sciendo

DOI 10.2478/sbe-2025-0020
SBE no. 20(1) 2025

# AN EMPIRICAL ANALYSIS OF THE INTERDEPENDENCIES BETWEEN INVESTMENT, ECONOMIC GROWTH, AND FISCAL PERFORMANCE: EVIDENCE FROM ROMANIA

**Nicoleta Claudia MOLDOVAN**
*West University of Timisoara, Romania*

**Cristi SPULBAR**
*University of Craiova, Romania*

**Simona Maria ENE**
*University of Craiova, Romania*

**Raluca Ioana RACATAIAN**
*West University of Timisoara, Romania*

***Abstract:***

*The main objective of this research is to analyze the complex interdependencies between economic growth, measured by GDP per capita, fiscal performance, and investment in physical capital. The analysis of how these variables influence each other, both in the long and short term, was conducted using the econometric Vector Error Correction Model (VECM). By testing hypotheses confirmed in the specialized literature regarding the relationships between tax revenues, public expenditures, and capital formation, the paper aims to contribute to the development of the academic foundation that supports policymakers and authorities in promoting effective and sustainable economic policies. To this end, we investigated how efficient taxation can stimulate economic growth, as well as the impact of an excessive fiscal burden on economic motivation. In addition, the relationships between tax revenues and public expenditures, the impact of economic growth on capital formation, and the influence of fiscal performance on government borrowing and long-term economic stability were examined. The existence of cointegration relationships among the variables suggests that they evolve along a common long-term equilibrium path, despite short-term fluctuations, with the results outlining the contribution of public expenditures and tax revenues to supporting a sustainable trajectory of real GDP. Shocks to fiscal pressure generate propagated effects on other economic components, including GDP and investment, demonstrating the systemic nature of fiscal transmission. The variance decomposition highlighted the significant contribution of fiscal variables to the evolution of net liquidity and fiscal pressure, indicating their importance in macroeconomic dynamics. Therefore, the formulation of effective economic policies must take into account the complexity of the relationships among economic variables. A balance between taxation, public expenditures, and investment in physical capital is essential for ensuring sustainable economic growth, while fiscal policy must be adapted to respond promptly to economic shocks in order to maintain long-term macroeconomic equilibrium.*

**Key words:** *Economic growth; Fiscal performance; Fiscal sustainability; Economic policies; Vector Error Correction Model (VECM)*

## 1. Introduction

The analysis of the interdependencies among fundamental economic variables such as economic growth, fiscal performance, and investment in physical capital remains a highly relevant and constantly evolving subject in understanding the dynamics of modern economies. As economies become increasingly complex, evaluating the relationships among these variables is essential for designing effective economic policies. The central motivation of this research lies in the analysis and validation of the interdependent relationships between the fundamental economic variables under consideration. In this context, the results aim to provide a robust analytical framework to support decision-makers in formulating economic strategies that balance economic development with long-term sustainability. Studying the interdependencies among these variables may reveal more resilient economic models, capable of responding to contemporary economic challenges.

The main objective of the research is to investigate these complex relationships by using empirical data and econometric models to test the formulated hypotheses. The study seeks to provide an in-depth understanding of how economic growth, fiscal performance, and investment in physical capital influence each other, thereby contributing to the development of an integrated economic theory.

The central hypothesis of this research suggests the existence of a complex interdependence between economic growth, measured by GDP per capita, fiscal performance, and investment in physical capital. It is assumed that these variables influence one another through multiple transmission channels, which highlights the complexity of economic relationships and the need for a detailed and integrated analysis. To this end, several secondary hypotheses were formulated. The first addresses the relationship between economic growth and tax revenues, assuming that efficient taxation may stimulate long-term economic growth by channeling resources toward infrastructure and education. However, an excessive fiscal burden can reduce economic motivation and have a negative impact on growth. The second secondary hypothesis focuses on the relationship between tax revenues and government expenditures. A high level of taxation may lead to reduced public spending due to a more cautious fiscal approach, limiting the government's ability to stimulate the economy, particularly in cases of inefficient use of public funds. The third secondary hypothesis explores the relationship between economic growth and capital formation, based on the idea that a growing economy encourages capital accumulation, which in turn contributes to an increase in GDP per capita by enhancing productivity and providing a sustainable foundation for economic development. The final hypothesis addresses the relationship between fiscal performance and government borrowing, considering that a volatile fiscal policy, characterized by large budget deficits or excessive government borrowing, can undermine economic stability. This may negatively affect long-term growth, as the government becomes increasingly dependent on external financing to support public expenditures.

To achieve the research objectives, a Vector Error Correction Model (VECM) was employed to assess the cointegration relationships and the short- and long-term dynamics among the key economic variables, namely economic growth (measured by GDP per capita), fiscal performance, and investment in physical capital. The use of this model allows for the identification of long-term interdependencies among the variables, as well as their short-term adjustments in response to economic shocks. Thus, the selected model facilitates a deeper understanding of how changes in one variable may influence the others, both immediately and over the long run, providing an appropriate analytical framework for testing the research hypotheses. The model also contributes to evaluating the stability of economic relationships and to formulating economic policy recommendations, considering their impact on sustainable economic development.

## 2. Literature Review

Beginning with the pioneering contribution of Kuznets (1955), who proposed a nonlinear relationship between income inequality and economic growth—known as the Kuznets curve, which suggests that inequality initially increases and later decreases during the process of economic development—interest in analyzing the interaction between these two variables has grown significantly (Eicher & Turnovsky, 2003). However, theoretical literature and empirical studies have produced controversial results, and economic theory does not provide a conclusive answer regarding the nature of the relationship between income inequality and economic growth. The effects of inequality on economic growth largely depend on the response of fiscal policy to income distribution.

Contemporary policy debates focus on decisions related to public spending and taxation, often linked to resource redistribution mechanisms that influence fiscal performance. Depending on these decisions, fiscal policy may have varying impacts on income inequality and economic growth, thereby representing an essential transmission channel between the two phenomena. In addition to fiscal policy, the literature identifies other transmission mechanisms between income inequality and growth, such as socio-political instability, which can negatively affect investment levels. As such, the interactions among economic growth, income inequality, and fiscal performance are extremely complex and operate through multiple channels of influence.

The validity of transmission channels and reduced-form relationships between income inequality and economic growth are empirically assessed primarily through the use of cross-sectional and panel data (Erhart, 2009; Neves & Silva, 2014). These relationships are typically examined using single-equation models. The relationship between income inequality and fiscal performance, in the context of economic growth, is approached in a similar way, as evidenced by the empirical analysis conducted by Larch (2012). However, the use of these variables in a single-equation framework often encounters the issue of endogeneity in the explanatory variables. Although this issue is generally addressed through the use of instrumental variables, identifying appropriate instruments remains a significant challenge.

The literature on the relationship between income inequality and economic growth is vast but often contradictory, as previously mentioned. In this context, the study conducted by Shin (2012) provided significant clarification by examining the relationship through a stochastic optimal growth model. The author highlighted that the effects of income inequality on economic growth may vary depending on the stage of economic development.

