

MACROECONOMIC DETERMINANTS OF ECONOMIC GROWTH IN EUROPEAN UNION MEMBER STATES

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ABSTRACT.

Background: Research on economic development represents an important factor in ensuring sustainability and competitiveness in today's global economy, which is influenced by various threats and shocks. **Aims:** The main objective of the paper is to identify and quantify the impact of selected macroeconomic factors on economic performance. **Sample:** The study examines the macroeconomic determinants of economic development—public debt, budget deficit, unemployment, dependency ratio, and inflation (HICP)—in the member states of the European Union over the period 2013–2024. **Methods:** The research is based on the analysis of secondary data processed using a linear regression model. Due to the confirmed presence of heteroskedasticity in the dataset, robust standard errors of the HC3 type were applied in the estimation of parameters. **Results:** The results of the analysis showed that the fiscal balance was statistically significantly associated with real GDP growth, reflecting the close relationship between economic performance and public finances, particularly during crisis periods. Conversely, unemployment and the old-age dependency ratio were identified as statistically significant negative factors, confirming the increasing sensitivity of European economies to demographic changes and labour market inefficiencies. Public debt and inflation did not prove to be statistically significant determinants within the selected model, which is explained by the specific environment of low interest rates and the broad nature of price shocks. **Implications:** There is a need for structural reforms aimed at mitigating demographic risks and maintaining the long-term stability of public finances in a changing macroeconomic environment.

Keywords: economic growth, European Union, regression analysis, public debt, budget deficit, demographic changes

JEL Classification: O11, F43, H62

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Introduction

The level of economic growth represents a key indicator for assessing the performance of economies and their competitiveness in the global environment. In the context of a dynamically changing international economic system, ensuring long-term economic sustainability and maintaining competitiveness have become strategic priorities for individual countries. These efforts are also shaped by current global trends, as well as by increasing uncertainty and external shocks. The identification and analysis of factors influencing the development of economic growth constitute an essential prerequisite for the effective management of an economy. This primarily involves recognizing determinants that act as drivers of growth, as well as those that may slow down or distort its dynamics. A comprehensive understanding of these relationships enables a better interpretation of development trends and supports the formulation of appropriate economic policies. Each economy possesses specific development potential, shaped by a set of economic, social, political, technological, and cultural factors. In this context, the economy can be perceived as a complex system whose performance depends on the quality of its governance. The effective design of economic policies and the institutional framework makes it possible to strengthen the positive effects of economic growth while minimizing negative impacts, thereby creating space for sustainable and inclusive development.

Theoretical background

Economic growth is one of the key topics of macroeconomic research and, in empirical models, is most often explained by a combination of fiscal, demographic, price-related, and market factors. The growth of real GDP is analysed in relation to public debt, the fiscal balance, unemployment, population ageing, and inflation. The authors state that, for several of these variables, the relationship is not linear, but rather threshold-based or conditional on institutional quality and the phase of the economic cycle (Égert, 2015; Kremer et al., 2013; Potrafke, 2025).

General government gross debt and real GDP growth

The relationship between public debt and economic growth is one of the most debated topics in modern macroeconomics. The classical line of research assumes that rising public debt may dampen economic growth through higher financing costs, the crowding out of private investment, increasing uncertainty, and a weakening of fiscal space. A different view is presented by Égert (2015), who points out that although a negative relationship between debt and growth is found relatively often, a universal “critical threshold” of debt is not robust, and the results depend on the sample of countries, the period analysed, and the econometric method applied. More recent empirical studies continue to confirm that non-linearity must be taken into account when examining public debt. Law, Ng, and Kutan (2021), using a sample of developing countries, show that the negative effect of debt on growth intensifies after a certain threshold level is exceeded, while higher institutional quality mitigates this effect. Similarly, Bozatli et al. (2024), using long-term data for G7 countries, demonstrate that the relationship between public debt and growth is not stable over time and changes depending on structural shifts. These findings are important and suggest that the relationship may differ under conditions of low and high indebtedness. For the European and advanced-economy context, it is also important that the consequences of debt cannot be separated from the fiscal framework. Potrafke (2025), in his synthesis of the literature on fiscal rules, shows that such rules reduce deficits, public expenditure, and financing costs, while also being associated with higher GDP growth. This indirectly supports the interpretation that the issue is not only the level of debt itself, but also the quality of its management and the credibility of fiscal policy. The literature most commonly supports a negative relationship between general government gross debt and real GDP growth, while also emphasizing the need to account for possible non-linearity and institutional conditionality (Égert, 2015; Law et al., 2021; Potrafke, 2025).

General Government Deficit/Surplus and Real GDP Growth

The literature on the fiscal balance is even more differentiated than the literature on debt. The classic study by Adam and Bevan (2005) shows that the effect of the deficit on growth is non-linear and, in the case of developing countries, identifies a deficit threshold of approximately 1.5% of GDP. Below

this threshold, reducing the deficit may bring growth benefits; however, excessive contraction may no longer support growth. This result therefore, suggests that the relationship between the deficit and growth cannot be interpreted mechanically. More recent studies confirm that the effect of the deficit depends on the time horizon, the economic cycle, and the quality of governance. Mwigeka (2025), using a sample of African countries, shows that the deficit may have a positive relationship with growth in the short term, but after exceeding the threshold of 14.3% of GDP, its effect becomes negative. Musa et al. (2025) also found that the budget deficit significantly affects growth mainly in the upper quantiles of growth, that is, during periods of economic expansion, while in weaker phases of the cycle, its effect fades, with the quality of governance systematically supporting growth.

