (primarily the distribution between debt and equity) affect growth. While some argue that differences in capital structure do not affect growth (Beck & Levine, 2004), others state that it is the equity and the financial market that absorbs shocks better and promotes higher growth rates (Gambacorta, 2014).

The impact of foreign capital on the economy is ambiguous as well. It can promote economic development if this capital is to finance strategic projects or simplify technological transfers (Dell'Ariccia, 2008). Additionally, it is believed that foreign direct investment increases total factor productivity growth (Kose, 2017). At the same time, if capital flows into the country in the form of debt, it can negatively impact the economy. The procyclical and volatile nature of debt flows (especially short-term debt) can make the economy less resistant to political or economic shocks (Prasad, 2007). Moreover, it is argued that some countries are better off relying less on foreign capital, especially if they have limited capacity to absorb it due to low financial and institutional development (Prasad, 2007). Additionally, the increase in expenditures on servicing the government debt can also lead to a crowding-out effect, reducing government investment. This can be counterproductive, as it is precisely the capital investment that drives long-term growth (Larch, 2022).

Despite many ambiguous concepts and interconnections, economists agree that foreign capital can promote growth if it is directed toward long-term investment and innovation, not short-term consumption, and if the recipient country is financially and institutionally developed. It is also generally agreed that the government should incentivize long-term investment and innovation. The high-risk and intangible nature of R&D results makes them difficult to protect from competitors, thus reducing private returns significantly (Veugelers, 2016). Additionally, the social benefits from the R&D outcomes can far exceed the private returns. Therefore, the government should support the companies that invest long-term in R&D and invest in R&D itself.

Single financial market

To understand the EU financial market, it is important to start by examining the process of financial integration, its benefits, and pitfalls. Guiso et al. (2004) define EU financial integration as the situation in which the availability of finance for any economic agent is not limited to the country of its registration. Companies registered in any EU member state have equal access to finance across the EU, regardless of the volumes and capacities of their local financial markets.

Although financial integration does not directly lead to economic growth (Guiso et al., 2004), it is believed to increase the availability of capital, competition with foreign financial intermediaries, and harmonize financial standards. These factors reduce the cost of financial services and promote investment, which in turn leads to economic growth.

It is believed that better-developed financial systems "ameliorate the effects of information, enforcement, and transactions costs and therefore do a correspondingly better job at providing the five financial functions": reduce the costs of acquiring and processing information and as a result improve capital allocation; mprove corporate governance by economizing on monitoring costs; ease the trading, hedging, and pooling of risk; mobilize savings and facilitate the exchange of goods and services (Levine, 2004).

However, economists (Lannoo & Thomadakis, 2019; Beck et. al., 2024) argue that full integration of the EU financial markets has yet to be achieved. One reason for this is the unequal distribution of the benefits from financial integration, which creates opposition among large financial players (both corporations and the national government) that benefit more from the status quo. Additionally, financial integration is a political process that depends on policymakers' political will, social movements, and market fluctuations - all of which make integration highly unpredictable and difficult to implement. As a result, neither a banking union nor a capital market union reform can be regarded as fully completed or successful. Consequently, nowadays the EU reaps far fewer benefits from its financial markets than the US or Canada (Lannoo & Thomadakis, 2019).

Post-2008 financial crisis uncertainty about bank capital and the low propensity to invest in securities indicate that EU authorities need to accelerate financial market reforms to boost the EU's competitiveness. Given the overwhelmingly bank-based nature of EU finances, the union should focus on developing its stock market. Although debt instruments can reduce the amount of free cash available to firms, thereby reducing managerial slack and accelerating the rate at which managers adopt new technologies (Levine, 2004), the stock market promotes growth by providing corporations with access to capital sources unavailable from banks. The stock market also encourages risk-taking, which promotes innovation. Additionally, non-bank-based capital is an alternative to government financing, providing access to additional financing without an increase in government debt.

All topics identified above revolve around innovations and their importance in economic growth, and although there are a lot of research and publications on the innovation-growth nexus, majority of them are at least decades old or focus only on innovation as a economic growth driver (Bilbao-Ozerio et al, 2004; Ulku, 2004; Tebaldi & Elmslie, 2008; Guloglu & Tekin, 2012; Dietrich et al., 2024; Dugo & Erixon, 2024).

We suggest using the latest data to review the more comprehensive picture - the impact of innovations, financial markets, and foreign capital on economic growth by taking into account regional and economic differences between EU member states.

AIMS AND OBJECTIVES

The goal of this research is to examine how financial markets, foreign capital, and innovation affect economic growth in EU countries, and how these relationships differ depending on the level of economic and financial development. The study also explores whether these factors contribute to the growing growth gap between the EU and the United States. Based on the literature review and econometric results, the research aims to identify ways for the EU to reduce internal disparities while remaining a competitive global economic player.

The objectives of the study are:

- to analyze the impact of foreign capital and financial market development on economic growth;
- to assess the role of innovation (R&D growth) in economic growth;
- to compare growth patterns across different EU country groups;
- to identify actions for reducing growth disparities within the EU and between the EU and the United States.

METHODS

Based on the factors described in the Literature review, we assume that economic growth drivers differ across the EU: for advanced economies, innovations could play a much bigger role than for developed countries still approaching the economic frontier. Meanwhile, for the latter, it is the capital that is still much more important to reach desired economic growth rates.

To verify this assumption, we have divided EU member-states into three distinct groups: Southern Europe (GIPS economies), Central and Eastern Europe (CEE), and Northern Europe (Scandinavian). These groups differ not only in geography but also in their levels of economic development. The first group includes Greece, Italy, Portugal, and Spain - the countries that experienced harsh financial crises caused by high levels of external debt. The CEE group includes Hungary, Poland, the Czech Republic, and the Slovak Republic: these post-Soviet bloc countries have relatively low levels of economic development but have experienced high economic growth rates since joining the EU. The Scandinavian group includes the most developed countries - Finland, Denmark, Sweden, and Norway (although Norway is the only country in our research that is not an EU member-state, it is closely associated with the EU through its membership in the European Economic

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Area). While countries within each group have their patterns of development, their geographic and economic proximity make them ideal for comparative analysis. This allows us to gain a more comprehensive picture of what drives economic growth in each region.

For the research, we collected data from 1996 to 2022 (27 years) and averaged it into 3-year periods (9 periods) to smooth out fluctuations.

As an indicator of economic development, we used GDP growth in current prices. It allows us to align with other nominal indicators such as FDI and debt growth. GDP data was sourced from the World Bank.

