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The Causal Relationship between Banking, Capital Markets and Economic Growth in the European Union

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Abstract: The current paper investigates the causal relationship between financial development and economic growth in 27 European Union (EU) countries. Granger causality tests are applied, using the cointegration and Vector Error-Correction (VEC) methodology. Through the empirical analysis, we found evidence of the presence of Granger causality between finance and growth, sometimes even bi-directional causality, but the nature of the relationship is far from uniform across EU countries. Therefore, an one-size-fits-all approach of policymakers may not be effective for the financial sector to drive economic growth. The results suggest that there are different interactions between the financial sector and economic expansion, based on country specifics, as the causality is sustained by the banking sub-sector in some cases, especially in the case of countries that were part of the former communist bloc, and it is driven by the capital market in other cases. There are also cases in which both financial sectors Granger cause economic growth mostly in the countries that succeeded to better diversify their sources of funding. These findings highlight the presence of financial structural differences among EU countries, and, at the same time, the importance of tailored policies to support further economic expansion.

Keywords: economic growth; financial development; time-series; Granger causality.

JEL classification: F43; E44; G15; G21.

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1. INTRODUCTION

The worldwide economic challenges require customized responses from the national economies to promote sustainable growth, aligned to their specific needs. While the European Union is focusing on a deeper integration at various dimensions among its 27 member countries, some structural differences remain a threat to the process of promoting sustainable growth. Even more, when thinking about economic and financial integration, the structural differences between Eastern and Western economies might make uniform regulations difficult to implement. The present paper investigates in which way different financial structures are in a causality relationship with economic growth and provides updated empirical evidence useful for policy decisions, by employing a comparative analysis of all 27 European Union countries.

According to Statista (2023), from a total of 5,640 monetary financial institutions available in European Union countries in 2023, the credit institutions (banks), represented the majority (87.8%). Therefore, the European financial system is still dominated by banks in terms of financial institutions. Even so, the current paper searches for Granger causality not only between banking proxies and economic growth but also between capital market proxies and economic growth. These two could play a complementary role in financing the economy. While it is commonly thought that bank loans are essential for an economy, is there actually a Granger causal relationship between the banking sector and economic growth in the European Union countries? What about the capital market? If yes, which would be the significant financial measures that might sustain the presence of causality?

The academic and non-academic understanding of the relationship between finance and economic growth suffered some changes over time. The conclusions and empirical results are inconsistent across nations and regions, time spans, periods of crisis, and vary significantly across methodologies and interpretations (Pagano, 1993). The literature reveals a variety of opinions on key aspects of the nexus, including direction, significance, and the mechanisms and channels of causality. While there is plenty of evidence of a uni-directional causality from finance to growth in the specialized literature, for some economies there is also evidence of bi-directional causality or even cases of missing causality. In this study, we focus on testing the causality between finance and growth in European Union countries, and the interpretation is based on the empirical results of Vector-Error Correction (VEC) and cointegration methodology, with Granger causality tests. The analysis at the individual country level allows us to differentiate 3 categories of national economies: 11 countries, the ones with significant banking proxies that Granger cause growth, other 10 countries with capital market proxies that are in causal relationship with growth, and, the third category, 6 national economies with both banking and stock market being statistically significant in Granger causing economic growth.

Thus, we provide evidence that a higher level of productivity and economic growth can be achieved through promoted access and availability of financial markets and institutions in European Union countries. When these are in proper functioning, they could reduce economic volatility, absorb shocks, and promote economic resilience. We support the early well-known state, that efficient resource allocation and innovation are crucial in the process of creating opportunities, not only for individuals in fostering savings, and investments but also for the governments – Schumpeter (1911), apud Eliott (2017).

The current paper consists of the following sections: Section 2 presents the literature review, Section 3 describes the methodology, and Section 4 shows the results by

comprehending three subsections. These illustrate the findings while distinguishing three different categories of countries. The conclusions can be found in Section 5.

2. LITERATURE REVIEW

The relationship between finance and growth started to present interest since decades ago. By introducing the concept of „creative destruction" – Schumpeter (1911), apud Eliott (2017). is acknowledged as an important early contributor to this research area, drawing attention to the power of entrepreneurship and innovation, and the role of banking institutions in the efficient allocation of funds. In this way, the private sector could contribute significantly to the process of growth. Thus, a first theoretical view regarding the financial-growth nexus was born, the so-called „Supply-Leading Hypothesis", under which the development of the financial sector drives economic growth. Many other early contributors to the field agreed with this (Goldsmith, 1969; King and Levine, 1993a, 1993b; King and Levine, 1993c). Goldsmith (1969), supported the statement that financial development is essential for fostering economic growth and that an underdeveloped financial system could restrict it. In his empirical analysis, he tested cross-country regressions and time-series analysis on 35 countries, from which 19 developed and 16 less developed, with both market-based financial systems and banking-based financial systems. However, the findings indicated that the country's financial structure is not a statistically significant coefficient in fostering economic growth. It is relevant to say that the '90 years were dominated by intense theoretical frameworks in the specialized literature. The contributions of King and Levine (1993a, 1993b) aligned with this trend. The significance of innovative financial technologies that could decrease the problem of information asymmetry was emphasized by the authors. The informational asymmetry is thought to make it difficult to initiate investment projects and allocate financial resources effectively. Even more, in a third essential work, the authors came up with empirical evidence on the formerly socialist economies of Europe, during the years of the post World War II (King and Levine, 1993c). Through their cross-country multiple regressions, they validate their initial hypothesis of a positive relationship between finance and economic growth, underlining the importance of financial sector reform in the economic reconstruction process of these countries. We take further this empirical work by testing the causal relationship between finance and growth in all European Union countries after '90, including countries that were part of the former communist bloc. More recently, by employing regional panel estimations for 26 European Union countries over the period 1990-2016, Asteriou and Spanos (2019) obtained a positive statistically significant impact of finance on growth. Besides the financial proxies, there are included in the model additional variables such as trade openness, net inflows of foreign direct investments, and inflation. In another study that followed, the authors provided evidence of the capital market's importance in sustaining economic growth (Asteriou and Spanos, 2021). They show that its impact on growth is higher than the banking sector's impact in the pre-crisis years. The present paper extends the literature as it examines the finance-growth nexus bi-directionally.

A second key theoretical standpoint is the „Demand-Following Hypothesis", economic growth being the one driving financial development. Firms demand more financial services, both in quantity and efficiency, once the economies expand, promoting the growth of the financial sector. According to Robinson (1952), economic expansion supports the

development of the financial sector rather than the other way around because „where enterprise leads finance follows".

A third theoretical perspective, namely the „Feedback Hypothesis", supports a bi-directional causality between finance and growth, based on a feedback loop. Here the discussion is even more complex. The stage of growth of one economy and the structure of its financial sector are considered central factors that influence the presence of a bi-directional causality. The moment of introducing in the literature the „Granger causality" concept is believed to be extremely important in the evolution of studying the relationship between finance and growth (Granger, 1988). This type of causality assesses if past values of one variable could help in predicting future values of another variable. Therefore, we consider it very useful while assessing the finance-growth causality relationship, especially as it is a common approach in the specific literature. The Granger tests within an Error-Correction model show the presence of mutual causality between financial development and economic growth in many developing countries, over the years 1970-1999 (Al-Yousif, 2002). Only a small number of the 30 tested countries support the „Neutrality Hypothesis" or the „No Relationship Hypothesis", representing a fourth theoretical view, according to which there is no causal relationship between finance and growth. The methodology is completed by one additional approach, through panel analysis, and the results remain unchanged. Based on the final conclusions, the different levels of financial development and the dissimilarity between applied policies among the countries would be the reason for the different impact of the financial proxies on economic growth.