For the broader European fiscal framework, findings on fiscal rules are also relevant. Potrafke (2025) summarizes that fiscal rules typically reduce deficits and financing costs, which means that, on average, they are associated with higher GDP growth. This implies that, in the long term, a larger deficit tends to be associated rather with lower growth, while better budgetary discipline and a surplus may create a more favourable macroeconomic environment. At the same time, however, the literature does not deny that, during a recession, a temporary deficit may serve as a stabilizing tool. From a long-term perspective, a higher deficit can therefore be expected to have a rather negative effect, but with possible non-linearity and differences between the short and long run (Adam & Bevan, 2005; Musa et al., 2025; Potrafke, 2025).

Unemployment Rate and Real GDP Growth

The relationship between unemployment and growth is traditionally explained by Okun's law, according to which higher growth of real output leads to a decline in unemployment, and vice versa. Although this is a classic macroeconomic relationship, more recent literature shows that this mechanism operates not only cyclically but also structurally. Bräuninger and Pannenberg (2002) had already shown that rising unemployment may reduce productivity and, consequently, the long-term growth potential of an economy. More recent studies focusing on OECD and EU countries extend this perspective. Wiese et al. (2025) show that changes in labour market institutions affect employment growth non-linearly and depending on the phase of the economic cycle. Camarero et al. (2026), in the case of EU countries, found that participation in global value chains affects unemployment differently in core and less-developed economies, pointing to labour market heterogeneity within the Union. In addition, Török (2025), in a VAR analysis of the EU for the period 2013–2023, identifies unemployment as one of the key macroeconomic variables that, together with inflation, investment, and the government balance, significantly co-determines the dynamics of GDP growth. Theoretically, this is a consequence of unused labour and lower demand, while the literature also emphasizes that the strength of this relationship depends on the institutional setting of the labour market, productivity, and the phase of the economic cycle (Bräuninger & Pannenberg, 2002; Wiese et al., 2025; Török, 2025).

Old-Age Dependency Ratio and Real GDP Growth

Demographic ageing has, in recent years, moved from a marginal topic to the centre of macroeconomic research. Emerson, Knabb, and Sirbu (2024), using a panel of OECD countries for the period 1975–2014, show that an increase in the old-age dependency ratio reduces secular growth. They identify the mechanism in lower accumulation of human and physical capital, as the growing share of older cohorts shifts resources away from investment towards transfers and consumption. Kotamäki and Lehtimäki (2025) analysed rapid population ageing in Finland and showed that accelerated ageing reduced GDP per capita and productivity, while at the same time increasing public debt. The work of Domonkos et al. (2024) is also relevant, as it shows that Slovakia is among the fastest-ageing countries in the EU and that the economic and budgetary consequences of ageing will be substantial. An older, but still highly relevant, European line of research also confirms that demographic ageing may negatively affect economic growth, particularly through changes in labour supply and productivity (Crespo et al., 2014). Overall, the literature therefore quite clearly supports the expectation that a higher old-age dependency ratio has a negative effect on real GDP growth, through a lower labour supply, weaker capital accumulation, and greater pressure on public finances (Emerson et al., 2024; Kotamäki & Lehtimäki, 2025).

Harmonised Index of Consumer Prices and Real GDP Growth

The relationship between inflation and growth is one of the most stable, yet at the same time most non-linear, findings in empirical macroeconomics. Kremer, Bick, and Nautz (2013) showed that inflation begins to significantly harm economic growth only after a certain threshold is exceeded, with this threshold differing between advanced and developing economies. Bick (2010) similarly shows that threshold models explain the relationship between inflation and growth better than linear specifications. The most recent literature tends to further strengthen this conclusion. Owusu and Bökemeier (2026) find a negative effect of inflation on economic growth using both panel linear and dynamic GMM estimates. Garrón et al. (2026), in a broader macroeconomic context, emphasize that low and stable inflation is generally associated with a more favourable environment for growth and employment, whereas high or volatile inflation worsens macroeconomic stability.

Methodology

The main aim of this paper is to identify and quantify the impact of selected macroeconomic factors – public debt, the budget deficit, unemployment, the dependency ratio, and inflation measured by the Harmonised Index of Consumer Prices (HICP) – on economic performance. In line with this objective, the study formulates the following research questions and research hypotheses:

RQ1: Do selected macroeconomic indicators differ across EU countries?

H1: Statistically significant differences are expected in selected macroeconomic indicators among EU countries.

RQ2: Do selected macroeconomic indicators have a statistically significant relationship with real GDP growth?

H2: Statistically significant relationships are expected between selected macroeconomic indicators and real GDP growth.

Table 1 Definition of variables used in the empirical analysis

Variable	Symbol	Description	Unit
Real GDP growth rate	gdp_growth	Annual percentage change in real gross domestic product, adjusted for inflation.	%
General government gross debt	debt	Total consolidated liabilities of the general government sector.	% of GDP
General government deficit/surplus	deficit	Balance of general government revenue and expenditure.	% of GDP
Unemployment rate	unemployment	Share of unemployed persons in the total labour force.	% of labour force
Old-age dependency ratio	old_age_dependency	Ratio of persons aged 65 and over to persons aged 15–64.	per 100 persons
Harmonised Index of Consumer Prices	HICP	Indicator measuring changes in consumer prices using a harmonised EU methodology.	annual average index

Note: Own processing based on Eurostat data (2026)

For the purposes of the research, we use data for the 27 European Union countries for the period 2013–2024. The following variables are included in the analyses:

Dependent variable:

- Real GDP growth rate,

Independent variables:

- General government gross debt,
- Government deficit,
- Unemployment,
- Old-age dependency ratio,
- Harmonised Index of Consumer Prices (HICP).

Table 1 presents the variables obtained from the Eurostat database that are included in the analysis.