As for the factors that can potentially influence economic growth, we consider the following variables:

1. R&D growth is used as a proxy for innovations. The data (R&D as a percentage of GDP) sourced from the World Bank were multiplied by GDP to calculate R&D expenditure growth.
2. FDI growth serves as a proxy for entrepreneurial capital invested in the country. As FDI is invested directly in countries, it does not require repayment and reflects the lasting interest of a resident entity in one economy by an entity resident in another economy (IMF, 2002, IIP: A Guide to Data Sources). Higher FDI rates indicate greater confidence among investors in the country's stability and growth potential. FDI data was taken from the IMF International Investment Position (Liabilities section, Direct Investment indicator).
3. Debt growth is used as an indicator of the debt capital borrowed by the country. Debt data was sourced from the IMF International Investment Position, Liabilities section, as the sum of Portfolio investment (Debt securities) and Other Investments. Although a high level of debt instruments is regarded as risky for the economy, it can also be an indicator of financial market development.
4. Financial Market Depth, a component of the IMF Financial Development Index, serves as a proxy for financial market development. Financial Market Index includes data on stock market capitalization to GDP, stocks traded to GDP, international debt securities of government to GDP, and total debt securities of financial and nonfinancial corporations to GDP.
5. Inflation (GDP deflator) is used as a comprehensive indicator of inflation across the entire economy. Data was also sourced from the World Bank.

Analytical Approach: To measure the causal impact of these factors on economic growth, we employed a panel fixed-effects model with least-squares estimation. Additionally, we applied the Dumitrescu–Hurlin panel Granger causality test to determine the direction of causal relationships among the variables.

RESULTS

The results from the panel fixed-effects model regression are summarised in Table 1. The analysis provides separate regression models for each group, illustrating the effect of factors on economic growth.

For the Scandinavian group, the equation is as follows (with an R-squared of 82%, indicating a strong fit between the model and data):

$$\text{GDP growth} = 0.06 \times \text{FDI growth} + 0.21 \times \text{Debt growth} + 0.58 \times \text{R\&D growth} - 0.006 \times Inflation + 0.65 \times Financial\ market\ depth \quad (1)$$

For CEE economies, panel regression showed the following results (R-squared shows that the data fit the model for 85%):

$$\text{GDP growth} = 0.2 \times \text{FDI growth} + 0.17 \times \text{Debt growth} + 0.39 \times \text{R\&D growth} - 0.001 \times Inflation + 0.05 \times Financial\ market\ depth \quad (2)$$

The GIPS group's regression model yields (R-squared 86%):

$$\text{GDP growth} = 0.16 \times \text{FDI growth} + 0.35 \times \text{Debt growth} + 0.22 \times \text{R\&D growth} - 0.007 \times Inflation + 0.06 \times Financial\ market\ depth \quad (3)$$

Table 1. Result of panel fixed-effect model regression. Note: * - t-statistics in brackets. *(Source: developed by authors based on World Bank Open Data and IMF Database)*

GDP growth (dependent variable)	Scandinavian	CEE	GIPS
FDI growth	0.061367 (0.893274) - insignificant	0.199292 (3.914982)	0.156124 (2.051773)
Debt growth	0.212383 (2.323454)	0.167743 (2.397443)	0.353588 (3.570747)
R&D growth	0.580003 (3.458927)	0.391585 (4.917789)	0.215142 (2.333102)
Inflation (GDP deflator)	0.006226 (1.872386)	-0.001601 (-0.940725) - insignificant	-0.004649 (-0.768009) - insignificant
Financial market depth	0.060964 (2.106793)	0.047571 (0.580153)- insignificant	0.060622 (1.984514)
R-squared	0.821906	0.850251	0.86192

To examine the specific impact of each indicator on economic growth across the three groups, we divided this analysis into three sections. First, we will review how investment in the form of FDI and debt capital affects economic growth and how the different levels of financial market development impact the long-term economic growth of each group. In the second section, we will examine the impact of innovation activity on economic growth, provide an overview of current R&D activity, its disparities across groups, and the implications for the long term. In the third section, we will analyze bidirectional causal relationships between the indicators using Granger Causality tests.

Foreign Capital and Financial Market Impact on Economic Growth

The impact of FDI is most substantial in CEE economies, where 1% of FDI growth is associated with 0.2% of GDP growth (2). It also has a significant effect on GIPS economies, as a 1% increase leads to a 0.15% increase in GDP growth (3). However, the impact is much smaller in the Scandinavian countries: 1% of FDI growth yields only a 0.06% rise in GDP growth, three times lower than in other groups (1).

The impact of FDI growth on GDP growth varies, despite similar FDI-to-GDP ratios across the three groups (Figures 1-3). This is mainly due to differences in economic development.

Due to their higher level of development, Scandinavian countries are less dependent on foreign investment. With access to more domestic capital and a better functioning financial market, they can finance growth internally. Additionally, Scandinavian economies are less capital-intensive, focusing on services such as finance and technology. As a result, the capital invested in the country plays a less significant role in the economy.

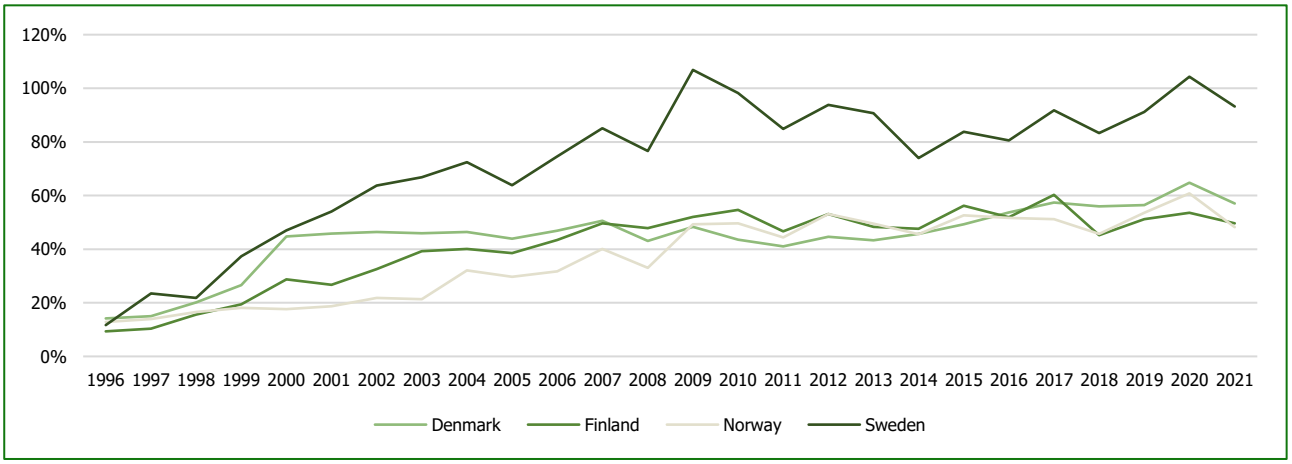

Figure 1. FDI to GDP ratio for the Scandinavian group. *(Source: developed by the author based on World Bank Open Data and IMF Database)*