Another important aspect of the literature is the link between financial development, economic growth, income inequality, and poverty. The study conducted by Sehrawat and Giri (2017) analyzed this relationship in the context of the Indian economy using the ARDL bounds testing approach for the period 1970–2015. The research results revealed a robust long-term relationship between financial development, economic growth, inequality, and poverty.

Seabela et al. (2024) applied the Vector Error Correction Model (VECM) to analyze the relationship between income inequality and its determinants in South Africa. Their study shows that social support programs and gross savings significantly contribute to reducing inequality, while population growth intensifies it. These findings highlight the usefulness of the VECM methodology in exploring the complex dynamics between economic and social variables.

Ilesanmi and Tewari (2023) conducted a similar study in South Africa, using the VECM model to investigate the dynamic relationship between energy consumption, investment in human capital, and economic growth over the period 1960–2015. The study confirmed the existence of cointegration among the variables, demonstrating a long-run bidirectional relationship between economic growth and energy consumption.

Another relevant example in the literature is the study by Chakraborty and Aktar (2024), which explores the long-term relationship between income inequality and economic growth in Bangladesh, using advanced econometric techniques such as the Johansen cointegration test and VECM. This study highlights that although economic development was accompanied by increasing inequality, such inequality may slow the pace of economic growth.

The present research is grounded in the methodological approach proposed by Davtyan (2015), who investigates the complex interrelationships among economic growth, income inequality, and fiscal performance. His study examines the dynamics of these variables by applying structural VAR models, focusing on the transmission channels between them. The empirical analysis is conducted on a sample of developed economies—the United Kingdom, the United States, and Canada—using extended time series data with consistent measures of income inequality. The results indicate a negative impact of inequality on economic growth in the United Kingdom, and a positive effect in the U.S. and Canada. Furthermore, the findings show that increasing income inequality negatively affects fiscal performance in all three countries analyzed.

Building on this theoretical and empirical foundation, the main objective of our research is to analyze the interdependent relationships among economic growth (measured by GDP per capita), fiscal performance, and investment in physical capital within an integrated macroeconomic framework. Specifically, the investigation focuses on: (i) the impact of fiscal efficiency on economic growth and GDP per capita; (ii) the influence of taxation on the level of government expenditure and fiscal behavior of the state; (iii) the relationship between economic dynamics and capital formation; and (iv) the effects of fiscal volatility and government debt on long-term economic stability.

In this context, our research adopts the methodology used by Davtyan (2015), applying it to the same set of economic indicators, but for a different period (1995–2023) and within the framework of a single-country analysis. This provides a contextualized perspective by adapting a validated international methodology to the structural and institutional specificities of the Romanian economy. The paper also examines the existence of stable long-term relationships among these economic variables and analyzes how they influence short-term dynamics. Accordingly, a VECM model will be applied to model the economic interactions and assess the impact of these relationships on sustainable economic development.

The empirical analysis will be conducted for Romania, an emerging economy which, despite having made progress in economic development, faces challenges related to the implementation of effective fiscal policy. Romania applies fiscal policies shaped by its integration into the European Union, but generally maintains a more flexible fiscal framework compared to Eurozone countries. The Romanian economy is characterized by moderate government regulation and relatively high income inequality, despite recent progress in reducing disparities. By comparing the empirical results, the study aims to identify whether similar trends to those observed in developed economies also apply to the Romanian case, taking into account its different economic and political context. The paper suggests that income inequality has a negative effect on economic growth in Romania—similar to the case of the United Kingdom—and that rising income inequality adversely affects fiscal performance, limiting the government's capacity to support sustainable economic development.

## 3. Methodology

This research adopts the methodological framework proposed by Davtyan (2015), adapting it to the context of the Romanian economy for the period 1995–2023. Unlike the structural VAR model used in Davtyan's analysis, the present study applies a Vector Error Correction Model (VECM), which is more appropriate for capturing long-term equilibrium relationships as well as short-term adjustments among the analyzed variables. The data used were sourced from the statistical databases of the World Bank and Eurostat, with annual frequency, and cover indicators related to economic growth, fiscal performance, and capital investment. Data processing was conducted using EViews 12 software, ensuring consistency and accuracy throughout the analysis. To meet the methodological requirements specific to econometric modeling, all time series were transformed to satisfy the stationarity condition.

The empirical analysis focused on the following relevant economic indicators: tax revenues (% of GDP), structured into two main categories in accordance with the economic classification used by Romanian fiscal authorities: (i) taxes on production and imports (including VAT, excise duties, customs duties, and certain local taxes); and (ii) taxes on income, profit, and capital gains (such as personal income tax, corporate profit tax, dividend tax, and other capital-related taxes). Fiscal pressure, reflecting the overall share of tax revenues in GDP, was calculated by adding mandatory social contributions to the previously mentioned tax revenues. Real GDP growth (annual %) represents the annual growth rate of

GDP, adjusted for inflation. Government final consumption expenditure as a percentage of GDP reflects the size of the public sector. Gross fixed capital formation (% of GDP) expresses the level of investment as a share of GDP. Net lending (+)/net borrowing (–) (% of GDP) measures the difference between general government revenues and expenditures as a percentage of GDP.

In Romania, social contributions are not included in the category of tax revenues, as is the case in some international statistics. This methodological particularity justifies the separate inclusion of both concepts - tax revenue and fiscal pressure - within the analysis, in order to more accurately capture the fiscal impact on the economy. Regarding the fiscal pressure variable, it was retrieved from the Eurostat database, while the other economic indicators were collected from the World Bank. The choice of Eurostat as the main source for this indicator is justified by its more detailed and methodologically harmonized approach, which ensures improved comparability and higher accuracy in measuring the tax burden. Unlike the World Bank, which provides a global perspective on this indicator, Eurostat adopts a consolidated and standardized methodology, making it a more appropriate reference source for fiscal pressure analysis in the context of this study.

**Table 1.** List of Abbreviations and Their Detailed Definitions

| **Abrevieri** | **Definiții conform specificațiilor din sursa datelor** |
|---|---|
| RGDPG | Real GDP Growth |
| GOVEXP | Government Expenditure (% of GDP) |
| GFCF_GDP | Gross fixed capital formation as a percentage of GDP |
| TAXREV | Represents the share of tax revenue derived from production, imports, income, profit, and capital gains, expressed as a percentage of GDP |
| NLB | Represents the net lending (+) or net borrowing (–) position of the general government, expressed as a percentage of GDP. It reflects the fiscal balance resulting from the difference between total revenues and total expenditures |
| FISC_PRESS | Represents the overall tax burden, calculated as the share of total tax revenue and mandatory social contributions in GDP. This indicator reflects the total fiscal pressure exerted by the government on the economy |

**Source:** Definitions adapted from the World Bank (World Development Indicators) and Eurostat (ESA 2010 methodology). The fiscal pressure indicator (FISC_PRESS) includes both tax revenues and mandatory social contributions, expressed as a percentage of GDP.