The Harmonised Index of Consumer Prices (HICP) was included in the analysis as an annual average index in order to capture comparable price developments across EU Member States using a harmonised Eurostat methodology. The use of HICP enables cross-country comparison of the overall price level dynamics within the EU. However, it should be noted that annual changes in HICP could provide a more direct measure of inflation dynamics and may represent a more suitable stationary variable in time-series terms. For this reason, the results related to HICP are interpreted cautiously. The estimated coefficient should therefore be understood as an indication of the relationship between the selected price indicator and real GDP growth within the applied model, rather than as evidence of a direct causal effect of inflation on economic growth.

The statistical analysis was based on a country-year panel dataset obtained from the Eurostat database (2026), covering 27 EU member states and annual data on real GDP growth, general government gross debt, unemployment rate, general government deficit/surplus, old-age dependency ratio, and the Harmonised Index of Consumer Prices (HICP).

1. In the initial step, descriptive statistics were calculated for all analysed variables, including the number of observations, mean, median, standard deviation, minimum, maximum, skewness, and kurtosis. This provided a basic overview of the level and variability of individual indicators over time and across countries.
2. Multivariate normality was tested using the energy test.
3. Differences in individual indicators across EU countries were therefore tested using the Kruskal–Wallis test, which assesses whether the distribution of a given variable differs statistically significantly between groups, in this case between countries.
4. To assess the relationships between variables, Spearman's rank correlation was used. This method allows the identification of monotonic, but not necessarily linear, relationships even when the data are not normally distributed. The results are presented in the form of a correlation matrix.
5. In the next step, a multiple linear regression model was estimated to examine the determinants of economic growth in more detail. Real GDP growth was included as the dependent variable, while general government gross debt, the unemployment rate, the general government deficit/surplus, the old-age dependency ratio, and the HICP were included as independent, explanatory variables. The model parameters were estimated using the ordinary least squares method (OLS). Although the dataset has a panel structure, consisting of 27 EU Member States observed over the period 2013–2024, the empirical analysis applies a pooled OLS regression model. This approach was chosen because the primary aim of the study is to identify general relationships between selected macroeconomic indicators and real GDP growth across the EU as a whole, rather than to estimate country-specific effects. The pooled model, therefore, provides an initial overview of the average association between the analysed variables within the full sample. At the same time, the use of pooled OLS represents a methodological limitation. The Kruskal–Wallis test confirmed statistically significant cross-country heterogeneity for most of the analysed indicators, suggesting that EU countries differ substantially in terms of fiscal position, labour market conditions, demographic structure, and economic performance. Since pooled OLS does not explicitly control for unobserved country-specific characteristics, such as institutional quality, economic structure, fiscal rules, or long-term development paths, the regression results should be interpreted with caution. Future research could therefore extend the analysis by applying fixed effects or random effects panel models, accompanied by the Hausman test, in order to account more precisely for country-specific heterogeneity.
6. Model diagnostics included checking for multicollinearity using the Variance Inflation Factor (VIF). The VIF values for all explanatory variables ranged approximately between 1.28 and 1.94, while the corresponding tolerance values ($1/\text{VIF}$) were higher than 0.5. This indicates that multicollinearity does not represent a serious problem.
7. The assumption of homoscedasticity of residuals was verified using the Breusch–Pagan test. The test result ($\text{BP} = 23.53$; $\text{df} = 5$; $p = 0.00027$) confirmed the statistically significant presence of heteroscedasticity. For this reason, robust HC3 standard errors were used when testing the statistical significance of the regression coefficients. The text therefore interprets the OLS coefficients, while the p-values and confidence intervals are based on robust standard errors.

Results

For each quantitative variable, basic descriptive statistics were calculated, as presented in Table 2. For most of the analysed variables, the dataset contains 324 observations, with the exception of unemployment, due to missing data for some years.

Table 2 Descriptive Statistics

Variable	n	Mean	SD	Median	Min	Max
GDP growth	324	2.43	3.68	2.30	-10.90	24.60
Public debt	324	69.14	38.45	60.90	8.50	209.40
Unemployment	297	7.66	4.26	6.60	2.00	27.80
Deficit	324	-2.22	3.02	-2.00	-14.60	4.50
Dependency	324	29.43	4.48	29.90	18.40	38.40
HICP	324	109.26	13.03	103.59	97.77	166.56

Note: Own processing based on Eurostat data

The average real GDP growth rate in the analysed sample reaches 2.43%, while the standard deviation of 3.68 indicates relatively high volatility in economic growth. The values range from -10.9% to 24.6%, pointing to substantial fluctuations in economic activity during the observed period. The average level of general government gross debt is 69.14% of GDP, with the median being slightly lower at 60.9% of GDP. The range of values is relatively wide, from 8.5% to 209.4% of GDP, indicating considerable heterogeneity among the analysed countries in terms of public indebtedness. The average unemployment rate is 7.66%, while the median is 6.6%. The minimum value is 2%, whereas the maximum reaches 27.8%, which points to significant differences in labour market conditions across individual observations. The average value of the government deficit is -2.22% of GDP, meaning that, on average, the analysed countries operated with a deficit. The values range from -14.6% of GDP to 4.5% of GDP, indicating the presence of periods of substantial fiscal loosening as well as budget surpluses. The old-age dependency ratio averages 29.43%, with a median of 29.9%. The relatively narrow range of values, from 18.4% to 38.4%, indicates a gradual but stable process of demographic ageing in the analysed economies. The average value of the Harmonised Index of Consumer Prices (HICP) is 109.26 points, while the median reaches 103.59. The range from 97.77 to 166.56 points reflects differing developments in price levels across countries and periods. Overall, the descriptive statistics indicate considerable variability in macroeconomic variables, which is typical of panel macroeconomic data.

Multivariate normality

Multivariate normality was tested using the energy test with Monte Carlo simulations ($R = 1000$). The results showed a statistically significant deviation from the normal distribution ($E = 6.6367$; $p < 2.2 \times 10^{-16}$). Based on this finding, the null hypothesis of multivariate normality was rejected, meaning that the analysed data do not follow a multivariate normal distribution.