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Figure 2. FDI to GDP ratio for the CEE group. *(Source: developed by the author based on World Bank Open Data and IMF Database)*

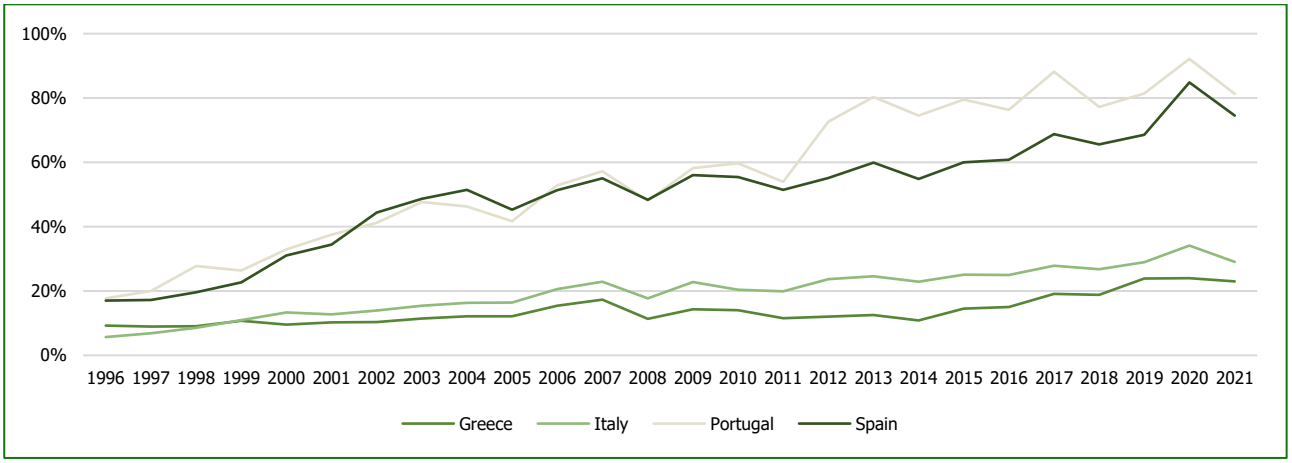

Figure 3. FDI to GDP ratio for the GIPS group. *(Source: Developed by the author based on World Bank Open Data and IMF Database)*

In contrast, both GIPS and CEE rely more on foreign investment due to a lack of domestic financing and underdeveloped financial markets. The volume of domestic credit to the private sector (% of GDP) further supports this explanation (Figure 4). Higher levels of domestic credit availability indicate a more developed financial infrastructure in Scandinavian countries, thereby reducing the need for external financing. At the same time, in the GIPS and CEE groups, neither the banking sectors nor the financial markets can sufficiently support economic development. Thus, for those countries, FDI plays a crucial role in their catch-up process, facilitating technological modernization and industrial development.

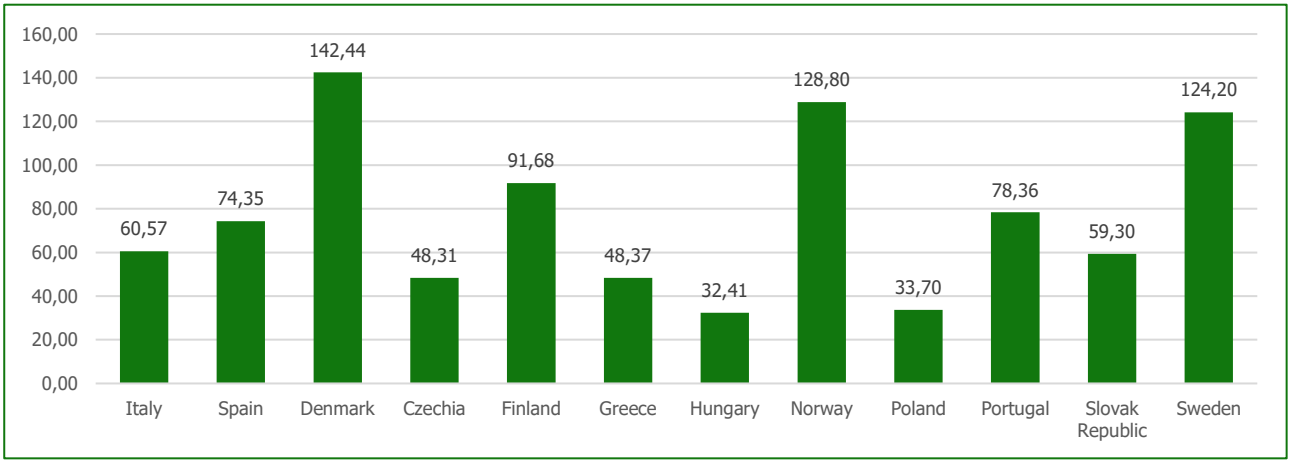

Figure 4. Domestic credit to private sector (% of GDP), 2024. *(Source: data from the database: World Development Indicators (11/23/25))*

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In this research, we regard debt capital as the sum of portfolio investments (bonds, notes, and money-market instruments) and other investments (trade credits, loans, currency, and deposits), including both long- and short-term investments.

The analysis shows that debt capital has the largest impact on economic growth in the GIPS economies, followed by Scandinavian economies, with the CEE economies experiencing the smallest effect.

Figures 5-7 show that the difference in the coefficients strongly correlates with the level of foreign debt capital per group (in % of GDP). GIPS countries have the highest ratio, while CEE countries have the lowest (approximately 3 times lower).