However, there are prior studies that support a bi-directional causality between finance and growth (Calderón and Liu (2003), for 29 high-income countries; Apergis *et al.* (2007), for 15 OECD and 50 non-OECD countries; Hassan *et al.* (2011), for low- and middle-income countries, but not for African countries). For a study over 25 years of another dimension of the financial sector, a probably narrower area, the authors focus on the insurance market, which is seen as a nevertheless important component of the financial sector (Dash *et al.*, 2018). The paper explores the causal link between insurance market penetration and economic development in 19 Eurozone countries between 1980 and 2014, through Granger causality tests. We consider the authors' decision to test the causality within two different methodologies useful. At first, they employed the Vector Error-Correction (VEC) methodology to study the causality at the individual country level, an empirical approach employed in the current study as well. Additionally, a panel data methodology is employed by the authors to gain an overview of the Granger causality between financial development proxied by the insurance market and economic growth. Both methodologies present mixed results regarding the insurance market penetration-economic growth relationship. In certain situations, the insurance market influences economic growth, in other cases the relationship is reversed. However, there are also cases when the insurance market and economic growth influence each other, so there is a bi-directional causal relationship, and cases when there is no statistically significant relationship that can be established between the two. While focusing on the main dimensions of the financial sector, banking and capital market, we also test for the presence of Granger causality.

Fuinhas *et al.* (2019) already addressed the finance-growth nexus in 12 European countries: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, and Spain. The analysis is performed for the years 1990-2015 and, through panel Vector Autoregressive model and Granger causality tests, it investigates the

presence of a bi-directional relationship between the banking sector development, stock market development, and economic growth. The authors constructed a composite Banking Sector Development index, and a Stock Market Development index, using 5 different variables. The proxies for both the banking sector and capital market are simultaneously included in the model while searching for dynamic interactions. Interestingly, there is evidence of a bi-directional relationship between the banking sector and the stock market, but only a uni-directional causal relationship from economic growth to banking, and from the stock market to economic growth. We take further the authors' work, not only by extending the sample of European countries and the analyzed period but also by employing a country-level analysis for all 27 European Union members instead of a panel analysis. This allows us to identify different interactions between finance and growth for each country in particular, revealing countries' specificities. Even more, the paper contributes by analyzing the causal relationship between economic growth and certain variables that are representative of the banking and stock market development, including them in our models individually. The applied methodology is described in the next chapter.

3. METHODOLOGY

We test for the presence of Granger causality between financial development and economic growth in 27 European Union countries, over 30 years. The empirical analysis is conducted through cointegration and Vector Error-Correction (VEC) methodology with Granger causality tests (Engle and Granger, 1987; Granger, 1988). The motivation for adding the VEC Granger Causality/Block Exogeneity Wald Tests to the individual-country data is to empirically check for predictive significance, or in other words, to assess the significance of one variable in forecasting another variable. The applied methodology is suitable when the time-series are non-stationary and cointegrated, meaning they share a long-run equilibrium relationship.

3.1 Data collection

We collected data published and maintained by the World Bank and included in the Global Financial Development Database (WB, 2023a) and World Development Indicators Database (WB, 2023c). Gross domestic product per capita is used to measure economic growth for the period 1990-2019, while four different measures of financial development are included in the analysis. The financial development proxies are chosen to respond to the depth and efficiency of the financial sector, both in the case of the banking sub-sector, as well as the capital market sub-sector, according to data availability. To ensure normality in the distribution of data, some variables were transformed by taking their natural logarithms.

When data for capital markets is available, our model includes two proxies for the depth and efficiency of the banking sector (credit to government and credit to private sector) and two proxies for depth and efficiency of the capital market (stock market capitalization and stock market turnover ratio). When data for capital markets is unavailable, we test only for banking proxies: credit to government and credit to private sector, including additionally deposit money banks' assets, considered as a second measure of financial depth, and bank non-performing loans, considered as a second measure of financial efficiency.

The extended model is constructed by incorporating trade openness (as a percentage of GDP), allowing us to check for the robustness of the results. International trade is considered to successfully contribute to stimulating growth, firstly by determining the expansion of production (WB, 2023b); that also leads to the necessity of increasing the labor force. Secondly, international competition eventually stimulates productivity. The used variables are presented in Table no. 1.

Table no. 1 – Variables used and the source of data

Variable	Abbreviation	Source
GDP per capita (current LCU)	GDP	WDI*
Trade (% of GDP)	T	WDI*
Credit to government and state owned enterprises to GDP (%)	CR	GFD**
Domestic credit to private sector (% of GDP)	DC	GFD**
Deposit money banks' assets to GDP (%)	DEP	GFD**
Bank non-performing loans to gross loans (%)	NP	GFD**
Stock market capitalization to GDP (%)	S	GFD**
Stock market turnover ratio (%)	STR	GFD**

Note: *World Development Indicators, World Bank Database; **Global Financial Development, World Bank Database

3.2 Data analysis

Firstly, the Unit-Root Test Augmented Dickey-Fuller is employed to check for the series' stationarity, and then the Johansen Cointegration Test follows. When two or more variables indicate a common trend, there is a sign of cointegration. Moreover, if there is a sign of cointegration, Granger causality must occur in at least one direction (Granger, 1988). Vector Error-Correction (VEC) methodology allows us to test for the long-run causality (Brooks, 2019). To determine the optimal number of lags, we employed selection criteria. The EViews software allows the comparison view, which includes the Akaike Information Criterion (AIC), Schwarz Bayesian Criterion (SBC/BIC), and Hannan-Quinn Criterion (HQC). As the Hannan-Quinn Criterion (HQC) is seen to be a more likely balanced criterion, we mainly used the number of lags indicated by this one. We also took into consideration that, for annual macroeconomic data, the generally used lag length is 1 or 2 (Wooldridge, 2012). Also, the Inverse Roots Test is employed for all 27 models, to check the stability of the models. Any root outside the circle would imply instability. Finally, diagnostic tests such as the VEC Heteroskedasticity and Residual Serial Correlation Tests are applied. The results can be found in the Annex, while data and EViews files are available upon request.

To include four different financial proxies, as well as trade openness as a control variable, the regression equation is expanded as follows (1):

$$\Delta GDPpercapita_t = \alpha\,(\beta_0 + \beta_1 GDPpercapita_{t-1} + \beta_2 F1_{t-1} + \beta_3 F2_{t-1} + \beta_4 F3_{t-1} + \beta_5 F4_{t-1} + \beta_6 Trade_{t-1} + \epsilon_{t-1}) + \gamma_1 \Delta GDPpercapita_{t-1} + \gamma_2 \Delta F1_{t-1} + \cdots + \gamma_6 \Delta Trade_{t-1} \quad (1)$$

where:

$\Delta GDPpercapita_t$ is the change (difference) in economic growth at time t;

α is the speed of adjustment coefficient, which determines how quickly deviations from the long-run equilibrium are corrected;

β_0, β_1, ..., β_6 are the cointegration coefficients, representing the long-run relationship between economic growth and the financial development proxies, as well as trade openness;

ϵ_{t-1} is the error-correction term, which shows the deviation from long-run equilibrium;

$\gamma 1i$, $\gamma 2i$, ..., $\gamma 6i$ are the short-run coefficients;

$\Delta F1_t$, $\Delta F2_t$, ..., $\Delta F4_t$, and $\Delta Trade_t$ are the short-run changes (differences) in the financial proxies and trade openness (calculated as the sum of exports and imports over GDP).

VEC Granger Causality/Block Exogeneity Wald Tests help to evaluate the presence of Granger causality, an understanding of the predictive significance between the independent and dependent variables. The null hypothesis (H_0) states that the financial development proxy does not Granger cause economic growth. To reject the null hypothesis, the probability needs to be less than the significance level of 10 percent.