The visual analysis using boxplots confirmed the presence of several outliers and asymmetry in the distribution of the examined variables, reflecting differences between countries, which explains the results of the multivariate normality test.

The presence of numerous outliers, identified mainly in the period 2020–2022, points to non-standard economic shocks that led to pronounced asymmetries in the data. This represents an important factor that contributed to the rejection of the assumption of normal distribution of the variables. For this reason, the use of non-parametric statistical methods in the subsequent part of the analysis is justified.

Differences between countries were tested using the non-parametric Kruskal–Wallis test (Table 3), as the normality of the distribution of the analysed variables was not confirmed.



Figure 1. Variability and outlier analysis
Source: own processing based on Eurostat data

Table 3. Kruskal–Wallis test

Indicator	χ^2	df	p-value
GDP growth	58.379	26	< 0.001
Public debt	303.300	26	< 0.001
Unemployment	175.610	26	< 0.001
Deficit	106.710	26	< 0.001
Old-age dependency ratio	233.580	26	< 0.001
HICP	12.144	26	0.990

Note: Own processing based on Eurostat data

For all indicators except HICP, statistically significant differences between countries were identified at the significance level $\alpha = 0.05$. This indicates substantial heterogeneity in the levels of public debt, GDP growth, unemployment, fiscal position, and demographic burden, whereas inflation measured by HICP shows a relatively homogeneous pattern across countries.

For real GDP growth, the test statistic reached $\chi^2(26) = 58.38$; $p = 0.00028$, indicating statistically significant differences in the pace of economic growth between countries. Even more pronounced heterogeneity was observed in the case of general government gross debt, where the Kruskal–Wallis test reached $\chi^2(26) = 303.30$; $p < 0.001$. This means that countries differ substantially in terms of the level of general government indebtedness and clearly do not form a homogeneous group.

Significant differences between countries were also confirmed for the unemployment rate ($\chi^2(26) = 175.61$; $p < 0.001$), suggesting that labour market conditions differ persistently across individual states. Similarly, statistically significant differences were identified for the government deficit/surplus indicator ($\chi^2(26) = 106.71$; $p < 0.001$), reflecting different fiscal policy settings and outcomes during the observed period. Pronounced heterogeneity was also found in the demographic area: the old-age dependency ratio reached $\chi^2(26) = 233.58$; $p < 0.001$, indicating that the demographic burden associated with the older population differs significantly between countries.

An interesting contrast to these results is provided by the Harmonised Index of Consumer Prices (HICP). In this case, the Kruskal–Wallis test produced $\chi^2(26) = 12.14$; $p = 0.99$, meaning that no statistically significant differences between countries were identified. Although the test also worked with

26 degrees of freedom, corresponding to 27 countries, inflation measured by HICP appears to be relatively homogeneous across the analysed states.

In the context of the other indicators, this means that while differences between countries are pronounced and statistically significant in the areas of debt, GDP growth, unemployment, fiscal position, and demographic burden, price developments are much less differentiated. This may be related to the common market environment and the coordination of monetary policy within the EU.

Spearman’s Correlation Analysis

Spearman’s correlation analysis was applied to identify monotonic relationships between the analysed macroeconomic indicators. Its use was justified by the fact that the assumption of normality of the data was not met.

Table 4. Spearman correlation matrix

Indicator	GDP growth	Debt	Unemployment	Deficit	Dependency	HICP
GDP growth	1					
Debt	-0.108	1				
Unemployment	-0.158	0.423	1			
Deficit	0.258	-0.423	-0.237	1		
Dependency	-0.171	0.188	-0.036	-0.088	1	
HICP	-0.021	-0.157	-0.490	-0.117	0.427	1

Note: Own processing , Significance level $\alpha = 0.05$.

Spearman’s correlation analysis (Table 4) revealed complex relationships between the examined macroeconomic indicators. The statistically most notable relationships appear to be those between inflation and unemployment, indicating an inverse relationship, and between inflation and the dependency ratio, indicating a direct relationship. The results of the correlation matrix indicate that the relationships between the variables are mostly of low to moderate intensity. GDP growth shows a weak negative correlation with public debt (-0.108), unemployment (-0.158), and the dependency ratio (-0.171), while a weak positive relationship was identified in relation to the deficit (0.258). The correlation between GDP growth and inflation measured by HICP is negligible (-0.021), suggesting the absence of a significant monotonic relationship between these variables.

With regard to the mutual relationships among the explanatory variables, several more pronounced correlation links can be identified. Unemployment shows a moderately strong positive correlation with public debt (0.423) and, at the same time, a moderately strong negative correlation with inflation (-0.490). Public debt is moderately negatively related to the deficit (-0.423), which points to their interconnection within fiscal policy.

The dependency ratio is generally weakly correlated with the other variables, with the exception of inflation, where a moderately strong positive relationship was identified (0.427).

Based on these results, it can be concluded that statistically significant monotonic relationships exist among the analysed variables; however, their intensity is limited in most cases. This suggests the multifactorial nature of the determinants of economic growth.

Regression Model Diagnostics

To verify the stability of the model and rule out multicollinearity, the Variance Inflation Factor (VIF) and tolerance coefficient were calculated for all independent variables. The diagnostic results (Table 5) showed that VIF values ranged at a low level, from 1.284 for the deficit to 1.936 for public debt. Since none of the VIF values exceeded the conservative threshold of 2.5, or the commonly accepted threshold of 5, it can be concluded that harmful multicollinearity is not present among the variables. The model is therefore stable in terms of the mutual dependence of regressors and suitable for further interpretation.