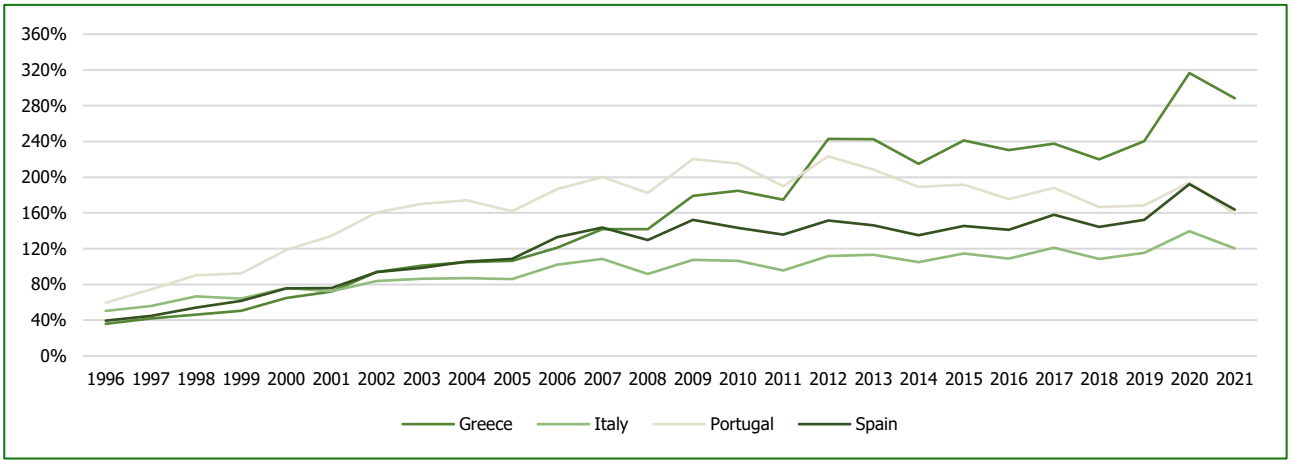

Figure 5. Foreign debt to GDP (%) for the GIPS group. *(Source: developed by the author based on World Bank Open Data and IMF Database)*

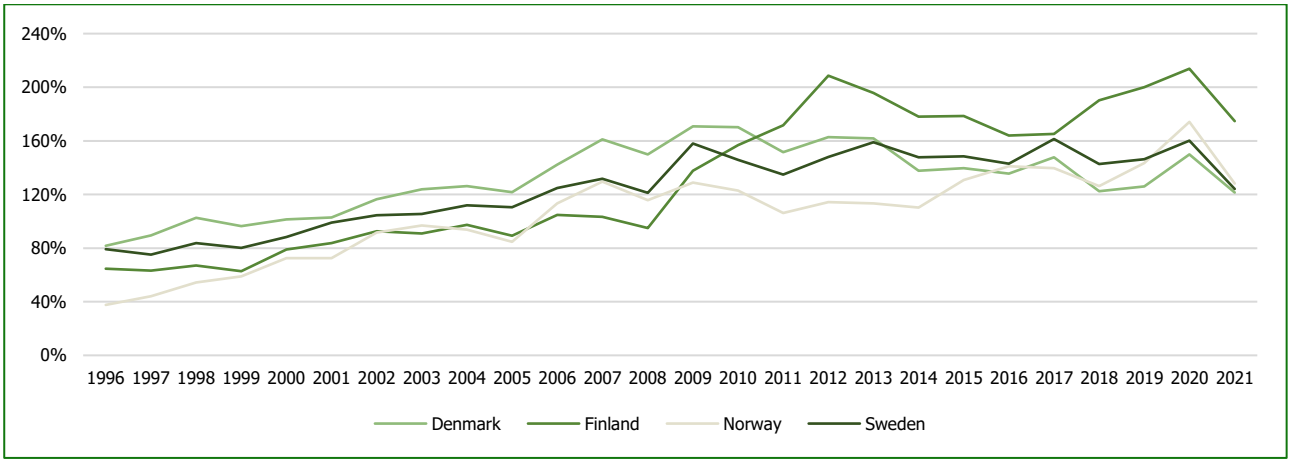

Figure 6. Foreign debt-to-GDP (%) for the Scandinavian group. *(Source: developed by the author based on World Bank Open Data and IMF Database)*

Figure 7. Foreign debt to GDP (%) for the CEE group. *(Source: developed by the author based on World Bank Open Data and IMF Database)*

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Debt capital does not play an important role in CEE economies. They did not attract portfolio investors due to the low level of financial development. Additionally, CEE economies do not rely heavily on credit financing because, as relatively recent EU members, they receive sufficient capital through foreign direct investment (FDI) rather than debt.

Scandinavian economies' robust financial markets allow them to leverage debt efficiently and finance long-term investments in innovation and infrastructure.

In GIPS economies, however, the ratio of the portfolio to other investments is much lower, especially in Greece and Portugal. After the 2008 financial crisis, portfolio investors' confidence declined sharply, leaving these countries more dependent on trade credit and loans to sustain economic activity. Although the amount of foreign investments has been increasing since the crisis, credits and loans still play a significant role.

The third factor influencing the impact of financial markets and foreign capital on economic growth is financial market depth, which is statistically significant only for Scandinavian groups (1). Why is this the case?

The financial market depth metric mainly reflects stock and bond market activity. However, Europe is traditionally regarded as bank-based in its financial structure, while the US is more focused on market-based finance. For example, the Eurozone credit market accounts for 70% of its GDP, while the capital market accounts for only 30-40%. At the same time, in the USA, it is 50% and 190%, respectively. Although the difference in credit is not that significant, the difference in market capitalization is substantial (Lannoo & Thomadakis, 2019).

For developed economies, it is important to have both bank- and market-based finances, but attracting finances through credit has some limitations in terms of volumes (lower than for market-based finances), risk profile (not suitable for high-risk activities) and incentive (the creditor (typically a bank) has no upside from granting credit and the focus is on getting the money back) (Næss-Schmidt et al., 2021). Bank-based finance is suitable for small and medium-sized enterprises (SMEs) with the traditional structure of the business, which is why, according to the European Commission, more than 99 percent of all European nonfinancial businesses are SMEs (Xafa, 2017).

For companies aiming to diversify risks, decrease the costs of raising capital, and focus on disruptive technologies and innovation, well-developed capital markets are essential.

According to The Capital Flywheel – European Capital Markets Report, in the US, the assets available for long-term investments (including all types of investors such as households, pension funds, and insurance companies) account for 622% of GDP and while Scandinavian countries have a similar amount (Denmark - 654% and Sweden - 483%), some major European economies lag significantly behind with 200% to 300% of GDP (Wyman, 2024). The most significant gap, however, is that whereas the US allocates 525% of GDP into capital markets, the major EU economies' capital markets receive at most half of it (with Scandinavian countries being an exception, investing 411% and 468% of GDP in capital markets in Sweden and Denmark, respectively). Direct and indirect capital market investment in the UK achieves 297%, in Italy - 200%, in Germany - 141%, and in Spain - 131%. The largest share of available funds goes to non-capital markets, such as currency and deposits, land and buildings, and loans. Such limited activity in the capital markets oppresses economic growth for European nations, and although the immediate effects of this are not highly visible, the long-term implications are significant, and some of them are reflected in the limited innovation potential.