The first step of the analysis involved testing the stationarity of the time series using the Augmented Dickey-Fuller (ADF) test. The results confirmed that all series are integrated of order I(1), which makes them suitable for modeling using the Vector Error Correction Model (VECM). Subsequently, the Johansen cointegration test was applied to identify the existence of long-term equilibrium relationships among the variables. Descriptive statistics were used to analyze the economic variables, including indicators such as: the arithmetic mean, to highlight central tendency; standard deviation, to measure variability; minimum and maximum values, to identify dataset limits; skewness and kurtosis, to describe the distribution of the data. The number of cointegration relationships was determined based on the trace statistic and the maximum eigenvalue, using predefined significance thresholds. The optimal lag length of the model was selected using econometric criteria such as the Akaike Information Criterion (AIC), the Schwarz Information Criterion (SIC), and the Final

Prediction Error (FPE). Choosing an appropriate lag structure was essential to avoid model overparameterization.

After specifying the model, estimation was performed, including the error correction coefficients, which measure the speed at which variables adjust toward the long-term equilibrium. Subsequently, the dynamic analysis was extended through variance decomposition and impulse response functions, in order to assess the short- and long-term impact of shocks on the variables. To validate the model, diagnostic tests were carried out, including the Breusch-Godfrey test for serial correlation and the White test for heteroskedasticity, which examined the quality of model specification. Additionally, the Jarque-Bera test was applied to assess the normality of the residuals—an important condition for the statistical validity of the model.

The methodology employed in this study included impulse response analysis, forecast error variance decomposition, and forecasting. Impulse response analysis was applied to evaluate how shocks to one variable influence the other variables in the model over time. Moreover, the variance decomposition enabled the identification of the contribution of shocks to the total variation of each variable, providing additional insight into the relationships among the studied variables. Finally, forecasts were produced to assess the future behavior of the time series, using the structure of the econometric model estimated over a five-year horizon.

## 4. Results and Discussion

In this study, a descriptive statistical analysis was conducted to evaluate the main characteristics of the variables used. This step facilitated the identification of central tendencies, such as the mean and median, measures of dispersion including the standard deviation and range, as well as the shape of the distribution through the calculation of skewness and kurtosis coefficients. Additionally, the Jarque-Bera test was employed to verify the conformity of the distributions with the normality assumption. This preliminary analysis was performed to provide a solid foundation for the subsequent interpretation of econometric results and to ensure a clear understanding of the dataset under study.

**Table 2.** Descriptive Statistical Analysis of the Indicators

| | | | | | | |
|---|---|---|---|---|---|---|
| Mean | 3.552400 | -4.480000 | 27.82400 | 15.77960 | 25.02440 | 16.65640 |
| Median | 4.110000 | -4.200000 | 27.50000 | 15.88000 | 24.98000 | 17.06000 |
| Maximum | 10.43000 | 2.400000 | 31.40000 | 18.67000 | 33.09000 | 18.92000 |
| Minimum | -5.520000 | -13.00000 | 25.90000 | 13.47000 | 15.65000 | 14.18000 |
| Std. Dev. | 3.984550 | 3.778007 | 1.352553 | 1.304998 | 3.416488 | 1.262342 |
| Skewness | -0.569467 | -0.235349 | 0.912720 | 0.156419 | -0.206760 | -0.477525 |
| Kurtosis | 3.003644 | 3.045614 | 3.491651 | 2.561475 | 4.667788 | 2.336651 |
| Jarque-Bera | 1.351234 | 0.232955 | 3.722864 | 0.302263 | 3.075536 | 1.408493 |
| Probability | 0.508842 | 0.890050 | 0.155450 | 0.859735 | 0.214860 | 0.494481 |
| Sum | 88.81000 | -112.0000 | 695.6000 | 394.4900 | 625.6100 | 416.4100 |
| Sum Sq. Dev. | 381.0393 | 342.5600 | 43.90560 | 40.87250 | 280.1374 | 38.24418 |
| Observations | 25 | 25 | 25 | 25 | 25 | 25 |

**Source:** Author's elaboration based on the research methodology.

Since the VECM model focuses on long-term interactions and relationships among multiple variables, joint descriptive statistics are more relevant for the accurate estimation of parameters and for understanding the overall behavior of the economic variables. The individual analysis of each variable would not provide sufficient information about the interdependencies and relationships among them within such a model. Joint descriptive statistics (or descriptive statistics for an entire dataset) refer to the application of data analysis techniques to the complete dataset as a whole. Measures of central tendency (mean, median, mode), measures of dispersion (variance, standard deviation), and others are calculated for the entire set of observations. In this context, the data are treated as representative of the full group of observations.

Table 2 shows that the analyzed economic indicators reflect significant volatility, with both short- and long-term fluctuations. RGDPG exhibits high dispersion, suggesting considerable economic fluctuations in Romania's real GDP. NLB, with a negative mean and extreme values, indicates a declining trend in internal or external debt levels—potentially reflecting austerity policies or periods of economic recession. FISC_PRESS, which displays positive skewness, indicates a relatively stable inflationary pressure, but with risks of rising prices, which may affect households' purchasing power. The high fluctuations and variation observed in GFCF_GDP and TAXREV signal instability in fiscal policy, which may undermine long-term economic planning. Overall, the data suggest a highly volatile economy, vulnerable to both internal and external shocks, which calls for adaptive and sustainable economic policies.

Testing for stationarity represents an essential step in building a Vector Error Correction Model (VECM), since the model relies on identifying cointegration relationships among the analyzed variables. In order to validate the integration hypothesis of the variables used in the VECM model, Augmented Dickey-Fuller (ADF) stationarity tests were applied to each time series. The tests included both a constant and a linear trend, and the optimal lag length was automatically selected based on the Schwarz Information Criterion (SIC).

The results indicate that most of the series are non-stationary in levels, as the null hypothesis of a unit root could not be rejected in their raw form. However, all series became stationary after applying first-order differencing, confirming that the variables are integrated of order one, I(1). This finding validates the use of the VECM model, which requires that the variables be integrated of the same order and exhibit cointegration relationships. Once stationarity was confirmed, the next econometric step consisted of performing preliminary analyses to ensure the validity and correctness of the VECM specification. These analyses are necessary to avoid misspecification issues and to guarantee that the model estimates are both statistically and economically meaningful.

Determining the optimal lag order is necessary for modeling the dynamic relationships among the variables included in the model. Choosing an appropriate number of lags is essential to ensure that the model accurately captures short-term adjustment effects, while avoiding the overestimation or underestimation of the explanatory variables' influence. To determine the optimal number of lags, Vector AutoRegression (VAR) selection criteria were used, including the Akaike Information Criterion (AIC), the Schwarz Criterion (SC), and the Hannan-Quinn Criterion (HQ). These criteria offer different approaches for evaluating model specification, and the final selection was based on identifying the lowest penalty criterion, ensuring a balance between estimation precision and avoiding model over-parameterization. This preparatory step is necessary for the correct implementation of the VECM model, allowing for the subsequent analysis of long-run equilibrium relationships among the variables, as well as short-term adjustments in response to deviations from economic equilibrium.