Table 5. Multicollinearity diagnostics

Variable	VIF	Tolerance
Public debt	1.936	0.516
Unemployment	1.776	0.563
Deficit	1.284	0.779
Old-age dependency ratio	1.321	0.757
HICP	1.384	0.722

Note: Own processing

The quality of the regression model was subsequently verified using the studentized Breusch–Pagan test for the presence of heteroscedasticity. The test result (BP = 23.533; df = 5; $p < 0.001$) indicates the presence of heteroscedasticity, leading to the rejection of the null hypothesis of constant residual variance. For this reason, robust standard errors (HC) were used in the interpretation of the regression coefficients, ensuring the validity of statistical inference even when the assumption of homoscedasticity is violated.

Assumptions of the Linear Regression Model

To ensure the statistical validity of the estimates, the following conditions were tested:

1. **Normality of residuals** was verified using the multivariate energy test with Monte Carlo simulations. According to the central limit theorem, with a sufficiently large number of observations, the distribution of sample means tends to approximate a normal distribution, which supports the use of regression even when the data are moderately non-normal.
2. **Heteroscedasticity of residuals** was tested using the studentized Breusch–Pagan test in order to ensure the correctness of the standard error estimates.
3. **The absence of multicollinearity** among the independent variables was confirmed by calculating the Variance Inflation Factor (VIF) and the tolerance coefficient, thereby ensuring the stability and reliability of the coefficient estimates.

Based on the diagnostic tests, multicollinearity was not identified as a serious problem, while heteroscedasticity was confirmed and addressed through the use of robust HC3 standard errors. The estimated pooled OLS model can therefore be used for the initial identification of average relationships between the analysed variables. Nevertheless, given the panel structure of the dataset and the confirmed cross-country heterogeneity, the results should be interpreted as associations rather than as strictly causal effects.

Table 6. Regression analysis and interpretation of results

Variable	Estimate	Std. Error	t-statistic	p-value
Constant	9.242	2.077	4.451	0.000***
Public debt	0.010	0.007	1.392	0.165
Unemployment	-0.142	0.058	-2.435	0.016*
Deficit	0.339	0.092	3.679	0.000***
Dependency ratio	-0.159	0.069	-2.298	0.022*
HICP	-0.009	0.015	-0.560	0.576

Note: significance levels: *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

The strongest statistically significant variable in the model was the general government deficit/surplus indicator ($\beta = 0.339$; $p < 0.001$). The positive coefficient indicates that a more favourable fiscal balance was associated with higher real GDP growth within the analysed sample. However, this relationship should not be interpreted mechanically as evidence that increasing deficits automatically promote economic growth. Rather, it may reflect the close interconnection between the business cycle and public finances. During periods of stronger economic growth, public revenues tend to increase and selected social expenditures decline, which improves the budgetary position. Conversely, during economic downturns, budget deficits often widen as a result of lower revenues and higher stabilisation expenditures. The result may therefore partly reflect the stabilising role of fiscal policy during periods of economic downturn, rather than a direct and general growth-enhancing effect of higher deficits. In this context, the result may also reflect the specific crisis period of 2020–2022, when fiscal measures

played an important stabilising role in mitigating the negative effects of the pandemic and subsequent energy-related shocks.

A statistically significant negative effect was confirmed for the unemployment rate ($\beta = -0.142$; $p = 0.016$). Unemployment represents unused human capital, and when a large share of the population is without work, the economy produces less than its potential output. Moreover, unemployed individuals consume less, which reduces demand in the economy. The negative effect of unemployment is consistent with Okun's law, which defines an inverse relationship between the unemployment rate and the real output of the economy. High unemployment not only reduces the purchasing power of the population, but also represents an inefficient use of production factors.

Demographic ageing, reflected in the old-age dependency ratio, also proved to be a significant factor with a negative effect ($\beta = -0.159$; $p = 0.022$). The dependency ratio indicates how many economically inactive persons, particularly older people, depend on the working-age population. As this ratio increases, a smaller number of workers must support a larger number of non-working individuals. This increases pressure on the social system and may reduce savings and investment in the economy, thereby slowing economic growth. The identified negative effect of the dependency ratio points to the demographic limits of economic growth. Population ageing increases public expenditure on social security and healthcare, which may divert resources away from productive investments necessary for long-term growth.

The results indicate that rising unemployment and a deteriorating demographic structure, expressed by the dependency ratio, act as limiting factors that statistically significantly reduce the value of the dependent variable. In the case of unemployment, the results confirm the relevance of Okun's law in the conditions of the European labour market. An even more important finding, however, is the effect of the dependency ratio. The negative coefficient suggests that population ageing in the EU is no longer only a theoretical threat, but a real factor limiting economic dynamics by increasing mandatory expenditures and reducing the share of the productive component of the population.

By contrast, the effects of public debt ($\beta = 0.010$; $p = 0.165$) and inflation measured by HICP ($\beta = -0.009$; $p = 0.576$) were not statistically significant at the selected significance level of $\alpha = 0.05$. The results of the model suggest that the level of accumulated public debt, resulting from past deficits, is less important for current growth than the current fiscal balance. It may be assumed that, despite relatively high levels of public debt in some countries during the observed period, debt did not reach a critical threshold at which it would significantly suppress economic growth. The EU countries therefore appear to have remained within a debt range that did not yet represent a decisive barrier to growth. In addition, in the environment of historically low interest rates, particularly under the ECB's monetary policy during 2013–2021, the costs of servicing public debt did not represent a substantial obstacle to public or private investment. As a result, no pronounced crowding-out effect occurred that would otherwise have constrained economic activity.

A surprising finding is the statistically insignificant effect of inflation on growth. It can be stated that, during the period 2013–2024, inflation was shaped first by deflationary pressures and, after 2021, mainly by the energy crisis and the war in Ukraine. These were predominantly external supply-side shocks that affected the EU as a whole. Therefore, differences in inflation rates did not explain the variability of GDP growth across countries within the model.