Specialists of the European Investment Bank conceive that "investment plays a crucial role in explaining Europe's constrained innovation performance. European investors appear far more risk-averse than their counterparts elsewhere, adopting a wait-and-see attitude. This matters, as innovation today is happening at a faster pace, has a deeply transformative character, and is increasingly science-based and complex. The lack of risk capital and other investments makes it difficult for European innovators to adopt new technologies or grow new, disruptive businesses" (European Investment Bank, 2023, p.2).

Innovations and Economic Growth

R&D growth as a proxy for innovations has a massive impact on the economic growth of all the groups (1)(2)(3). However, the regression results show that Scandinavian countries benefit the most from R&D growth.

One of the main reasons for this is explained above: the well-developed capital markets that are suitable for financing high-risk projects and promoting innovation. The second reason is the sums spent on R&D itself: R&D expenditures (% of GDP) are the highest for the Scandinavian countries (around 3%), but they are much lower for the CEE and GIPS countries (Figures 8-10).

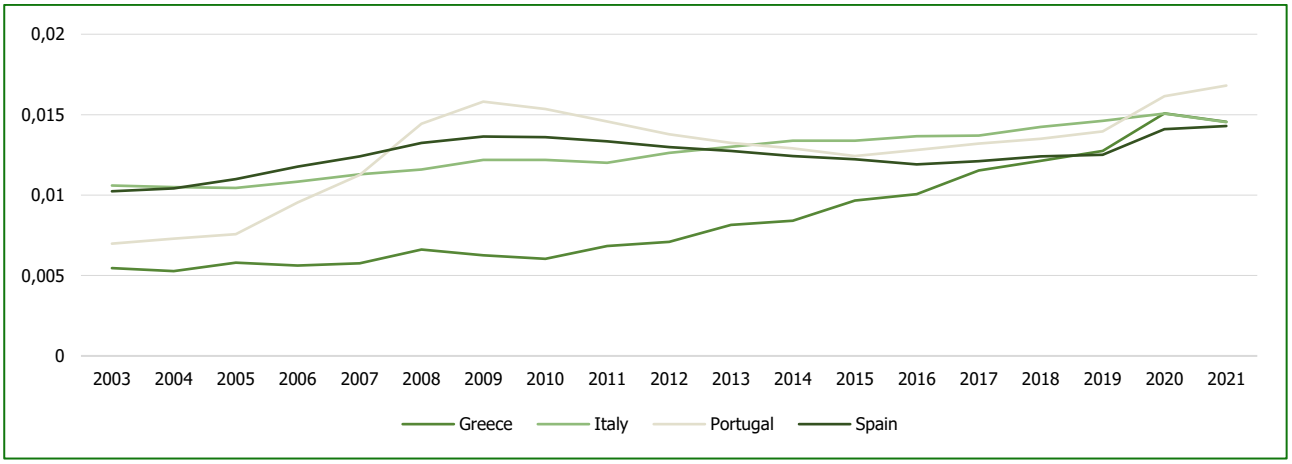

Figure 8. R&D to GDP (%) for the GIPS group. *(Source: developed by the author based on World Bank Open Data)*

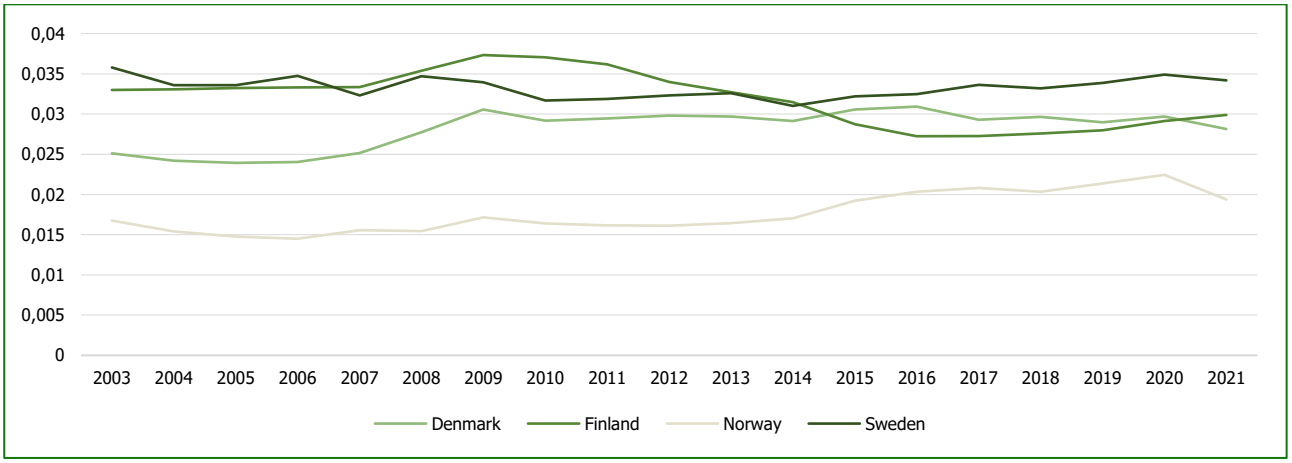

Figure 9. R&D to GDP (%) for the Scandinavian group. *(Source: developed by the author based on World Bank Open Data)*

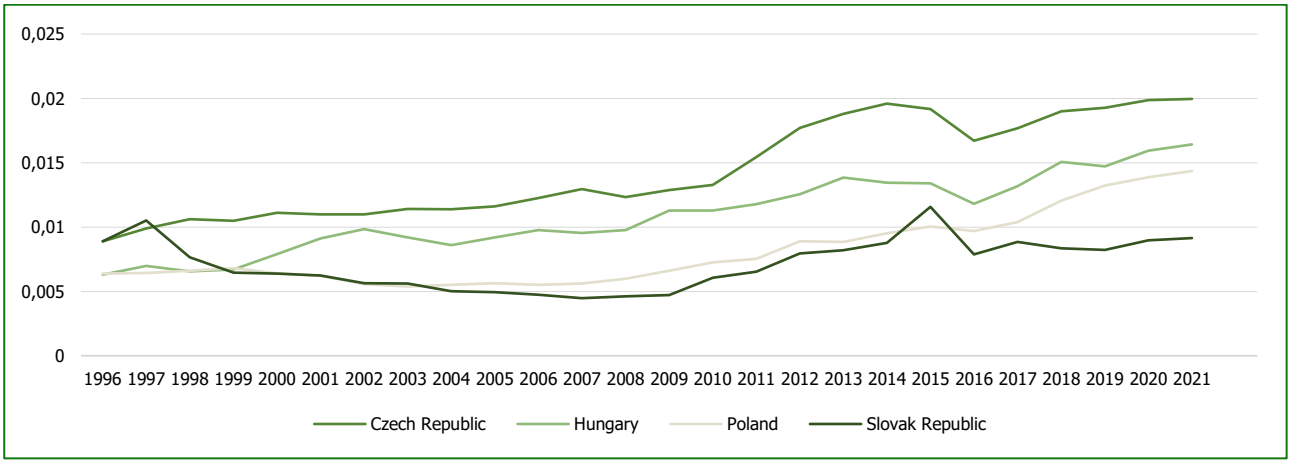

Figure 10. R&D to GDP (%) for the CEE group. *(Source: developed by the author based on World Bank Open Data)*