**Table 3.** VAR Lag Order Selection Criteria for Endogenous Variables

| | | | | | | |
|---|---|---|---|---|---|---|
| VAR Lag Order Selection Criteria | | | | | | |
| Endogenous variables: RGDPG NLB FISC_PRESS GFCF_GDP GOVEXP TAXREV | | | | | | |
| Exogenous variables: C | | | | | | |
| Sample: 1995 2023 | | | | | | |
| Included observations: 24 | | | | | | |
| Lag | LogL | LR | FPE | AIC | SC | HQ |
| 0 | -265.8623 | NA | 278.1671 | 22.65519 | 22.94971 | 22.73333 |
| 1 | -183.4361 | 116.7705* | 6.447695* | 18.78634* | 20.84794* | 19.33328* |

**Source:** Author's elaboration based on the research methodology.

Table 3 presents the results of applying standard lag order selection criteria for the VAR model estimated based on endogenous variables, with 24 observations included. The selection criteria used—LogL (log-likelihood), LR (Likelihood Ratio), FPE (Final Prediction Error), AIC (Akaike Information Criterion), SC (Schwarz Criterion), and HQ (Hannan–Quinn Criterion)—unanimously indicate that a lag order of 1 is optimal for specifying the VAR model. This is shown by the minimum (or maximum, where applicable) values of the criteria corresponding to lag 1, all marked with an asterisk (*). The adoption of a first-order lag is statistically justified, as it minimizes forecast errors and optimizes the model's balance. At the same time, from an economic perspective, this choice allows for the capture of short-term dynamics without overparameterizing the model, which is essential given the relatively small sample size (24 observations).

This choice is also relevant for the subsequent stability of the VECM model, as the VAR lag order determines the structure of the derived VECM. The correct selection of lag length helps prevent misspecification of the dynamic relationships among the variables and contributes to obtaining robust and reliable estimates. Furthermore, the optimal lag selection was influenced by the trade-off between model complexity and its ability to capture economic relationships without overloading the model with unnecessary variables. Thus, a lag order of 1 was considered the most efficient in terms of overall model performance. The use of a single lag in the VAR model is justified in this context, given the relatively small number of available observations and the criteria used for lag selection. A first-order lag ensures more stable estimation and avoids issues such as multicollinearity or poor statistical test performance.

For the period 1995–2023, based on a sample of 23 observations, a model with a single lag (1–1) was estimated in accordance with the Johansen cointegration test results, which indicated the presence of three significant cointegration relationships. Both the Trace test and the Max-Eigenvalue test confirmed these relationships across various model specifications that included intercepts and either linear or quadratic trends, depending on the characteristics of each estimated model.

The cointegration rank selection criteria were adjusted to test between four and five potential relationships, and in all scenarios—except for the model with intercept and no trend (where the Trace test indicated six relationships)—three significant relationships were consistently identified. This result validates the use of a VECM structure, capable of capturing both long-run equilibrium relationships and short-run dynamic adjustments among the analyzed variables.

**Table 4. Number of Cointegration Relationships Selected Based on VAR Model Criteria**

| | | | | | |
|---|---|---|---|---|---|
| Sample: 1995 2023 | | | | | |
| Included observations: 23 | | | | | |
| Series: RGDPG NLB FISC_PRESS GFCF_GDP GOVEXP TAXREV | | | | | |
| Lags interval: 1 to 1 | | | | | |
| Selected (0.05 level*) Number of Cointegrating Relations by Model | | | | | |
| Data Trend: | None | None | Linear | Linear | Quadratic |
| Test Type | No Intercept | Intercept | Intercept | Intercept | Intercept |
| | No Trend | No Trend | No Trend | Trend | Trend |
| Trace | 3 | 3 | 6 | 3 | 3 |
| Max-Eig | 1 | 2 | 2 | 3 | 3 |

**Source:** Author's elaboration based on the research methodology.

The Trace test consistently indicates the presence of three cointegration relationships across almost all specifications, at the 5% significance level, suggesting the existence of linearly independent combinations of the variables that are stationary and reflect stable long-term equilibria. In parallel, the Max-Eigenvalue test confirms these results, indicating—depending on the specification—two or three cointegration relationships, thus reinforcing the conclusion regarding the interdependence among the variables. The choice of the (1,1) lag structure is supported by the results of the VAR lag selection analysis, in which the AIC, SC, and HQ criteria consistently indicated a preference for a single lag. Given the small sample size, this choice is also justified and ensures efficient estimation without loss of degrees of freedom. Furthermore, the robustness of the identified relationships was verified by applying Johansen tests under alternative assumptions regarding the deterministic trend (no trend, linear trend, and quadratic trend).

The statistical significance of the estimated coefficients was evaluated according to standard econometric conventions, using the t-test. The interpretation of the associated p-values was as follows:
p-value in the interval [0.05 – 0.01] ⇒ * (statistically significant at the 5% level);
p-value in the interval (0.01 – 0.001] ⇒ ** (statistically significant at the 1% level);
p-value less than 0.001 ⇒ *** (statistically significant at the 0.1% level).

The t-statistic was calculated using degrees of freedom equal to N−1, where *N* represents the sample size. In this analysis, the *t*-distribution is defined with 22 degrees of freedom.

The estimated VECM model reveals the existence of three cointegration relationships, each representing long-run economic equilibria among the included variables (Table 5). In the first cointegration equation (CointEq1), where RGDPG is the dependent variable, all coefficients (except GOVEXP) are statistically significant at rigorous levels ($p <$

0.01 or $p < 0.001$), suggesting that GFCF_GDP, TAXREV, and the long-run trend contribute significantly to explaining the evolution of real GDP per capita. The lack of statistical significance for GOVEXP indicates a marginal or negligible influence in the long-term equilibrium relationship. The error correction coefficient (–1.82) is negative and significant, suggesting a rapid and efficient correction of deviations from equilibrium. The high value of the adjusted coefficient of determination (adj. $R^2 = 0.857$) supports the validity and explanatory power of this model. The second cointegration equation (CointEq2), where NLB is the dependent variable, shows low statistical significance for TAXREV, indicating a weak contribution to long-term budgetary equilibrium in this relationship. GFCF_GDP and GOVEXP are statistically significant, suggesting a stronger link between public investment, government expenditure, and net lending dynamics. However, the adjustment coefficient is not significant, implying a slow or even absent correction of disequilibria in this case. The adjusted $R^2$ is considerably lower (0.146), indicating weak explanatory power. The third cointegration relationship (CointEq3) displays statistical significance for all coefficients, including GFCF_GDP, GOVEXP, and TAXREV, suggesting a stable and well-defined economic equilibrium. The negative and significant error correction term in the FISC_PRESS equation indicates an effective mechanism of adjustment toward equilibrium. Although the adjusted $R^2$ is more modest (0.265), it still supports the validity of the relationship.