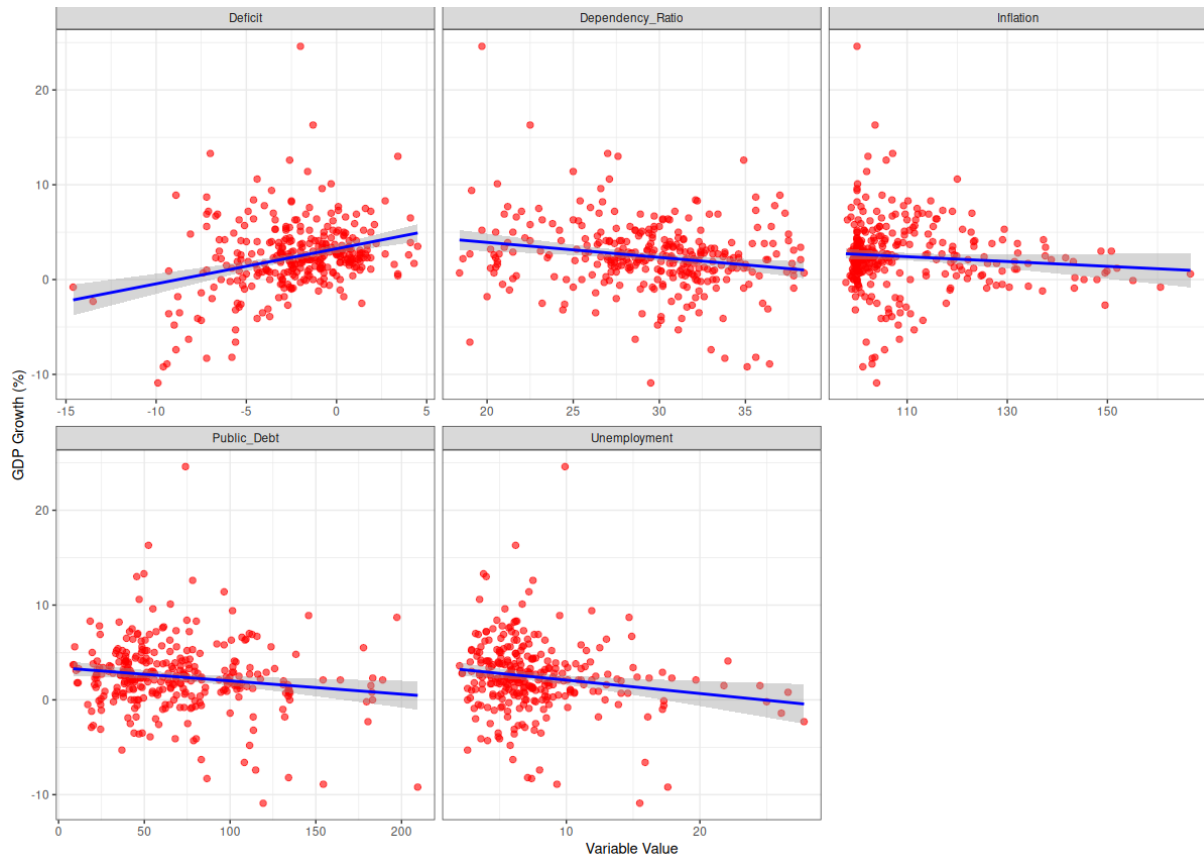


Figure 2. Effect of macroeconomic variables on GDP growth
Source: own processing based on Eurostat data

The results of the regression analysis for the period 2013–2024 reflect important macroeconomic developments in the European Union. The statistically significant coefficient of the fiscal balance points to the close link between economic performance and public finances, particularly during the crisis years 2020–2022. At the same time, the fact that public debt did not emerge as a statistically significant barrier to growth may be explained by the prolonged environment of low interest rates, which dominated most of the observed period and reduced the negative effects of high indebtedness on investment activity.

Evaluation of hypotheses

After conducting the partial statistical analyses and the diagnostics of the regression model, this section provides a synthesis of the findings obtained. Based on the results of testing the significance of differences and the estimated regression coefficients, the formulated hypotheses are verified. Each hypothesis is evaluated at the selected significance level of $\alpha = 0.05$, taking into account not only the p-values but also the economic context of the analysed period.

Table 7. Evaluation of hypotheses

Hypothesis	Statement	Method used	Result
H1	Existence of differences between EU countries	Kruskal–Wallis test	Confirmed
H2	Existence of relationships with GDP growth	Regression analysis (HC3)	Partially confirmed

Note: Own processing

Discussion

The aim of the research was to identify and quantify the impact of selected macroeconomic factors—public debt, the budget deficit, unemployment, the dependency ratio, and inflation measured by the Harmonised Index of Consumer Prices (HICP)—on economic performance. The analysis was based on data for the EU-27 countries covering the period 2013–2024. The regression results showed that the general government fiscal balance, the unemployment rate, and the old-age dependency ratio were statistically significant variables. By contrast, no statistically significant relationship with real GDP growth was confirmed for gross general government debt or the Harmonised Index of Consumer Prices. The findings therefore indicate that economic growth during the period under review was primarily associated with current labour market conditions, demographic structure, and the countries' short-term fiscal position, whereas the accumulated level of public debt and the price level did not explain differences in economic growth sufficiently convincingly.

When interpreting these results, potential endogeneity and reverse causality should also be considered. The relationships between economic growth, the budget balance, and unemployment are unlikely to be strictly one-directional. Fiscal policy may influence economic growth through public expenditure, automatic stabilisers, and crisis-related support measures. At the same time, economic growth itself affects the fiscal balance through tax revenues, social security contributions, and expenditure on unemployment-related support. Similarly, unemployment may reduce economic growth through lower labour utilisation and weaker aggregate demand, while slower economic growth may also contribute to rising unemployment. Therefore, the estimated coefficients should be interpreted as statistically significant associations rather than as definitive evidence of causal effects.