4. RESULTS

We provide evidence of the presence of Granger causality between finance and growth. Some differences may be observed, based on country specifics, as in some cases the most statistically significant is the banking sub-sector, Granger causing economic growth, while for other countries the capital market shows a stronger relationship of causality with growth. A third category of countries is the one for which both banking and capital market proxies have a Granger causality relationship with growth. There are some cases of bi-directional Granger causality between finance and growth, compared to several prior studies that confirm only uni-directional causality – Christopoulos and Tsionas (2004), in case of 10 developing countries; Fuinhas *et al.* (2019) in the case of 12 European countries. However, we agree with the view that the presence of bi-directionality differs across economies, due to country specifics; the authors showed mixed results for the presence of bi-directional causality between finance and growth when analyzing MENA countries (Kar *et al.*, 2011). We also support the statement under which the presence of mutual causality might be connected to the economic structure of a certain country or group of countries, but also to the analyzed period (Čižo *et al.*, 2020). Similar to the authors' findings, we found evidence of bi-directional causality between finance and growth in countries like Bulgaria, Romania, and Greece, while in the case of Austria and Finland, our model only provides evidence of a uni-directional relationship, from finance to growth. Other countries for which our results support uni-directionality from finance to economic growth are: Cyprus, Denmark, France, Hungary, and Slovenia.

Additionally, the current analysis distinguishes between one financial sub-sector or another, supporting the presence of causality in each country. Most of the European Union countries rely on the banking system when choosing the sources of funding, a fact that is also shown by our results. However, the number of credit institutions (banks) is decreasing in the Euro area (Statista, 2024), showing that some of the members managed to diversify their sources of funding. As a matter of fact, the financial structure varies significantly across the 27 EU countries, the Southern and Eastern Europe being predominantly dependent on bank financing, while other countries such as France, Germany, or the Netherlands have a developed capital market.

Overall, there is no evidence of missing causality between financial development and economic growth in our models. The results for the Granger Causality/Block Exogeneity Wald Tests showing the direction of causality between finance and growth are summarized in Table no. 2. In the next subsections, we discuss further our findings, obtained through the individual country-level analysis (Subsections 4.1, 4.2, 4.3).

Table no. 2 – Summary for the direction of causality between financial development and economic growth

Country	CR	DC	DEP	NP	S	STR
Austria					⇨	⇨
Belgium					⇨	⇦
Bulgaria	⇨					⇦
Croatia		⇔			⇨	⇨
Cyprus		⇨				
Czech Republic					⇔	
Denmark						⇨
Estonia		⇔		⇔		
Finland	⇨					
France					⇨	⇨
Germany		⇦			⇔	⇔
Greece	⇨				⇔	⇦
Hungary	⇨	⇨				
Ireland	⇔	⇦				
Italy	⇨	⇔			⇨	⇨
Latvia				⇔		
Lithuania			⇦	⇔		
Luxembourg						⇔
Malta	⇦					⇨
Poland	⇨					⇦
Portugal	⇨	⇔			⇨	
Romania	⇦	⇨				
Slovak Republic		⇦			⇨	
Slovenia					⇨	
Spain	⇨	⇔			⇔	⇦
Sweden	⇦	⇦		⇨		
The Netherlands		⇨			⇨	⇦

Note: ***CR*** is Credit to government and state owned enterprises to GDP; ***DC*** is domestic credit to private sector; ***DEP*** is Deposit money banks' assets to GDP; ***NP*** is Bank non-performing loans to gross loans; ***S*** is Stock market capitalization to GDP; ***STR*** is Stock market turnover ratio; ⇨ from financial development to economic growth; ⇦ from economic growth to financial development; ⇔ from financial development to economic growth & from economic growth to financial development

Source: Authors' estimation results performed in EViews (version 12 University Edition, IHS Markit, London, UK, distributed via OnTheHub) by employing Vector Error-Correction (VEC) models

4.1 Countries with banking-oriented financial sectors

We consider the countries for which the empirical results support a stronger Granger causality relationship from banking proxies to economic growth, countries with banking-oriented financial sectors. These are: Bulgaria, Cyprus, Estonia, Finland, Hungary, Ireland, Latvia, Lithuania, Poland, Romania, and Sweden. In the case of Estonia, Latvia, Lithuania, and Sweden, only banking proxies were included in the estimations due to missing data for the capital market.

For Bulgaria, Cyprus, Finland, Hungary, Ireland, Poland, and Romania, our analysis shows that the banking loans Granger cause economic growth, be they to the private or the public sector. As the significant variables are relevant proxies for the efficiency and depth of

the financial sector, the policymakers in these countries should keep an eye on promoting the development of a healthy, dynamic, and accessible banking environment. Improving credit accessibility and, in the meantime, fostering competition in the area of banking institutions would support further economic growth. Additionally, we consider that creating a favorable environment for the private economic agents could boost even more sustainable growth. In Poland, state-owned enterprises seem to have a strategic role in the process of development. A very important aspect for policy markers would be to find solutions for maintaining favorable borrowing conditions. However, what should be kept in mind is that too much reliance on banks may increase credit risk exposure and create potential vulnerabilities in the banking industry. Another related aspect is the public debt. Until 2019, the Polish government managed to effectively maintain moderate levels of public debt, even below the European Union's average: 45.7% public debt of GDP in 2019 (FocusEconomics, 2023). The challenge is to maintain these levels even after the COVID-19 pandemic.

Besides regular loans to the private sector, the measure of non-performing loans presents causality with growth in Estonia. The country has a growing banking sector, but the policymakers should keep an eye on its efficiency but also stability. Similarly, the cases of Latvia, Lithuania, and Sweden, show presence of causality between non-performing loans and growth, highlighting that the quality and health of the banking sector play a critical role in the growth process.

In the cases of Bulgaria, Estonia, Ireland, Latvia, Lithuania, Poland, Romania, and Sweden, the finance-growth nexus appears to be mutually causal, partially following the findings of Gaffeo and Garalova (2014) who were testing the finance-growth nexus among Central and Eastern European countries. This could be explained by the structural differences between countries' financial systems and levels of growth. Interestingly, for some countries like Bulgaria and Poland, the bi-directional relationship is sustained by a capital market proxy, showing that historical values of economic growth could predict future values of the stock market activity.

4.2 Countries with capital market-oriented financial sectors

We consider the countries for which the empirical results support a stronger Granger causality relationship from the capital market to economic growth, countries with a capital market-oriented financial sector: Austria, Belgium, Czech Republic, Denmark, France, Germany, Luxembourg, Malta, Slovak Republic, and Slovenia. In these countries, the causality is supported by financial proxies representing the depth and/or efficiency of the capital market. Other studies showed as well that in the case of more developed countries, the stock market tends to be the one in a causal relationship with growth (Peia and Roszbach, 2015).

The results for these countries show the presence of Granger causality between financial development and growth, through stock market turnover ratio, and sometimes stock market capitalization as well. For supporting further economic growth, it would be important for policymakers to prioritize regulations in financial areas such as the depth and efficiency of the financial markets, but also their stability. One way would be by promoting market transparency and enhancing investor protection. Excepting the cases of Austria, Denmark, France, and Slovenia, we found a two-way relationship of causality between financial development and economic growth.

Even if Germany has a developed banking industry, the restructuring needs and the low profitability might impact the overall lending capabilities. Some other factors may explain why capital markets have shown a more significant causal effect on growth than banking proxies in recent years: the reforms focused on diversifying financial resources and strengthening capital markets since the early 2000s, the presence of institutional investors, and numerous corporates that have increasingly accessed capital markets for long-term funding. The results reinforce the importance of a well-functioning and dynamic, vibrant stock market in supporting economic development. The efficiency of the capital market can be encouraged, for example, through sustaining investor education.

The Czech Republic is reviewed as an emerging financial market in the yearly evaluation of equity markets, the „Global Market Accessibility Review", while the rest of the countries are considered developed markets (MSCI, 2023). As exceptions, Malta, Slovak Republic, and Slovenia could be classified as frontier markets. Policymakers need to continue to promote the development of the financial markets in these countries. However, stability should be also one main priority during the expansion period. While increasing their overall importance, the financial markets will eventually be more and more integrated into the global markets, which could lead to spillover effects on domestic conditions.