In the short run, significant coefficients in the differenced equations (e.g., D(RGDPG(-1)), D(NLB(-1)), D(FISC_PRESS(-1)), D(GOVEXP(-1)), D(TAXREV(-1))) reveal that some variables respond immediately to deviations from equilibrium. In particular, RGDPG demonstrates a strong and rapid adjustment capacity, supported by the significance of the error correction coefficient in CointEq1. GFCF_GDP and TAXREV also exhibit short-term significance, indicating an active role of fiscal policy and public investment in the economic adjustment process.

Overall, the first cointegration equation proves to be the most robust, explaining a significant portion of the variation in the dependent variable and ensuring effective correction of long-run disequilibria. The other equations, while relevant, make a more modest contribution. This structure suggests that, within the fiscal and macroeconomic context of Romania, the mechanisms of adjustment back to equilibrium are more pronounced in GDP dynamics than in the budgetary position or fiscal revenue components.

**Table 5.** Vector Error Correction (VEC) Estimates

| | | | | | | |
|---|---|---|---|---|---|---|
| Vector Error Correction Estimates | | | | | | |
| Sample (adjusted): 2001 2023 | | | | | | |
| Included observations: 23 after adjustments | | | | | | |
| t-statistics in * | | | | | | |
| Cointegrating Eq: | CointEq1 | CointEq2 | CointEq3 | | | |
| RGDPG(-1) | 1.000000 | 0.000000 | 0.000000 | | | |
| NLB(-1) | 0.000000 | 1.000000 | 0.000000 | | | |
| FISC_PRESS(-1) | 0.000000 | 0.000000 | 1.000000 | | | |
| GFCF_GDP(-1) | -1.970689*** | 3.847246*** | -0.684857*** | | | |
| GOVEXP(-1) | -0.012174 | 1.035313*** | 0.126969*** | | | |
| TAXREV(-1) | -2.130028*** | 0.664812 | -0.845294*** | | | |
| @TREND(95) | 0.136906* | -0.579252*** | 0.042091*** | | | |
| C | 60.61606 | -83.41595 | -6.786453 | | | |

| Error Correction: | D(RGDPG) | D(NLB) | D(FISC_PRESS) | D(GFCF_GDP) | D(GOVEXP) | D(TAXREV) |
|---|---|---|---|---|---|---|
| CointEq1 | -1.822460*** | 0.125904 | 0.094964 | 0.178505* | -0.337199 | -0.002568 |
| CointEq2 | -0.306032 | -0.414150 | 0.011630 | -0.179408* | 0.068243 | 0.183416 |
| CointEq3 | 3.710182* | 1.088051 | -1.136488* | -0.541231 | 0.470085 | 0.681480 |
| D(RGDPG(-1)) | 0.570856** | -0.145208 | -0.052636 | -0.105000 | 0.085112 | 0.040447 |
| D(NLB(-1)) | -1.333736** | 0.503923 | 0.050218 | 0.176385 | -0.238701 | -0.095427 |
| D(FISC_PRESS(-1)) | 2.721395* | -2.106696* | 0.533480 | -0.142105 | 1.947223* | 0.630271 |
| D(GFCF_GDP(-1)) | 0.883565 | 0.777371 | -0.604986* | 0.042162 | 0.116404 | -0.385708 |
| D(GOVEXP(-1)) | -1.368209* | 0.551425 | -0.023467 | 0.285497 | 0.079422 | -0.462010 |
| D(TAXREV(-1)) | -3.272315** | 1.269929 | -0.216151 | 0.088803 | -1.427867 | -0.122208 |
| C | 0.714321 | -0.518259 | -0.031051 | -0.117591 | 0.435851 | 0.220579 |
| | | | | | | |
| R-squared | 0.915617 | 0.495592 | 0.566121 | 0.677012 | 0.530384 | 0.485018 |
| Adj. R-squared | 0.857199 | 0.146386 | 0.265743 | 0.453405 | 0.205265 | 0.128492 |
| Sum sq. resids | 54.17647 | 63.61467 | 5.791717 | 6.490782 | 46.69743 | 9.721196 |
| S.E. equation | 2.041426 | 2.212111 | 0.667470 | 0.706605 | 1.895286 | 0.864745 |
| F-statistic | 15.67334 | 1.419196 | 1.884698 | 3.027685 | 1.631355 | 1.360400 |
| Log likelihood | -42.48824 | -44.33511 | -16.77633 | -18.08681 | -40.77983 | -22.73195 |
| Akaike AIC | 4.564195 | 4.724792 | 2.328377 | 2.442331 | 4.415637 | 2.846257 |
| Schwarz SC | 5.057888 | 5.218485 | 2.822070 | 2.936024 | 4.909330 | 3.339950 |
| Mean dependent | -0.013478 | -0.047826 | -0.130435 | 0.002609 | 0.260435 | -0.084348 |
| S.D. dependent | 5.402158 | 2.394287 | 0.778947 | 0.955749 | 2.126002 | 0.926302 |
| Determinant resid covariance (dof adj.) | | 0.030815 | | | | |
| Determinant resid covariance | | 0.001005 | | | | |
| Log likelihood | | -116.4286 | | | | |
| Akaike information criterion | | 17.16770 | | | | |
| Schwarz criterion | | 21.16662 | | | | |
| Number of coefficients | | 81 | | | | |

**Source:** Author's elaboration based on the research methodology.

Figure 1 shows that all roots lie inside the unit root circle, which visually confirms the stability of the VECM V4 model and the absence of explosive behavior in the system's dynamics. The results indicate that, except for the three imposed unit roots (modulus = 1), all other roots have moduli less than one, confirming the stability of the VECM model. The presence of these three unit roots is consistent with the model specification, indicating the existence of three cointegration relationships and confirming that the series used are integrated of order one (I(1)), maintaining stable long-run relationships.

As part of the continued diagnostic analysis of the VECM model, after verifying its stability through examination of the characteristic polynomial roots, it is necessary to test for the absence of serial autocorrelation in the residuals. Therefore, in order to assess the validity of the estimated model and to confirm the correct lag specification, the Lagrange Multiplier (LM) test for residual autocorrelation is routinely applied. This test provides an additional diagnostic for evaluating the adequacy of the model's dynamic structure.

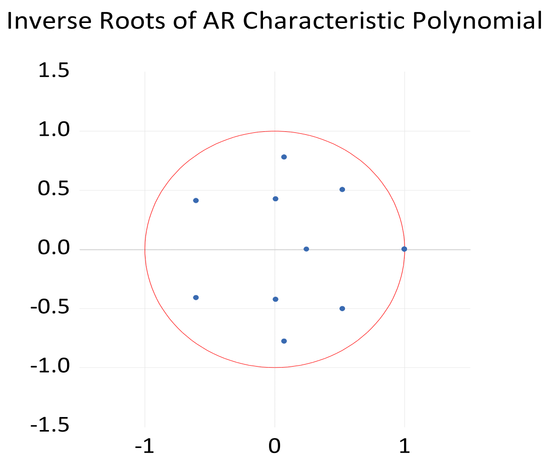


**Figure 1.** Inverse Characteristic Roots of the V4 Autoregressive Polynomial
**Source:** Author's elaboration based on the research methodology.