The budget balance emerged as the strongest determinant of the dependent variable, real GDP growth ($\beta = 0.339$; $p < 0.001$). The positive regression coefficient for the fiscal balance means that an improvement in the budget balance — either a reduction in the deficit or an increase in the surplus by one percentage point of GDP — was associated with an average increase in real GDP growth of 0.339 percentage points, holding the other variables constant. However, this result should not be interpreted as indicating that a widening deficit automatically promotes economic growth. Rather, it suggests that periods of more favourable economic performance were also associated with a stronger budgetary position. This finding may be explained by the operation of automatic stabilisers and by the bidirectional relationship between economic growth and public finances. During periods of economic expansion, tax and social security contribution revenues increase, while certain social expenditures decline, thereby naturally reducing the budget deficit. Conversely, during recessions, public revenues fall and expenditures aimed at supporting households, employment, and businesses increase. The positive coefficient may therefore capture not only the effect of the fiscal balance on economic growth, but also the reverse effect of the economic cycle on the budget balance. The years 2020–2022 are particularly important in this respect, as the decline in economic activity was accompanied by substantial budget deficits resulting from the COVID-19 pandemic and the subsequent support measures. The result is partly consistent with the conclusions of Adam and Bevan (2005), who emphasise that the relationship between the budget deficit and economic growth is nonlinear and should not be interpreted mechanically. In the short term, fiscal expansion may stabilise aggregate demand and mitigate a recession, whereas persistent and excessive deficits may reduce fiscal space and increase financing costs in the long term. Similarly, Potrafke (2025) highlights the importance of fiscal rules and budgetary discipline for the stability of public finances and long-term economic growth. The findings of this study therefore support the importance of sustainable fiscal policy rather than a general conclusion that increasing deficits have a favourable effect on economic growth.

A positive but statistically insignificant coefficient was found for gross general government debt. The result did not confirm the initial expectation of a negative linear relationship between public debt and real GDP growth. However, it cannot be interpreted as evidence that public debt has no effect on economic growth. The lack of statistical significance may indicate that the effect of debt is nonlinear, occurs with a time lag, or is conditional on other factors, such as interest rates, the composition of public expenditure, the credibility of fiscal policy, and institutional quality. This interpretation is consistent with the conclusions of Egert (2015), according to whom no single universally applicable critical threshold for public debt can be established. Similarly, Law, Ng, and Kutan (2021) point out that the adverse effects of debt may intensify only after a certain threshold has been exceeded and that they depend on the quality of the institutional environment. Bozatli et al. (2024) further show that the relationship between debt and economic growth may change over time. A linear model applied to all EU countries may therefore fail to capture the different effects of debt in low- and high-debt economies. The statistical insignificance of public debt may also be related to the monetary conditions prevailing during most of the period under review, particularly between 2013 and 2021, when European economies operated in a low-interest-rate environment. This reduced the cost of servicing public debt. At the same

time, the effect of public debt may have differed depending on how the borrowed resources were used. Debt financing productive investment in infrastructure, human capital, or digitalisation may not have the same consequences as debt used to finance current consumption. The aggregate indicator of gross public debt employed in this study does not capture these differences.

The statistically significant negative coefficient for the unemployment rate confirms the expected inverse relationship between unemployment and economic growth. A one-percentage-point increase in unemployment was associated with an average decrease in real GDP growth of 0.142 percentage points, holding the other variables constant. This result is consistent with Okun's law, according to which an increase in economic activity leads to higher employment and a decline in unemployment. The negative relationship can be explained by the underutilisation of available labour, the loss of productive capacity, and lower household disposable income. Higher unemployment reduces consumer demand, tax revenues, and human capital accumulation, while simultaneously increasing public-sector social expenditure. This finding is consistent with the conclusions of Bräuninger and Pannenberg (2002), according to whom long-term unemployment may adversely affect productivity and long-term growth potential. It also supports the more recent findings of Wiese (2025) and Camarero et al. (2026), who emphasise that the strength of this relationship depends on labour market institutions, the structure of the economy, and the phase of the business cycle. The results should also be interpreted with regard to bidirectional causality. Higher unemployment constrains economic growth, while a decline in GDP simultaneously leads to reductions in production and employment. The regression coefficient therefore, captures a conditional statistical association rather than a clearly established one-way causal effect of unemployment on economic growth.

Another significant finding is the negative relationship between the old-age dependency ratio and real GDP growth. A one-percentage-point increase in the dependency ratio was associated with an average decrease in real GDP growth of 0.159 percentage points. This result confirms the assumption that population ageing represents a significant constraint on long-term economic growth in the European Union. An increasing proportion of older people reduces the relative size of the working-age population, limits labour supply, and places greater pressure on pension, healthcare, and social security systems. As a result, a larger share of public resources is allocated to transfers and healthcare expenditure, which may reduce the fiscal space available for productive investment. This finding is consistent with the conclusions of Emerson, Knabb, and Sirbu (2024), who identified a negative effect of a rising old-age dependency ratio on secular economic growth. It also supports the findings of Kotamäki and Lehtimäki (2025), according to whom rapid population ageing reduces GDP per capita and productivity while increasing pressure on public debt. These results are particularly relevant for Central and Eastern European countries, where demographic ageing is accompanied by labour outflows and alarmingly low fertility rates. As Domonkos (2024) notes, Slovakia is among the countries in which substantial economic and fiscal consequences of population ageing can be expected. Policies aimed at increasing the labour market participation of older people and women, promoting managed labour migration, supporting lifelong learning, and enhancing productivity may therefore help mitigate the adverse macroeconomic effects of demographic change.