4.3 Countries with mixed financial sectors

The countries for which both banking and capital market Granger cause economic growth, are considered countries with mixed financial sectors: Croatia, Greece, Italy, the Netherlands, Portugal, and Spain. This means that the financial proxies can be used to determine future values of the dependent variable, economic growth. The results also support the „Feedback Hypothesis" for some countries, as there is evidence of a bi-directional relationship between financial development and economic growth.

In the cases of Croatia and the Netherlands, the loans taken by the private sector and stock market capitalization Granger cause economic growth, while there is also evidence that growth Granger causes stock market turnover ratio in the Netherlands. This supports the view that growth creates investment opportunities. The situation is similar for Greece, Spain and Portugal, as the empirical analysis shows that financial development Granger causes economic growth through banking loans and stock market capitalization. Evidence of mutual causality between finance and growth was found for all these countries. Besides encouraging the listing of companies on the stock exchange, policymakers should focus on boosting innovation and integrating new digital solutions, for example, by fostering collaboration between traditional financial institutions and fintech start-ups. This way, not only costs can be reduced, but also the speed of transactions can be enhanced. This could contribute to future high values of stock market capitalization, and economic growth.

Italy stands out with the presence of Granger causality in the case of all four tested proxies of financial development. Even though the banking proxies are more statistically significant, the capital market is also relevant and Granger causes economic growth. The mixed significance of both sectors reflects the country's diversified financial system, where the traditional dominance of banks is gradually being complemented by the capital market, especially after the post-crisis reforms. In Italy, we found evidence of two-way causality, for the loans to the private sector.

Figure no. 1 provides a geographical overview of the study's main findings. Countries where the banking proxies Granger cause economic growth are the ones shaded in yellow (Bulgaria, Cyprus, Estonia, Finland, Hungary, Ireland, Latvia, Lithuania, Poland, Romania, and Sweden). Countries where the capital markets present significance in Granger causing economic growth are shaded in blue (Austria, Belgium, Czech Republic, Denmark, France, Germany, Luxembourg, Malta, Slovak Republic, and Slovenia). Finally, the countries where both banking and capital market proxies Granger cause economic growth are shaded in green (Croatia, Greece, Italy, the Netherlands, Portugal, and Spain). Additionally, the map illustrates distinct regional trends in the finance-growth nexus within the European Union.

Thus, we consider that our results can help policymakers in understanding the key mechanisms of financial influence on economic growth, while taking into account the affinities of their national financial system.

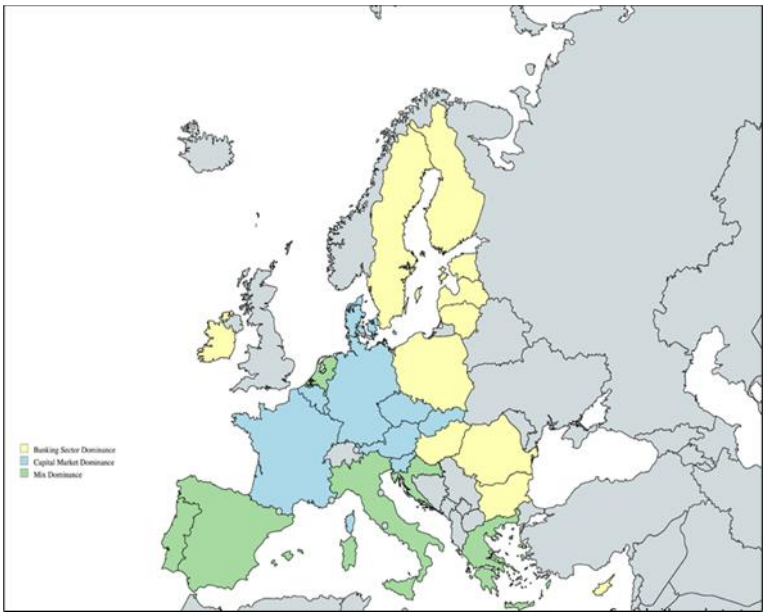

Figure no. 1 – Mapping the results
Source: authors, based on results

5. CONCLUSION AND FUTURE STUDIES

Based on our results, there is evidence of the presence of Granger causality between financial development and economic growth. As we test our hypothesis on 27 European Union countries over the years 1990-2019, we confirm the presence of Granger causality between growth and finance in all European Union countries, but with some alterations, as follows. For Bulgaria, Cyprus, Estonia, Finland, Hungary, Ireland, Latvia, Lithuania, Poland, Romania, and Sweden there is empirical evidence that their banking sectors Granger cause economic growth. Thus, promoting a stable and inclusive banking environment might support further economic growth. As many of these countries were part of the former communist bloc, targeted policy

decisions could perhaps foster financial diversification, so that the risk of too much reliance on the banking sector would be reduced. In Austria, Belgium, Czech Republic, Denmark, France, Germany, Luxembourg, Malta, Slovak Republic, and Slovenia, the capital market proxies have a stronger causal relationship with growth. In accordance with prior studies, generally, this is the case for countries that managed to better mitigate the risk of too much reliance on a main funding source, so they promoted financial variety. While continuing to foster the capital markets development in these countries, policymakers should take into consideration the side effects of the financial system deepening, both at the European and global levels, which might cause external shock and spillover effects. Only in 6 of 27 European Union countries, both the banking and capital market financial sub-sectors present significant Granger causality with growth: the cases of Croatia, Greece, Italy, the Netherlands, Portugal, and Spain. Additionally, to ensure a virtuous circle between financial development quantitative measures and economic growth, we believe that bi-directional causality is important. In most of the cases this condition was satisfied for our analyzed period. Policy makers should find ways to foster investments while efficiency in banking funding (such as an increased way of digitalization and reduction of bureaucracy) is ensured. Also, offering ways to increase financial literacy for own investors might increase the diversification of funding through capital markets. An important note is that investors should understand the risks involved, especially in turbulent times. Because the level of market integration is extremely high when referring to the European Union countries, we consider it absolutely economically rational that financial development successfully contributes to economic growth. Free capital flows, diversification in financial services, and several investment opportunities are the main pillars of promoting growth. Moreover, as many of the countries share the same currency (Euro), with 20 out of 27 countries being part of the Eurozone, financial stability is positively affected. Possible limitations of the study could be the unavailable data for stock markets in the case of certain countries, the methodological approach, which, while appropriate for the current analysis, may be enhanced by future econometric developments, but also the growing number of significant control variables presented in the specific literature, that could be included in further studies. Even more, future research such as employing threshold dynamic panel estimation could provide additional interesting insights.

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ANNEX

Table no. A 1 – Descriptive statistics: Austria

Austria									
Variable	Mean	Standard Error	Median	Standard Deviation	Kurtosis	Skewness	Minimum	Maximum	Count
GDP	30.781,59	1.463,46	30.268,01	8.015,71	-1,23	0,06	17.915,00	44.724,19	30,00
T	88,89	2,70	89,16	14,81	-1,40	-0,32	63,27	107,92	30,00
CR	17,06	0,54	17,57	2,94	-0,86	-0,66	11,26	19,82	30,00
DC	90,27	0,71	89,71	3,89	-0,22	0,34	83,17	98,53	30,00
S	23,35	2,36	20,65	12,92	2,37	1,34	1,19	60,75	30,00
STR	63,49	22,88	32,34	125,31	24,04	4,77	19,38	694,43	30,00