**Table 6.** LM Test for Serial Correlation in VECM Residuals

| VEC Residual Serial Correlation LM Tests | | | | | | |
|---|---|---|---|---|---|---|
| Sample: 1995 2023 | | | | | | |
| Included observations: 23 | | | | | | |
| Null hypothesis: No serial correlation at lag h | | | | | | |
| Lag | LRE* stat | df | Prob. | Rao F-stat | df | Prob. |
| 1 | 33.77523 | 36 | 0.5748 | 0.726310 | (36, 11.5) | 0.7765 |
| 2 | 33.20044 | 36 | 0.6025 | 0.705438 | (36, 11.5) | 0.7950 |
| 3 | 57.57293 | 36 | 0.0127 | 2.089350 | (36, 11.5) | 0.0902 |
| 4 | 46.69145 | 36 | 0.1093 | 1.325438 | (36, 11.5) | 0.3138 |
| 5 | 38.10952 | 36 | 0.3736 | 0.897995 | (36, 11.5) | 0.6205 |
| 6 | 44.99414 | 36 | 0.1446 | 1.230408 | (36, 11.5) | 0.3677 |
| 7 | 44.92709 | 36 | 0.1462 | 1.226769 | (36, 11.5) | 0.3699 |
| 8 | 48.30365 | 36 | 0.0825 | 1.421089 | (36, 11.5) | 0.2673 |
| 9 | 24.83856 | 36 | 0.9195 | 0.444870 | (36, 11.5) | 0.9685 |
| 10 | 35.36835 | 36 | 0.4984 | 0.786406 | (36, 11.5) | 0.7220 |

**Source:** Author's elaboration based on the research methodology.

The LM test for serial correlation in the residuals confirms the absence of autocorrelation up to lag 10. All probabilities associated with the LRE*LRE* statistics and Rao's F-statistics are above the 5% significance level, except at lag 3, where only the LRE*LRE* statistic indicates autocorrelation at the 5% level; however, this result is not confirmed by the Rao F-statistic. We conclude that the model is well specified with respect to residual autocorrelation.

**Table 7.** Normality Test of VECM Residuals

| VEC Residual Normality Tests | | | | |
|---|---|---|---|---|
| Orthogonalization: Cholesky (Lutkepohl) | | | | |
| Null Hypothesis: Residuals are multivariate normal | | | | |
| Sample: 1995 2023 | | | | |
| Included observations: 23 | | | | |
| Component | Jarque-Bera | df | Prob. | |

| | | | | |
|---|---|---|---|---|
| 1 | 1.757969 | 2 | 0.4152 | |
| 2 | 0.334336 | 2 | 0.8461 | |
| 3 | 0.482574 | 2 | 0.7856 | |
| 4 | 0.511291 | 2 | 0.7744 | |
| 5 | 0.457805 | 2 | 0.7954 | |
| 6 | 1.082766 | 2 | 0.5819 | |
| Joint | 4.626742 | 12 | 0.9693 | |
| *Approximate p-values do not account for coefficient | | | | |
| estimation | | | | |

**Source:** Author's elaboration based on the research methodology.

To validate the specification of the econometric model, it is necessary to test the normality of the residuals—an essential criterion for ensuring the validity of statistical inferences and the robustness of parameter estimates. For this purpose, the Jarque-Bera test was applied, both individually for each component of the residuals and at the aggregate level through the Joint Jarque-Bera test, which examines the multivariate distribution of the residuals.

*Test Hypotheses*

Null hypothesis ($H_0$): Residuals are multivariate normally distributed.

Alternative hypothesis ($H_1$): Residuals are not multivariate normally distributed.

Jarque-Bera significance: All individual Jarque-Bera test values have $p > 0.05$, indicating normality at the level of each component.

Joint Jarque-Bera test: The joint statistic (4.626742, $p = 0.9693$) confirms that the residuals are multivariate normally distributed. The global test applied to the entire set of residuals returned a test statistic of 4.626742 with a p-value of 0.9693, supporting the null hypothesis and confirming multivariate normality of the residuals.

The normality test results show that the residuals of the model are multivariate normally distributed. All values for skewness, kurtosis, and Jarque-Bera are statistically insignificant ($p > 0.05$). Therefore, the null hypothesis is accepted. Although the normality of the residuals was confirmed, full model validation also requires testing for heteroskedasticity and residual autocorrelation in order to ensure the robustness of the estimates and the validity of econometric inferences. Residual heteroskedasticity arises when the variance of the error terms is not constant across observations, which can lead to inefficient estimators and incorrectly estimated standard errors, affecting statistical significance tests.

To verify the presence of heteroskedasticity, the White test was applied—an established method for detecting non-constant error variance, regardless of the functional form of the model.

**Table 8.** Heteroskedasticity Test of VECM Residuals

| | | | | | |
|---|---|---|---|---|---|
| VEC Residual Heteroskedasticity Tests (Levels and Squares) | | | | | |
| Sample: 1995 2023 | | | | | |
| Included observations: 23 | | | | | |
| Joint test: | | | | | |
| Chi-sq | df | Prob. | | | |
| 396.1413 | 378 | 0.2503 | | | |
| Individual components: | | | | | |

| Dependent | R-squared | F(18,4) | Prob. | Chi-sq(18) | Prob. |
|---|---|---|---|---|---|
| res1*res1 | 0.854628 | 1.306425 | 0.4386 | 19.65645 | 0.3525 |
| res2*res2 | 0.745942 | 0.652470 | 0.7650 | 17.15667 | 0.5124 |
| res3*res3 | 0.712503 | 0.550732 | 0.8302 | 16.38757 | 0.5655 |
| res4*res4 | 0.537571 | 0.258332 | 0.9806 | 12.36414 | 0.8279 |
| res5*res5 | 0.742018 | 0.639163 | 0.7735 | 17.06640 | 0.5185 |
| res6*res6 | 0.728573 | 0.596496 | 0.8009 | 16.75718 | 0.5399 |
| res2*res1 | 0.837715 | 1.147107 | 0.5001 | 19.26743 | 0.3755 |
| res3*res1 | 0.707186 | 0.536696 | 0.8392 | 16.26527 | 0.5740 |
| res3*res2 | 0.890810 | 1.812966 | 0.2996 | 20.48863 | 0.3060 |
| res4*res1 | 0.866655 | 1.444297 | 0.3932 | 19.93306 | 0.3366 |
| res4*res2 | 0.858061 | 1.343395 | 0.4257 | 19.73540 | 0.3479 |
| res4*res3 | 0.817766 | 0.997213 | 0.5682 | 18.80862 | 0.4037 |
| res5*res1 | 0.887115 | 1.746353 | 0.3140 | 20.40365 | 0.3106 |
| res5*res2 | 0.816217 | 0.986931 | 0.5733 | 18.77298 | 0.4059 |
| res5*res3 | 0.587950 | 0.317087 | 0.9605 | 13.52286 | 0.7596 |
| res5*res4 | 0.853927 | 1.299086 | 0.4412 | 19.64032 | 0.3534 |
| res6*res1 | 0.645730 | 0.405045 | 0.9182 | 14.85178 | 0.6721 |
| res6*res2 | 0.923841 | 2.695636 | 0.1738 | 21.24833 | 0.2671 |
| res6*res3 | 0.727341 | 0.592797 | 0.8032 | 16.72885 | 0.5418 |
| res6*res4 | 0.796994 | 0.872434 | 0.6332 | 18.33085 | 0.4341 |
| res6*res5 | 0.605365 | 0.340887 | 0.9503 | 13.92341 | 0.7341 |