Beyond low R&D expenditures (the EU average is 2.28%), the EU concentrates its main innovation activities on mid-tech industries - automotive and traditional manufacturing (chemicals, industrial machinery). The US, on the other hand, invests heavily in high-tech sectors, including ICT and health. Latter industries are both more R&D-intensive (4,8% for automotive vs 10,9% for ITC services vs 7,4% for ICT producers and 12,9% for health industries, where R&D intensity is defined as R&D investment divided by net sales per sector) and generate higher growth rates. According to the EU Industrial R&D Investment Scoreboard 2023, although the EU still has several global tech companies, the share of EU companies in the top 2,500 R&D investors has fallen over time. Only 82 new EU companies entered the Scoreboard over the period 2012-

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2022, while China had 657 and the US had 634. Another EU problem is the shortage of high performers, as only 7 of 126 EU regions have R&D spending rates higher than the US average (Dugo & Erixon, 2024).

UNCTAD specialists (UNCTAD, 2021, p.52) conducted a study of the relationship between the growth rates of R&D expenditures and economic growth for the period 2007-2017 for countries with different income levels and obtained the following results: for low-income countries, the growth rates of R&D (7.2%) are 1.8 times higher than the growth rates of GDP (4%) and their share in GDP is 0.3%; for lower middle-income countries, the growth rates of these indicators are almost equal and are 4.5% and 5.5% respectively, and the share of R&D in GDP is 0.43%; for upper-middle income countries, the growth rates of R&D expenditures are 2 times higher than the growth rates of GDP (10.2% Vs 5%) and the share of R&D in GDP is 1.48%; for high income countries, the growth rate of R&D (2.3%) is 1.64 times higher than the growth rate of GDP (1.4%) and accounts for 2.42% of GDP. In general, worldwide, the share of R&D expenditures is 1.72%, and its growth rate (4.3%) is 1.65 times higher than the growth rate of GDP (2.6%). From this study, we can conclude that income per capita growth stimulates innovation expenditures in the country, which, in turn, accelerates R&D financing growth, attracting additional capital for sustainable economic growth.

Simply spending on R&D, however, does not automatically lead to higher productivity. For instance, Japan consistently spends above 3% on R&D, yet its productivity is still slowing. For R&D spending to drive significant growth, it must target high-potential areas for innovation. However, the EU's risk-averse nature also promotes highly regulatory environments. Although EU regulations are aimed at protecting consumers' rights and supporting data protection, they can harm innovation. For instance, GDPR rules increased data storage costs for European firms by 20% compared to their American counterparts, causing an average 8% drop in profits and a 2% decrease in sales for regulated firms (Dugo & Erixon, 2024). While it went almost unnoticed for large firms, it strongly affected SMEs. This issue is also reflected in venture capital investments. For example, 42 of the 50 US states spent more on venture capital per capita than Germany, Europe's largest economy.

To conclude, R&D investments are crucial for economic growth, and both the amount invested and the sectors targeted make a difference. These factors, along with the level of financial market development, are major reasons for the growth gap between the U.S. and the EU.

Casuality research

The panel regression results indicate that factors affecting economic growth vary across groups: FDI does not affect Scandinavian economies, debt capital growth does not affect CEE countries, inflation is insignificant across all economies, and financial market depth matters only for Scandinavian countries. R&D growth, however, has a substantial and significant impact on all economies. This raises a question: Does innovation drive economic growth? Does increased economic output support more innovative activity? Or do other mediators support these relationships? To answer it, we held the Granger causality test for each group.

The EViews statistical program offers two approaches to causality testing in panels: the first one treats the panel data as one large stacked set of data, all coefficients are the same across all cross-sections, and then performs the Granger Causality test in the standard way; the second approach, adopted by Dumitrescu-Hurlin (2012), makes an extreme opposite assumption, allowing all coefficients to be different across cross-sections:

$$\alpha_{0,i} \neq \alpha_{0,j}\,, \alpha_{1,i} \neq \alpha_1\,, j, \dots, \alpha_l, i \neq \alpha_{l,j}, \forall\, i, j$$

$$\beta_{1,i} \neq \beta_{1,j} \dots, \beta_{l,i} \neq \beta_{lj}\ \forall\, i, j \qquad (4)$$

In this paper, we adopt the latter approach. The Dumitrescu–Hurlin test works in two steps. First, it computes the average of the individual Wald statistics across units (the $\bar{W}$ statistic). Second, it adjusts this average into a standardized form, called the $\bar{Z}$ statistic, which follows a normal distribution under the null hypothesis.

The null hypothesis is that there is no Granger causality among any of the panel units. If the $\bar{Z}$ statistic is bigger than the critical value, we reject the null and conclude that at least one country (or unit) shows Granger causality.

Table 2. Dumitrescu-Hurlin test results for the Scandinavian group. *(Source: developed by authors based on World Bank Open Data and IMF Database)*

Null Hypothesis	W-Stat.	Zbar-Stat.	Probability
R&D Growth does not homogenously cause GDP growth	0.46614	-1.34831	0.1776
GDP growth does not Granger-cause R&D Growth	1.01242	-0.9525	0.3408
R&D Growth does not homogenously cause Debt growth	1.72778	-0.43419	0.6642
Debt growth does not homogenously cause R&D Growth	12.0444	7.04075	2.00E-12
R&D Growth does not homogenously cause FDI growth	1.45684	-0.63049	0.5284
FDI growth does not homogenously cause R&D Growth	5.85859	2.55881	0.0105
R&D Growth does not homogenously cause Financial Markets Depth	3.93082	1.16204	0.2452
Financial Markets Depth does not homogenously cause R&D Growth	5.70826	2.44989	0.0143
Financial Markets Depth does not homogenously cause Debt growth	6.64609	3.50656	0.0005
Debt growth does not homogenously cause Financial Markets Depth	2.64275	0.32393	0.746
FDI growth does not homogenously cause GDP growth	4.57717	1.86178	0.0626
GDP growth does not homogenously cause FDI growth	1.83029	-0.32198	0.7475

In Scandinavian countries, the R&D growth is fueled by capital inflows (FDI, debt, and financial markets). Moreover, FDI growth that affects both R&D growth and GDP growth, suggesting that FDI plays a significant role in promoting innovation and economic growth by providing liquidity and resources to finance high-tech sectors, modernize industries, and enhance competitiveness (see Table 2).