Table no. A 2 – Descriptive statistics: Belgium

Belgium									
Variable	Mean	Standard Error	Median	Standard Deviation	Kurtosis	Skewness	Minimum	Maximum	Count
GDP	28.758,85	1.343,63	29.035,06	7.359,35	-1,23	0,02	17.065,35	41.663,94	30,00
T	140,53	3,33	140,90	18,25	-1,39	-0,16	109,01	166,49	30,00
CR	30,61	1,95	29,79	10,67	-1,76	-0,07	13,42	42,05	30,00
DC	63,72	0,75	66,07	4,11	-0,21	-0,93	54,74	69,85	30,00
S	60,04	3,75	59,10	20,54	-1,09	0,06	27,30	97,04	30,00
STR	30,16	3,54	28,33	19,42	11,92	2,98	9,51	114,05	30,00

Table no. A 3 – Descriptive statistics: Bulgaria

Bulgaria									
Variable	Mean	Standard Error	Median	Standard Deviation	Kurtosis	Skewness	Minimum	Maximum	Count
GDP	6.689,40	978,04	5.738,99	5.356,95	-1,16	0,26	5,21	17.251,45	30,00
T	100,52	4,04	96,39	22,11	-1,25	-0,05	55,26	130,27	30,00
CR	14,79	2,95	7,11	16,15	2,05	1,79	3,91	60,89	30,00
DC	47,49	4,14	50,52	22,66	-0,95	-0,40	8,55	82,80	30,00
S	12,41	2,26	12,51	12,36	0,68	0,84	0,05	48,80	30,00
STR	23,44	7,22	6,92	39,56	6,91	2,62	1,07	173,04	30,00

Table no. A 4 – Descriptive statistics: Croatia

Croatia									
Variable	Mean	Standard Error	Median	Standard Deviation	Kurtosis	Skewness	Minimum	Maximum	Count
GDP	7.765,05	614,04	8.106,81	3.363,23	-1,52	-0,04	3.402,62	13.507,14	30,00
T	77,56	2,11	79,36	11,55	-0,63	0,34	62,79	101,38	30,00
CR	18,56	1,12	18,22	6,13	-0,90	0,56	10,85	31,82	30,00
DC	46,95	3,07	49,42	16,79	-1,64	-0,07	24,16	69,99	30,00
S	27,57	4,12	29,09	22,55	7,20	2,03	3,93	115,99	30,00
STR	10,20	2,29	4,18	12,55	0,34	1,47	1,20	34,52	30,00

Table no. A 5 – Descriptive statistics: Cyprus

Cyprus									
Variable	Mean	Standard Error	Median	Standard Deviation	Kurtosis	Skewness	Minimum	Maximum	Count
GDP	17.720,56	1.057,15	19.551,92	5.790,24	-1,19	-0,42	7.530,07	26.280,18	30,00
T	122,56	2,98	117,62	16,33	-1,16	0,17	95,42	151,94	30,00
CR	17,16	1,51	16,03	8,29	-1,29	0,28	6,13	33,64	30,00
DC	175,04	8,10	147,27	44,36	-1,01	0,75	108,50	255,31	30,00
S	54,91	5,82	80,50	31,87	-1,75	-0,52	7,99	80,50	30,00
STR	15,15	1,38	19,47	7,57	-0,53	-1,02	1,31	25,88	30,00

Table no. A 6 – Descriptive statistics: Czech Republic

Czech Republic									
Variable	Mean	Standard Error	Median	Standard Deviation	Kurtosis	Skewness	Minimum	Maximum	Count
GDP	299.333,21	24.411,01	311.866,40	133.704,62	-1,02	-0,10	70.761,81	542.688,21	30,00
T	112,03	5,44	113,14	29,82	-1,50	0,05	63,50	157,57	30,00
CR	11,29	0,95	11,30	5,18	-1,21	0,10	3,15	19,95	30,00
DC	48,54	2,26	49,91	12,37	-0,42	-0,55	23,67	65,75	30,00
S	13,85	1,32	11,22	7,24	2,19	1,27	4,26	36,24	30,00
STR	58,20	4,54	65,92	24,86	-0,81	-0,62	13,64	98,43	30,00

Table no. A 7 – Descriptive statistics: Denmark

Denmark									
Variable	Mean	Standard Error	Median	Standard Deviation	Kurtosis	Skewness	Minimum	Maximum	Count
GDP	280.756,81	13.093,64	285.651,66	71.716,82	-1,27	-0,10	166.420,41	397.452,20	30,00
T	87,11	2,77	86,98	15,19	-1,61	-0,09	65,60	110,22	30,00
CR	9,64	0,35	9,71	1,94	0,06	-0,33	5,27	13,15	30,00
DC	123,07	11,86	151,60	64,96	-1,53	-0,55	30,26	201,26	30,00
S	51,82	2,42	60,21	13,25	-0,19	-1,15	21,25	68,12	30,00
STR	47,59	2,07	45,05	11,34	3,47	1,24	22,41	80,41	30,00

Table no. A 8 – Descriptive statistics: Estonia

Estonia									
Variable	Mean	Standard Error	Median	Standard Deviation	Kurtosis	Skewness	Minimum	Maximum	Count
GDP	8.846,30	1.098,99	7.774,33	6.019,40	-1,10	0,42	1.991,90	20.924,54	30,00
T	141,86	2,44	139,09	13,37	-0,06	0,43	116,76	170,76	30,00
CR	11,82	1,94	3,30	10,60	-1,45	0,42	1,26	32,59	30,00
DEP	53,07	4,93	55,36	27,02	-1,20	0,08	17,09	104,13	30,00
DC	57,26	3,55	48,45	19,42	-0,75	0,69	40,31	101,39	30,00
NP	1,48	0,24	1,40	1,29	4,02	2,02	0,20	5,38	30,00

Table no. A 9 – Descriptive statistics: Finland

Finland									
Variable	Mean	Standard Error	Median	Standard Deviation	Kurtosis	Skewness	Minimum	Maximum	Count
GDP	29.924,74	1.566,10	30.879,08	8.577,90	-1,32	-0,20	16.815,18	43.439,90	30,00
T	70,07	1,87	70,93	10,24	1,18	-1,09	43,49	86,18	30,00
CR	10,33	1,82	6,81	9,97	2,66	1,97	2,19	37,99	30,00
DC	70,77	3,31	66,49	18,14	-1,83	0,22	52,65	95,40	30,00
S	17,50	2,49	10,30	13,65	8,19	2,63	10,30	72,16	30,00
STR	621,35	75,12	927,82	411,47	-1,50	-0,71	10,66	941,15	30,00

Table no. A 10 – Descriptive statistics: France

France									
Variable	Mean	Standard Error	Median	Standard Deviation	Kurtosis	Skewness	Minimum	Maximum	Count
GDP	27.036,13	1.023,78	27.558,47	5.607,47	-1,35	-0,13	18.150,60	36.173,13	30,00
T	53,12	1,35	54,42	7,38	-1,08	-0,26	39,91	64,44	30,00
CR	23,48	2,94	17,52	16,09	3,69	2,30	14,59	69,91	30,00
DC	85,91	1,91	78,56	10,44	-1,33	0,53	75,57	107,12	30,00
S	65,92	5,13	72,65	28,11	-1,01	-0,33	10,06	105,94	30,00
STR	78,12	12,09	63,61	66,21	20,39	4,25	34,47	399,59	30,00

Table no. A 11 – Descriptive statistics: Germany

Germany									
Variable	Mean	Standard Error	Median	Standard Deviation	Kurtosis	Skewness	Minimum	Maximum	Count
GDP	29.051,60	1.181,86	27.583,23	6.473,29	-0,81	0,39	18.425,30	41.809,92	30,00
T	67,15	3,13	68,57	17,17	-1,59	-0,19	40,58	88,52	30,00
CR	30,81	2,84	25,93	15,57	-0,44	0,95	11,98	62,40	30,00
DC	99,56	2,61	105,95	14,29	-1,51	-0,53	77,45	112,42	30,00
S	41,22	2,64	42,34	14,47	-0,96	-0,11	15,42	65,25	30,00
STR	114,34	10,62	112,61	58,16	14,76	3,19	22,54	377,25	30,00