**Source:** Author's elaboration based on the research methodology

The results of the White test for heteroskedasticity confirm that the null hypothesis is accepted, which means that the residuals are homoskedastic (i.e., they have constant variance).

*White Test Hypotheses*

Null hypothesis ($H_0$): The residuals are homoskedastic (variance is constant).

Alternative hypothesis ($H_1$): The residuals are heteroskedastic (variance is not constant).

*Test Results*

Joint Test

Chi-squared statistic: 396.1413

Degrees of freedom: 378

Probability: 0.2503 ($p > 0.05$)

The test result supports the null hypothesis, indicating that the residuals exhibit constant variance and do not suffer from heteroskedasticity. Therefore, the VECM model satisfies the assumption of homoskedastic residuals, supporting the reliability of the parameter estimates.

The stationarity of residuals is an important condition for the validity of econometric models applied to time series, as it ensures that the estimated model accurately captures the dynamics of the analyzed economic phenomenon. A well-specified model should produce stationary residuals, meaning that its errors do not contain systematic information or trends that have not been accounted for by the variables included in the model. To test for residual stationarity, we employed the ADF test, the most commonly used method for detecting the presence of a unit root in time series.

The results of the ADF tests for the residuals (RESID01 – RESID06) indicate that all residual series are stationary at level around a zero mean. This outcome is an important indicator of the validity of the estimated model and supports the robustness of the relationships specified within the VECM model. The ADF test evaluates the null hypothesis that the series has a unit root (i.e., it is non-stationary). The alternative hypothesis is that the series is stationary. All residual series (D(RESID01) – D(RESID06)) exhibit t-statistic values significantly lower than the critical values at all significance levels (1%, 5%, 10%). The p-values are equal to 0.0000 for all series, indicating that the null hypothesis is rejected with a high degree of confidence. The residual series are stationary. The results of the stationarity tests for the residuals support the adequacy of the estimated VECM model. The stationarity of residuals around a zero mean reflects that the economic relationships captured in the model are stable in the long run and that the assumptions used in model specification are validated. These findings confirm the validity of the cointegration hypothesis, implying that an equilibrium relationship exists among the endogenous variables, and that deviations from this relationship are corrected over time.

The previously conducted statistical and econometric analyses, including the stationarity analysis of time series, descriptive statistics, and correlation tests, were aimed at validating the quality of the data and confirming their compatibility with the applied methods. These preliminary steps were undertaken to ensure the rigor of the analysis. With these aspects validated, the next step consists of applying the variance decomposition method in order to identify the contribution of the determining factors to the dynamics of the analyzed variables. This approach will allow for a deeper understanding of the economic relationships among the variables and their respective impacts. Variance decomposition is employed in VECM-type econometric models to evaluate the contribution of each explanatory variable to the variations in the dependent variables over the analyzed period. It provides a quantitative perspective on how shocks originating from one variable affect the others within the system, thereby allowing for a better understanding of the mechanisms through which economic influences are transmitted.

Through variance decomposition, it is possible to determine how much of the fluctuation in a dependent variable can be attributed to its own shocks and how much is generated by exogenous variables or other endogenous variables in the model. This analysis reveals the dynamic dependencies among variables and identifies which factors play a decisive role in the evolution of an economic phenomenon. Variance decomposition complements the Impulse Response Function (IRF) analysis. Furthermore, it allows for the evaluation of the relative weight of shocks originating from other endogenous variables in explaining the variation of the dependent variable over a ten-period horizon. Beyond quantifying individual contributions, the decomposition provides a dynamic perspective on how the influence of these variables evolves over time, reflecting the transmission process of shocks within the analyzed economic system. Consequently, the results enable the identification of variables that have a dominant and persistent impact on other indicators, as well as those influences that manifest only in the short term.

From a methodological perspective, variance decomposition provides a quantitative assessment of the sources of variability within the model. This approach captures not only the direct relationships between variables but also the aggregate impact of complex interactions within the system. As such, variance decomposition contributes to strengthening the empirical validity of the estimated model, supporting the interpretation of results. Moreover, it offers a comprehensive view of how shocks in the independent variables contribute to the variation of the dependent variable over the short, medium, and long term.

According to the following figure, the variation in RGDPG is initially explained entirely by its own dynamics. Starting from period 3, the influence of NLB becomes dominant (up to 36%), followed by GFCF_GDP (over 20%) and FISC_PRESS, whose contribution progressively increases, reaching 12.9% by period 10. These results highlight an indirect causal relationship between fiscal consolidation and GDP dynamics. For NLB, its own contribution remains high throughout the horizon (over 54% at the end), but the influence of GFCF_GDP (investment) becomes increasingly significant, reaching 23.4% in period 10, suggesting a bidirectional relationship between public investment policy and financing needs. FISC_PRESS is almost entirely explained by its own variation in the short term (97%), but in the long term, NLB becomes the main source of variation (50% in period 10), followed by RGDPG (9.4%). This transition indicates that fiscal balance is increasingly influenced by budgetary and overall economic dynamics. For GFCF_GDP, the dominant contribution of its own dynamics (60% in period 1) is gradually replaced by the growing impact of FISC_PRESS, which reaches 57.9% in period 10. This indicates that fiscal pressure has a significant influence on public investment decisions, especially in the long run. In the case of GOVEXP, the greatest influence is exerted by NLB (approximately 64% in period 10), followed by FISC_PRESS (24%). This result reflects a significant dependency of public expenditure on budgetary balance and fiscal revenue performance. For TAXREV, FISC_PRESS remains the dominant explanatory factor throughout the entire horizon (over 93% in period 1 and over 76% in period 10). The remaining variables have minor contributions, with a slight increase in the influence of NLB and RGDPG in the long term. This confirms the internal consistency of the model: fiscal pressure directly determines the evolution of budget revenues.