The huge differences between the panel regression model and Granger causality test results may be due to their different focuses: while panel regression analyzes long-term dynamics, Granger highlights short-term causal impacts. Although FDI does not directly drive long-term growth in Scandinavian countries, it provides essential resources for R&D and also brings technology transfers and managerial expertise that contribute to rapid productivity gains. Debt growth also drives R&D and GDP growth, which are important for debt-driven growth policies that strongly stimulate innovation. Financial Market Depth causes debt growth and R&D growth in Scandinavian countries.

In CEE economies, as shown in Table 3, FDI growth strongly drives GDP and R&D growth, which means that foreign investment boosts economic and innovation growth. Financial Markets Depth plays a central role, influencing GDP, R&D, and FDI. Debt growth has a widespread impact – affecting GDP, FDI, and R&D.

Table 3. Dumitrescu-Hurlin Test results for the CEE group. *(Source: developed by authors based on World Bank Open Data and IMF Database)*

Null Hypothesis	W-Stat.	Zbar-Stat.	Probability
R&D Growth does not homogenously cause GDP growth	2.30036	0.03947	0.9685
GDP growth does not Granger-cause R&D Growth	1.07754	-0.91913	0.358
R&D Growth does not homogenously cause Debt growth	2.19177	-0.04565	0.9636
Debt growth does not homogenously cause R&D Growth	6.20057	3.09696	0.002
R&D Growth does not homogenously cause FDI growth	3.67602	1.11789	0.2636
FDI growth does not homogenously cause R&D Growth	6.43965	3.28438	0.001
R&D Growth does not homogenously cause Financial Markets Depth	3.04474	0.62301	0.5333
Financial Markets Depth does not homogenously cause R&D Growth	9.98326	6.06231	1.00E-09
Financial Markets Depth does not homogenously cause FDI growth	5.44484	2.55157	0.0107
FDI growth does not homogenously cause Financial Markets Depth	2.24346	0.00649	0.9948
FDI growth does not homogenously cause GDP growth	11.247	7.18905	7.00E-13
GDP growth does not homogenously cause FDI growth	3.6484	1.1295	0.2587

In the case of GIPS economies (see Table 4), despite R&D's strong impact in the panel regression model, there is no direct causal link between R&D and GDP in the Granger causality test. Debt growth acts as a mediator and strongly affects both R&D and GDP growth. FDI growth significantly affects GDP, while R&D growth affects the FDI group. Inflation (measured

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by the GDP deflator) plays a central role, strongly influencing key macroeconomic variables (GDP, R&D, FDI, Debt). Financial market development affects Debt, but has no significant effect on GDP growth, which does not Granger-cause most variables — i.e., GDP growth does not appear to be the driver for changes in other indicators in this panel.

Due to the severe effects of the 2008 financial crisis, financial market confidence in GIPS economies has been weak; thus, growth in investment activity and the economy is an important indicator that stimulates financial market activity. At the same time, increased financial market activity facilitates credit access and liquidity, helping finance investment projects and economic activity.

Table 4. Dumitrescu-Hurlin test results for the GIPS group. *(Source: developed by authors based on World Bank Open Data and IMF Database)*

Null Hypothesis	W-Stat.	Zbar-Stat.	Probability
R&D Growth does not homogenously cause GDP growth	1.9454	-0.26274	0.7928
GDP growth does not Granger-cause R&D Growth	1.26893	-0.76593	0.4437
R&D Growth does not homogenously cause Debt growth	1.44868	-0.63223	0.5272
Debt growth does not homogenously cause R&D Growth	7.9336	4.1916	3.00E-05
R&D Growth does not homogenously cause FDI growth	8.3103	4.47181	8.00E-06
FDI growth does not homogenously cause R&D Growth	1.0343	-0.94046	0.347
R&D Growth does not homogenously cause Financial Markets Depth	3.82792	1.13758	0.2553
Financial Markets Depth does not homogenously cause R&D Growth	0.79091	-1.12151	0.2621
Financial Markets Depth does not homogenously cause Debt growth	7.46341	4.15632	3.00E-05
Debt growth does not homogenously cause Financial Markets Depth	0.6916	-1.22723	0.2197
FDI growth does not homogenously cause GDP growth	6.55255	3.4322	0.0006
GDP growth does not homogenously cause FDI growth	1.23875	-0.79225	0.4282
Debt growth does not homogenously cause GDP growth	17.5474	12.173	0
GDP growth does not homogenously cause Debt growth	1.12695	-0.88113	0.3782
Inflation (GDP deflator) does not homogenously cause R&D Growth	6.78595	3.33792	0.0008
R&D Growth does not homogenously cause Inflation (GDP deflator)	2.21624	-0.06127	0.9511
Inflation (GDP deflator) does not homogenously cause GDP growth	6.42959	3.33444	0.0009
GDP growth does not homogenously cause Inflation (GDP deflator)	2.8638	0.49966	0.6173

Maradana et al. (2017) similarly find mixed evidence on the relationship between innovation and per capita economic growth, noting that the causal relationships between innovation and economic growth differ from country to country. While in some countries these causal relationships are demand-led (GDP growth drives innovation), in others they are supply-led (R&D growth drives economic activity). The two factors can be interdependent or independent as well. Based on the factors we consider proxies for innovation (number of patents, R&D spending, number of researchers, high-technology exports, and scientific and technical journal articles), the impact on economic growth can differ significantly. However, the authors conclude that there is a long-term link between innovation and growth, as evidenced by cointegration in their study.

Overall, capital and innovation are also complementary processes. More capital accumulation stimulates innovation by raising the equilibrium flow of profits, just as more innovation stimulates capital accumulation by raising the rate of productivity growth. Neither process could take in the long run without the other. "For without innovation, diminishing returns would choke off net investment, and without net investment the rising cost of capital would choke off innovation" (Aghion & Howitt, 1998, p.99).

DISCUSSION

In contrast to other research that focuses mainly on specific indicators or specific countries, this paper adopts a comprehensive approach by analysing countries that differ in their levels of economic development and by examining several indicators simultaneously in order to understand how different factors affect each other. This allows for a broader comparison of growth drivers across heterogeneous EU economies.

For example, Caporale et al. (2014) focus on new EU member states and mainly on financial development. Their findings indicate a positive but relatively minor effect of financial development on economic growth, which aligns with the insignificant impact of financial market depth on economic growth in the CEE group in our study. However, their analysis is limited to internal financial indicators, such as credit to the private sector and stock market capitalization. In contrast, our research also incorporates international finances, including foreign direct investment and portfolio investments, which play a significant role in the economic development of CEE economies.