A negative but statistically insignificant coefficient was found for HICP. The result therefore, did not confirm a statistically significant linear relationship between the price indicator used and real GDP growth. The lack of statistical significance may be related to the fact that the period under review included both phases of very low inflation and a sharp increase in prices after 2021. The effects of low and high inflation may not be symmetrical. The result is therefore consistent with the threshold models of Kremer, Bick, and Nautz (2013) and Bick (2010), according to which inflation tends to adversely affect economic growth mainly after a certain threshold has been exceeded. The nature of the inflationary developments may also have played an important role. Price growth after 2021 was largely associated with energy, geopolitical, and supply-side shocks that affected the EU Member States relatively broadly. This may have limited the ability of HICP to explain differences in economic growth across countries. However, the statistically insignificant coefficient does not imply that high inflation has no economic consequences. Rather, it suggests that, within the linear specification used and after controlling for the other variables, its independent effect could not be statistically distinguished from the effects of the remaining factors.

The research findings show that real GDP growth in EU countries cannot be explained by a single macroeconomic factor. The statistically significant relationships involving unemployment and the old-age dependency ratio highlight the key importance of human capital, labour utilisation, and demographic sustainability. The significance of the fiscal balance also indicates a close interconnection between the business cycle and public finances. The statistical insignificance of public debt and HICP supports the assumption that their effects are likely to be nonlinear, time-varying, and conditional on

the institutional and macroeconomic environment. From an economic policy perspective, the results support the adoption of measures aimed at reducing structural unemployment, increasing labour productivity, and mitigating the consequences of population ageing. In the fiscal sphere, the findings should not be interpreted as an argument for automatic budget cuts during an economic downturn. Rather, they emphasise the need to create fiscal space during favourable economic periods so that governments can implement stabilisation measures during crises without disproportionately jeopardising the long-term sustainability of public finances.

Policy Implications

Based on the identified statistical relationships and the subsequent discussion of the results, the following recommendations can be formulated for economic policy makers within the EU.

Implementation of smart fiscal policy: Given the confirmed positive effect of the budget deficit ($\beta = 0.339$), policy makers should avoid procyclical restrictive policies, such as across-the-board austerity measures, during periods of economic stagnation. A shift towards targeted fiscal expansion is recommended, particularly towards investments with a high multiplier effect that stimulate aggregate demand without threatening long-term sustainability, provided that a favourable differential between interest rates and the growth rate is maintained ($r < g$).

Mitigation of demographic risks: The statistically significant negative effect of the dependency ratio ($\beta = -0.159$) highlights the urgent need for structural reforms. Recommended measures include increasing the labour market participation of older cohorts through active ageing policies and reforming pension systems in order to reduce pressure on public finances. Without an adequate response to demographic developments, rising social transfers may crowd out productive government investment.

Reduction of structural unemployment: Since unemployment represents a significant barrier to economic performance ($\beta = -0.142$), economic policy should focus on active labour market policies (ALMP). Emphasis should be placed on lifelong learning and retraining programmes that reduce the mismatch between the supply of and demand for skills, thereby increasing the overall efficiency of human capital utilisation.

Differentiated approach to debt management: Although public debt did not prove to be a critical determinant of growth during the observed period, policymakers should use the current period to adjust the debt structure towards longer maturities. The objective should be to strengthen the resilience of public budgets against potential future increases in interest rates, which could turn the currently insignificant effect of debt into a significant barrier to growth.

Limitations of the Study

A limitation of the present analysis is the presence of heteroscedasticity, which was addressed in the study by using robust estimates. Future research could focus on the decomposition of government expenditure in order to determine whether the positive effect of the deficit is generated primarily by investment expenditure or by household consumption stimulated through transfers.

Conclusion

The present paper focused on the identification and analysis of key macroeconomic determinants of economic development in the countries of the European Union over the period 2013–2024. The stated objective of the paper was fulfilled through quantitative research, within which a linear regression model was constructed. Due to the presence of heteroskedasticity in the dataset, the model parameters were estimated using HC3 robust standard errors, which ensured a high degree of stability and statistical validity of the presented results.

The results of the regression analysis indicate that the fiscal balance, unemployment rate, and old-age dependency ratio were statistically significant variables associated with real GDP growth in EU countries during the period 2013–2024. The positive coefficient of the fiscal balance suggests a close relationship between economic performance and public finances, particularly in the context of crisis-related fiscal measures. However, this result should be interpreted cautiously, as the relationship between fiscal variables and economic growth may also reflect reverse causality and the effects of the business cycle.

In contrast, public debt did not prove to be a statistically significant determinant of growth in the applied model. This finding may be attributed to the specific macroeconomic environment of the observed period, especially the prolonged period of low interest rates and the absence of a strong crowding-out effect. Similarly, inflation measured by HICP was not statistically significant, which may reflect the broad and largely external nature of price shocks affecting EU Member States after 2021.

Conversely, the analysis identified critical barriers to growth in the form of unemployment and the dependency ratio. The confirmed negative impact of unemployment is consistent with economic principles concerning the inefficient use of human capital. An even more urgent finding, however, is the significant negative impact of the dependency ratio, which demonstrates that population ageing in the EU is becoming a real structural constraint on economic dynamics. At the same time, the statistical insignificance of inflation, measured by the Harmonised Index of Consumer Prices (HICP), suggests that price shocks during the observed period affected member states broadly, and therefore differences in their intensity do not explain the variability of economic performance within the model.

From the perspective of economic practice, the paper emphasizes the need to implement structural reforms focused on the labour market and the mitigation of demographic risks. Fiscal policy should remain flexible, while being oriented towards investments with a high multiplier effect that are capable of generating growth even in an environment of gradually increasing debt servicing costs. The results of this paper thus provide a relevant empirical basis for discussion on the future direction of economic policy coordination within the European Union.

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