Table no. A 12 – Descriptive statistics: Greece

Greece									
Variable	Mean	Standard Error	Median	Standard Deviation	Kurtosis	Skewness	Minimum	Maximum	Count
GDP	14.458,39	906,45	16.285,22	4.964,82	-0,71	-0,53	4.466,01	21.844,54	30,00
T	52,93	2,32	51,05	12,71	-0,27	0,55	36,16	81,89	30,00
CR	22,33	1,46	24,62	8,01	-1,73	-0,28	10,14	30,14	30,00
DC	75,50	4,95	67,15	27,14	-1,42	0,49	50,08	119,30	30,00
S	46,34	3,73	55,62	20,42	-1,42	-0,24	11,94	83,09	30,00
STR	43,40	2,39	43,81	13,10	4,97	1,84	28,75	90,69	30,00

Table no. A 13 – Descriptive statistics: Hungary

Hungary									
Variable	Mean	Standard Error	Median	Standard Deviation	Kurtosis	Skewness	Minimum	Maximum	Count
GDP	2.081.473,65	243.660,17	2.164.310,59	1.334.581,72	-0,87	0,25	250.381,56	4.879.080,86	30,00
T	125,53	7,40	134,23	40,54	-0,99	-0,66	53,56	168,39	30,00
CR	13,97	0,83	13,62	4,57	0,71	-0,37	1,59	22,69	30,00
DC	37,90	2,15	34,73	11,79	-0,60	0,59	21,36	60,17	30,00
S	19,87	1,01	19,21	5,52	2,49	1,24	10,29	36,23	30,00
STR	58,59	4,49	51,14	24,62	5,56	2,09	26,36	149,27	30,00

Table no. A 14 – Descriptive statistics: Ireland

Ireland									
Variable	Mean	Standard Error	Median	Standard Deviation	Kurtosis	Skewness	Minimum	Maximum	Count
GDP	34.723,37	3.109,72	37.042,31	17.032,65	-0,39	0,38	10.771,83	72.219,87	30,00
T	166,11	6,88	159,96	37,69	-0,37	0,34	105,03	252,50	30,00
CR	7,67	1,22	5,95	6,66	4,18	2,18	0,86	27,09	30,00
DC	88,61	6,70	71,78	36,72	-0,06	0,87	36,00	169,25	30,00
S	52,68	2,87	57,05	15,73	-0,18	-0,44	17,97	81,71	30,00
STR	23,39	2,79	19,19	15,27	1,38	1,06	5,24	65,55	30,00

Table no. A 15 – Descriptive statistics: Italy

Italy									
Variable	Mean	Standard Error	Median	Standard Deviation	Kurtosis	Skewness	Minimum	Maximum	Count
GDP	23.343,71	944,38	25.471,23	5.172,60	-0,90	-0,68	12.887,00	30.079,96	30,00
T	48,98	1,36	49,67	7,43	-0,64	-0,45	33,88	60,30	30,00
CR	23,66	1,86	15,88	10,21	-1,27	0,68	14,02	42,22	30,00
DC	72,77	2,35	69,29	12,87	-1,51	0,40	60,35	94,06	30,00
S	29,18	2,76	27,17	15,13	0,30	0,63	0,02	67,01	30,00
STR	5.656,84	5.499,77	124,78	30.123,49	30,00	5,48	14,20	165.149,10	30,00

Table no. A 16 – Descriptive statistics: Latvia

Latvia									
Variable	Mean	Standard Error	Median	Standard Deviation	Kurtosis	Skewness	Minimum	Maximum	Count
GDP	6.823,22	879,98	5.502,89	4.819,87	-1,36	0,39	1.633,50	15.974,77	30,00
T	97,22	3,58	90,87	19,63	-1,41	0,39	73,87	128,23	30,00
CR	5,30	1,09	3,29	5,96	3,13	2,17	1,26	20,09	30,00
DEP	44,41	5,39	41,19	29,54	-1,05	0,46	11,44	99,11	30,00
DC	81,69	3,94	94,68	21,56	-0,16	-1,25	34,37	94,68	30,00
NP	5,56	0,69	6,00	3,78	1,98	1,24	0,50	15,93	30,00

Table no. A 17 – Descriptive statistics: Lithuania

Lithuania									
Variable	Mean	Standard Error	Median	Standard Deviation	Kurtosis	Skewness	Minimum	Maximum	Count
GDP	7.335,12	874,91	5.854,77	4.792,10	-0,91	0,58	2.138,53	17.522,10	30,00
T	112,89	4,82	104,97	26,39	-1,45	0,29	74,82	155,89	30,00
CR	10,21	1,04	6,78	5,72	-1,12	0,60	2,80	21,43	30,00
DEP	35,80	3,34	37,77	18,30	-1,54	0,21	13,64	65,41	30,00
DC	53,85	1,39	58,63	7,61	-0,76	-1,07	39,05	58,63	30,00
NP	9,42	1,18	11,44	6,47	-0,32	0,41	0,60	24,00	30,00

Table no. A 18 – Descriptive statistics: Luxembourg

Luxembourg									
Variable	Mean	Standard Error	Median	Standard Deviation	Kurtosis	Skewness	Minimum	Maximum	Count
GDP	65.189,82	4.483,33	63.317,20	24.556,21	-1,52	-0,03	27.722,80	100.695,85	30,00
T	270,78	11,20	271,59	61,33	-1,12	-0,01	181,40	382,35	30,00
CR	6,37	0,69	5,28	3,79	19,80	4,11	4,11	24,66	30,00
DC	83,61	2,04	78,45	11,18	-0,10	0,75	66,00	108,68	30,00
S	132,37	9,56	120,95	52,36	4,62	1,61	63,01	321,94	30,00
STR	1,06	0,21	0,72	1,13	0,80	1,29	0,11	4,06	30,00

Table no. A 19 – Descriptive statistics: Malta

Malta									
Variable	Mean	Standard Error	Median	Standard Deviation	Kurtosis	Skewness	Minimum	Maximum	Count
GDP	13.924,96	1.193,92	12.487,94	6.539,39	-0,36	0,70	5.324,18	28.340,97	30,00
T	251,24	9,15	251,23	50,13	-1,18	-0,26	164,48	322,68	30,00
CR	15,43	1,55	13,18	8,47	-1,36	0,22	3,49	29,01	30,00
DC	97,98	2,22	97,40	12,18	0,63	-0,35	71,64	122,11	30,00
S	45,12	1,85	46,74	10,11	0,51	0,72	30,73	71,08	30,00
STR	4,85	0,64	3,48	3,50	-1,80	0,37	0,89	9,18	30,00

Table no. A 20 – Descriptive statistics: Poland

Poland									
Variable	Mean	Standard Error	Median	Standard Deviation	Kurtosis	Skewness	Minimum	Maximum	Count
GDP	27.367,46	3.142,77	25.195,71	17.213,66	-1,05	0,18	1.644,65	60.278,24	30,00
T	70,53	3,77	70,99	20,67	-1,39	0,06	43,72	103,45	30,00
CR	13,56	0,93	12,66	5,11	1,62	0,84	2,34	27,45	30,00
DC	33,64	2,79	26,77	15,27	-1,77	0,19	12,87	54,42	30,00
S	21,58	2,56	21,77	14,00	-1,13	0,12	3,21	49,33	30,00
STR	43,30	2,70	37,86	14,79	-0,93	0,03	11,43	66,20	30,00

Table no. A 21 – Descriptive statistics: Portugal

Portugal									
Variable	Mean	Standard Error	Median	Standard Deviation	Kurtosis	Skewness	Minimum	Maximum	Count
GDP	13.766,37	772,62	14.808,82	4.231,81	-0,90	-0,40	5.606,75	20.840,87	30,00
T	68,31	1,69	65,07	9,26	-0,71	0,62	54,18	86,56	30,00
CR	11,24	1,28	6,69	6,99	-1,35	0,78	5,04	23,04	30,00
DC	123,71	3,26	115,00	17,86	-0,21	0,64	90,26	159,86	30,00
S	35,40	1,55	33,29	8,50	0,48	1,11	25,13	54,99	30,00
STR	63,88	3,38	54,67	18,53	0,02	0,95	40,35	110,21	30,00