Maradana et al. (2017) focus on the relationship between innovation and economic growth using a wide set of innovation proxies. Similarly, to our research, they conclude that there is no clear unidirectional relationship between innovation and economic growth, with causal links differing across countries and innovation indicators. While our article uses only R&D expenditure as a proxy for innovation, it clearly shows that even a single indicator affects economic growth differently across country groups. Importantly, due to its more comprehensive approach, our study suggests that innovation does not operate in isolation but is strongly mediated by capital flows.

Moreover, by combining Granger causality tests and panel fixed-effects estimations, this study captures both short- and long-term causal linkages, providing a more holistic picture of growth mechanisms in the European region.

CONCLUSIONS

This article examines how various factors impact economic growth and how they interact. The main purpose of this paper was to examine the complex relationships among these factors, showing that their influence on economic growth and the extent of their impact vary across groups depending on their levels of economic and financial development.

The research leads to conclusions:

1. Inflation does not play a role in long-run economic growth; however, for economies with underdeveloped markets, it could support short-run demand-led economic growth by increasing consumption and investments.
2. Financial markets, although not having a strong impact according to the panel regression, are crucial for countries that have reached the technological frontier. The development of stock and bond markets creates a pool of resources available for long-term and high-risk investments, supporting innovations. Developed financial markets in the Scandinavian countries (as evidenced by large reserves of capital available for long-term investment) finance all strategic initiatives, helping economies remain resilient during turbulent times and ensuring a high quality of life for their citizens. Advanced economies with developed financial markets and high levels of R&D spending grow faster, which explains some of the growth gap between the US and the EU.
3. The most important conclusion is, however, that foreign capital and innovations are complementary processes, and together they have the biggest impact on economic growth for the majority of EU economies, both in the short and the long term. While in the long-term (panel regression model results) the effects are more straightforward (R&D capital has a long-term impact on all economies, with more potent effects for countries with higher R&D spending), short-term effects often show foreign capital (either FDI or debt) as a key mediator, enhancing the R&D influence on GDP. Depending on the level of economic development (whether countries can finance themselves or require foreign investments) and the level of financial development (developed financial markets attract more portfolio investment), the different types of investments have different impacts on economies: debt capital supports Scandinavian and GIPS economies' growth, and FDI enhances the CEE countries.

Thus, for EU economies to catch up with the US and China, it is important to complete the capital market union reform and finally allow free capital movement. EU authorities should focus on both supply-side and demand-side solutions: completing Capital Market Union reform, reforming excessive regulation, and addressing Europe's risk aversion will help with the supply side, while incentivizing retirement savings and promoting long-term investment with diversification in some higher-risk assets among the population can support demand. This will help to create sufficient pools of capital for startups not only set up in the EU but also going public in the EU. Only by opening up its capital markets and filling them with a population’s savings can the EU boost the bloc’s competitiveness.

Future research can be expanded further by including additional important financial players, such as the UK and the US. Comparing these markets provides a better understanding of how different levels of financial development affect overall economic growth.

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ADDITIONAL INFORMATION

AUTHOR CONTRIBUTIONS

All authors have contributed equally.

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CONFLICT OF INTEREST

The Authors declare that there is no conflict of interest.

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Шкрум'як О., Біленко Ю.

ІННОВАЦІЇ, РОЗВИТОК ФІНАНСОВИХ РИНКІВ, ПРИТОКИ КАПІТАЛУ ТА ЕКОНОМІЧНЕ ЗРОСТАННЯ В КРАЇНАХ ЄВРОПИ

Питання економічного зростання та його причин досліджують протягом тривалого часу, проте традиційні моделі не можуть повною мірою пояснити, чому після того як держава досягає так званого «економічного рубежу зростання», конкурувати й наближатися до провідних економік за допомогою лише традиційних факторів, таких як нагромадження капіталу, стає дедалі складніше. І хоча проведено безліч досліджень, які стверджують, що людський капітал та інновації стимулюють зростання тоді, коли традиційні фактори втрачають свій вплив, досі немає одностайної відповіді щодо того, як саме ці чинники взаємодіють між собою.

Метою цієї роботи є відповідь на такі питання: чому Європа втратила звання лідера інновацій і першість у темпах економічного зростання та рівні фінансового розвитку? Чому в країнах Європи існують суттєві відмінності в рівні розвитку цих факторів і як регіонові їх подолати? Автори досліджують, як розвиток фінансових ринків, інноваційна діяльність та обсяги притоку іноземного капіталу впливають на економічний розвиток країн Європи.

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Систематизувавши існуючі підходи та дослідження, автори дійшли висновку, що різні фактори по-різному впливають на різні країни залежно від рівня їхньої структурної зрілості. Саме тому з метою отримання точніших результатів країни було поділено на три групи залежно від рівня розвитку: країни Східної та Центральної Європи, які, хоча й відстають від провідних економік, мають суттєвий потенціал до зростання; країни Південної Європи, які зазнали найбільшого стресу внаслідок кризи 2008 року та досі відчувають її вплив; а також скандинавські країни – провідні інноваційні європейські економіки з розвиненими фінансовими ринками.

Результати, отримані в ході економетричного аналізу, свідчать про те, що науково-дослідні та дослідно-конструкторські роботи (НДДКР) як індикатори інноваційної активності мають найбільший вплив на економічне зростання в усіх групах країн. Ба більше, іноземний капітал та інновації взаємодоповнюють одне одного, посилюючи свій вплив на економічний розвиток. У довгостроковому періоді НДДКР стабільно стимулюють економічне зростання, і цей вплив є тим сильнішим, чим більше країни інвестують в інновації. У короткостроковій перспективі саме іноземний капітал – і позичковий, і підприємницький – підсилює вплив інновацій на валовий внутрішній продукт.

Ця робота підтверджує наявність і короткого, і тривалого взаємозв'язку між економічним зростанням, інноваціями, фінансовим розвитком і розвитком ринку капіталів, а також пояснює, як і чому ці зв'язки відрізняються в різних країнах. Результати дослідження можуть бути корисними й для державних діячів, і для інституцій, що працюють над зміцненням інноваційної спроможності та підтримкою сталого економічного зростання в Європі.

Ключові слова: економіка, заснована на капіталі; позичковий капітал, економічна конвергенція, ендогенне зростання, підприємницький капітал, економічне зростання країн Європи; економіка, заснована на інноваціях; інституційний розвиток, тривале зростання, зростання обсягів НДДКР

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