Table no. A 22 – Descriptive statistics: Romania

Romania									
Variable	Mean	Standard Error	Median	Standard Deviation	Kurtosis	Skewness	Minimum	Maximum	Count
GDP	17.292,46	3.088,27	12.430,86	16.915,17	-0,82	0,61	3,70	54.915,03	30,00
T	64,50	2,52	61,23	13,83	-0,94	0,29	39,14	87,16	30,00
CR	14,19	2,74	11,26	15,02	5,90	2,38	1,03	62,40	30,00
DC	18,80	2,55	17,92	13,95	-1,49	0,01	0,00	39,33	30,00
S	7,02	1,08	7,29	5,92	-0,68	0,52	0,86	20,68	30,00
STR	20,14	2,86	10,82	15,68	-1,50	0,68	5,75	42,42	30,00

Table no. A 23 – Descriptive statistics: Slovak Republic

Slovak Republic									
Variable	Mean	Standard Error	Median	Standard Deviation	Kurtosis	Skewness	Minimum	Maximum	Count
GDP	9.106,20	905,61	8.995,80	4.960,24	-1,48	0,02	1.894,60	17.313,38	30,00
T	140,38	6,47	137,95	35,41	-0,78	-0,28	57,17	189,80	30,00
CR	14,70	0,40	15,01	2,19	2,16	-0,89	8,92	19,08	30,00
DC	40,88	1,79	33,75	9,82	-0,08	1,11	33,75	62,77	30,00
S	6,44	0,82	5,32	4,48	0,76	1,37	1,49	15,90	30,00
STR	41,16	11,99	2,20	65,67	0,88	1,47	0,10	215,51	30,00

Table no. A 24 – Descriptive statistics: Slovenia

Slovenia									
Variable	Mean	Standard Error	Median	Standard Deviation	Kurtosis	Skewness	Minimum	Maximum	Count
GDP	13.268,71	1.090,20	14.194,05	5.971,28	-1,48	-0,10	5.307,28	23.263,10	30,00
T	118,91	4,39	112,34	24,06	-1,46	0,34	92,54	161,14	30,00
CR	12,38	0,59	11,54	3,24	2,16	1,27	6,26	21,06	30,00
DC	31,30	6,12	21,32	33,51	-1,63	0,33	0,19	85,06	30,00
S	17,13	1,94	13,95	10,64	8,77	2,65	9,03	60,04	30,00
STR	15,40	1,87	9,98	10,22	-1,82	0,32	1,89	29,73	30,00

Table no. A 25 – Descriptive statistics: Spain

Spain									
Variable	Mean	Standard Error	Median	Standard Deviation	Kurtosis	Skewness	Minimum	Maximum	Count
GDP	18.511,75	1.040,94	20.633,52	5.701,45	-1,32	-0,43	8.456,87	26.424,47	30,00
T	53,85	1,75	54,93	9,60	-0,47	-0,62	35,48	67,57	30,00
CR	20,99	1,17	19,09	6,42	0,96	1,06	11,09	37,21	30,00
DC	119,11	5,48	102,73	30,04	-0,97	0,85	94,68	173,98	30,00
S	63,48	4,72	66,78	25,86	-0,27	-0,06	18,42	122,11	30,00
STR	104,24	13,21	90,31	72,33	3,70	1,92	32,60	318,33	30,00

Table no. A 26 – Descriptive statistics: Sweden

Sweden									
Variable	Mean	Standard Error	Median	Standard Deviation	Kurtosis	Skewness	Minimum	Maximum	Count
GDP	320.963,23	17.414,08	319.650,86	95.380,87	-1,21	0,10	181.077,83	491.261,26	30,00
T	77,17	2,12	81,15	11,62	0,19	-1,00	50,77	92,56	30,00
CR	7,99	0,25	7,91	1,36	-0,41	0,08	5,13	10,88	30,00
DEP	96,39	7,38	106,33	40,44	-1,71	-0,35	39,68	139,93	30,00
DC	87,60	7,30	95,32	39,96	-1,69	-0,31	31,29	131,87	30,00
NP	1,47	0,15	1,20	0,84	-1,43	0,31	0,10	2,60	30,00

Table no. A 27 – Descriptive statistics: The Netherlands

The Netherlands									
Variable	Mean	Standard Error	Median	Standard Deviation	Kurtosis	Skewness	Minimum	Maximum	Count
GDP	32.149,38	1.625,00	33.131,62	8.900,52	-1,27	-0,24	17.592,64	46.875,81	30,00
T	126,27	3,52	121,42	19,29	-1,24	0,41	98,94	158,82	30,00
CR	19,69	2,47	12,24	13,54	-0,74	1,09	8,98	46,48	30,00
DC	111,52	0,63	110,47	3,47	3,76	-1,11	99,68	117,23	30,00
S	90,88	6,00	85,59	32,89	-0,72	0,30	37,64	155,25	30,00
STR	78,26	8,48	60,54	46,42	5,42	1,92	25,16	249,73	30,00

Table no. A 28 – VEC Residual Heteroskedasticity & Residual Serial Correlation Tests (1990-2019)

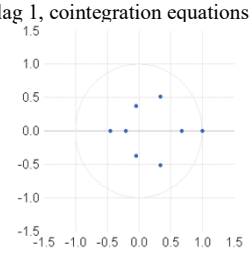
Test	VEC Residual Heteroskedasticity Test			VEC Residual Serial Correlation LM Test		
Null Hypothesis	No heteroskedasticity in the residuals			No serial correlation in the residuals		
Country	Chi-Sq	df	Probability	Lag	LRE Stat	Probability
Austria	308.0544	294	0.2749	1	22.54720	0.9608
Belgium	331.2217	336	0.5633	1	38.69089	0.3491
Bulgaria	397.5870	378	0.2344	2	48.87820	0.0744***
Croatia	410.6777	378	0.1190	1	30.39552	0.7319
Cyprus	313.0705	294	0.2126	1	49.33703	0.0684***
Czech Republic	402.4205	378	0.1857	1	29.53675	0.7682
Denmark	439.1452	420	0.2502	2	31.63651	0.6762
Estonia	411.6897	378	0.1122	1	45.36487	0.1362
Finland	363.6310	336	0.1438	1	23.85887	0.9397
France	329.8562	336	0.5842	1	43.81440	0.1739
Germany	384.6684	378	0.3954	1	49.96435	0.0609***
Greece	452.5874	420	0.1315	2	49.00915	0.0727
Hungary	471.1181	462	0.3745	1	41.34336	0.2486
Ireland	360.3055	336	0.1732	2	47.63059	0.0930***
Italy	392.6062	378	0.2916	1	42.49256	0.2116
Latvia	391.6434	378	0.3034	1	37.44959	0.4025
Lithuania	451.7508	420	0.1374	1	42.46099	0.2125
Luxembourg	425.3986	420	0.4174	2	37.97477	0.3795
Malta	433.7765	420	0.3109	1	23.46717	0.9467
Poland	336.6148	336	0.4803	1	40.06344	0.2946
Portugal	294.2111	294	0.4856	1	41.26737	0.2512
Romania	436.6654	420	0.2774	2	35.98183	0.4695
Slovak Republic	335.4493	336	0.4982	1	31.81541	0.6679
Slovenia	379.3164	336	0.0516	1	38.52840	0.3559
Spain	311.9437	294	0.2258	2	36.51208	0.4449
Sweden	431.6682	420	0.3366	1	30.47043	0.7286
The Netherlands	321.8353	294	0.1270	1	25.50233	0.9036

*, **, *** Indicate rejection of null hypothesis at the 1, 5, and 10 percent levels of significance

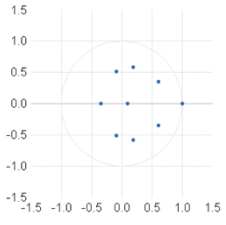
LRE Stat: Edgeworth expansion corrected likelihood ratio statistic

Source: Authors' estimation results performed in EViews (version 12 University Edition, IHS Markit, London, UK, distributed via OnTheHub), by employing Vector Error-Correction (VEC) models

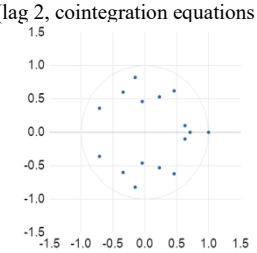
1. Austria
(lag 1, cointegration equations 1)



2. Belgium
(lag 1, cointegration equations 2)



3. Bulgaria
(lag 2, cointegration equations 3)



4. Croatia
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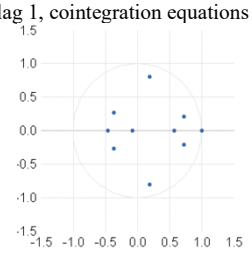
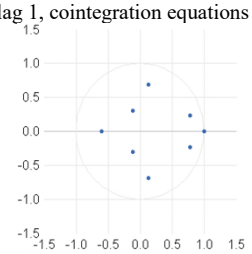
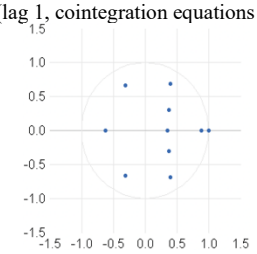


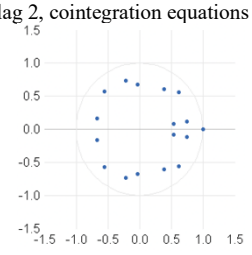
5. Cyprus
(lag 1, cointegration equations 1)



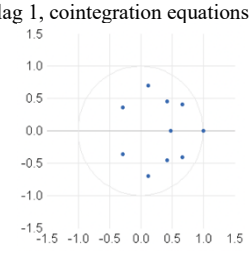
6. Czech Republic
(lag 1, cointegration equations 3)



7. Denmark
(lag 2, cointegration equations 4)



8. Estonia
(lag 1, cointegration equations 3)



9. Finland
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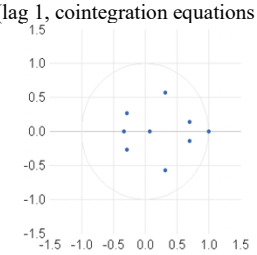
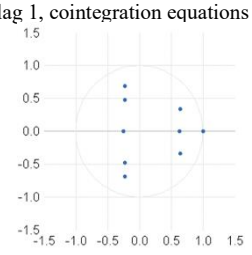
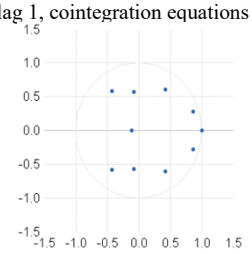


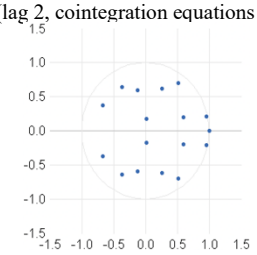
10. France
(lag 1, cointegration equations 2)



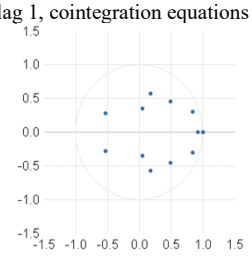
11. Germany
(lag 1, cointegration equations 3)



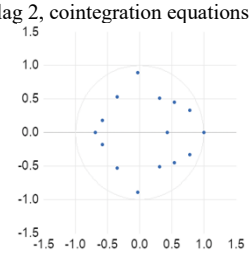
12. Greece
(lag 2, cointegration equations 4)



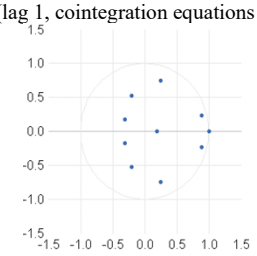
13. Hungary
(lag 1, cointegration equations 5)



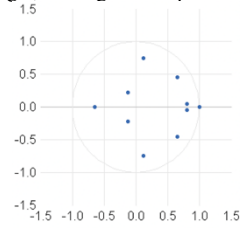
14. Ireland
(lag 2, cointegration equations 2)



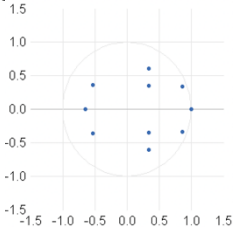
15. Italy
(lag 1, cointegration equations 3)



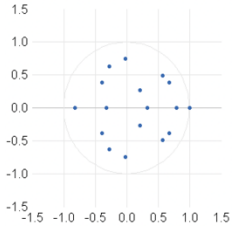
16. Latvia
(lag 1, cointegration equations 3)



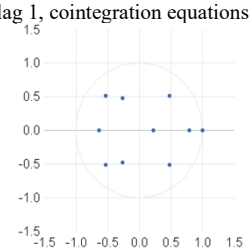
17. Lithuania
(lag 1, cointegration equations 3)



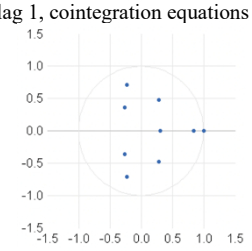
18. Luxembourg
(lag 2, cointegration equations 4)



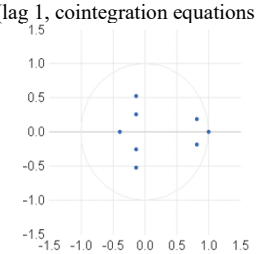
19. Malta
(lag 1, cointegration equations 3)



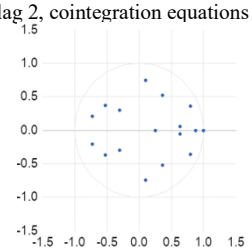
20. Poland
(lag 1, cointegration equations 2)



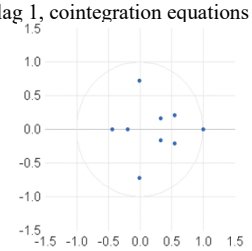
21. Portugal
(lag 1, cointegration equations 1)



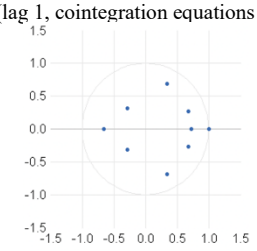
22. Romania
(lag 2, cointegration equations 4)



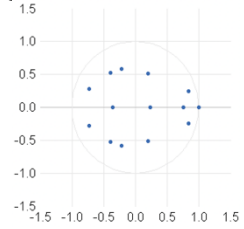
23. Slovak Republic
(lag 1, cointegration equations 2)



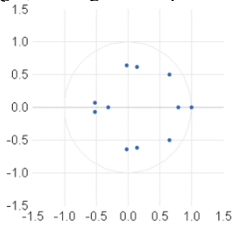
24. Slovenia
(lag 1, cointegration equations 2)



25. Spain
(lag 2, cointegration equations 4)



26. Sweden
(lag 1, cointegration equations 4)



27. The Netherlands
(lag 1, cointegration equations 1)

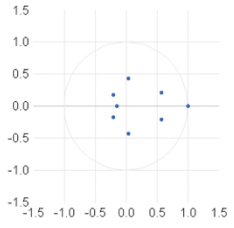


Figure no. A 1 – Inverse Roots of the AR Characteristic Polynomial

Source: Authors' estimation results performed in EViews (version 12 University Edition, IHS Markit, London, UK, distributed via OnTheHub), by employing Vector Error-Correction (VEC) models