The Impulse Response Function (IRF) measures the impact of a shock (impulse) in one variable on the other variables in the system over multiple periods. In this case, the effects of shocks are analyzed for the variables RGDPG, NLB, FISC_PRESS, GFCF_GDP, GOVEXP, and TAXREV. The IRF is an econometric technique used to examine how a dependent variable reacts to a shock or impulse. This analysis is useful for evaluating the dynamic relationships between variables and for understanding how the effects of a shock propagate over time. The shock (impulse) is introduced in period 1 for FISC_PRESS, with a magnitude of 0.168433.

According to Figure 3, RGDPG responds positively and immediately, with a significant peak in the third period, followed by a temporary correction and then a slight recovery. NLB shows a sustained positive response, indicating an improvement in the budgetary position as a result of increased fiscal pressure. In practice, the government reduces borrowing needs by increasing fiscal revenues. TAXREV responds positively and steadily, confirming the consistency of the estimation—a shock to fiscal pressure is correlated with an increase in tax revenues, reflecting improved fiscal efficiency. GFCF_GDP exhibits a short-term negative response, which may suggest a reallocation of budgetary resources toward current expenditures at the expense of investment, in a context of fiscal consolidation. In the case of GOVEXP, a moderate positive reaction is observed, especially in the initial periods, suggesting that increased fiscal revenues may support the expansion of public expenditure, most likely in areas such as wages, social transfers, or administrative consumption. FISC_PRESS (self-response) – the autoregressive function shows a gradual deceleration of the initial effect, with relatively high persistence over the analyzed horizon, characteristic of a permanent shock in the fiscal structure. Fiscal pressure is moderate in the first period and increases in period 2, possibly indicating the impact of fiscal policy measures. It remains stable thereafter, suggesting continued fiscal policy management to ensure budgetary balance.

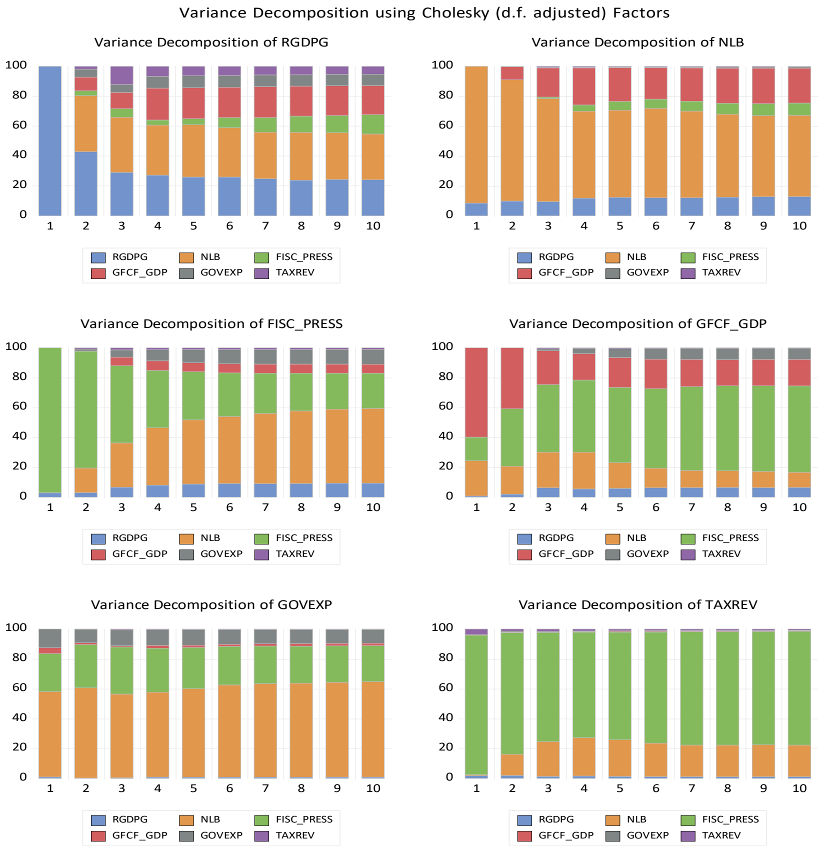


**Figure 2.** Variance decomposition using Cholesky-adjusted factors V4
**Source**: Author's elaboration based on the research methodology

The economy exhibits a reaction to initial shocks marked by significant fluctuations, followed by long-term stabilization. As time progresses, economic variables become more stable, indicating that the economy gradually returns to equilibrium. The results point to an economy capable of withstanding internal or external shocks, with an adaptation process beginning in period 4 and a gradual recovery thereafter. Overall, the analysis suggests a resilient economy which, although affected by short-term shocks, maintains stability over the medium and long term.

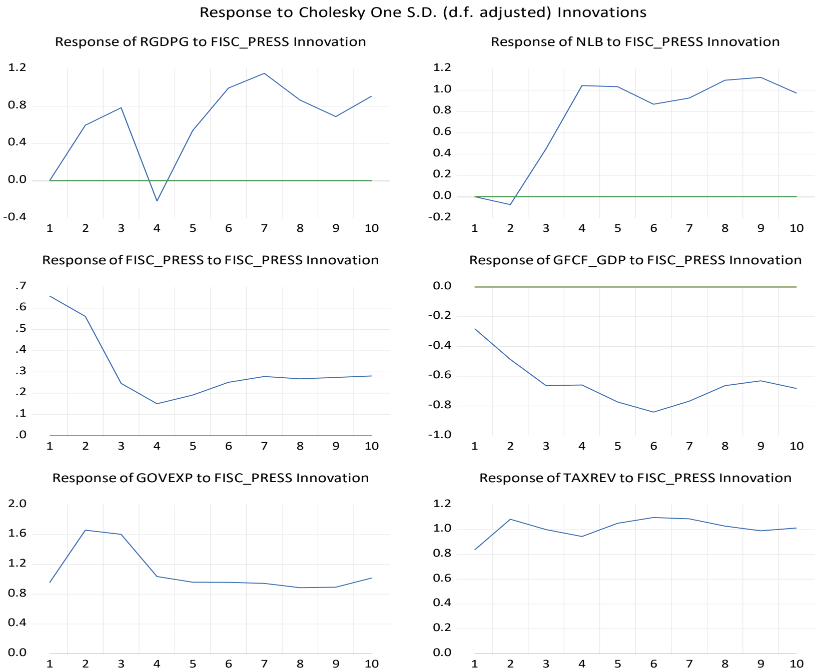


**Figure 3.** Impulse Response – V4
**Source**: Author's elaboration based on the research methodology

Continuing the analysis, the model's ability to provide relevant forecasts represents a fundamental element in validating its econometric soundness and applicability, contributing to the foundation of economic decisions and strategies. Forecasts derived from the VECM model allow for a rigorous evaluation of the dynamics of economic variables, offering essential insights for identifying emerging trends and associated risks. The forecasts produced using the VECM model constitute a robust analytical tool, facilitating the analysis of both long-term and short-term relationships among interdependent economic variables. The VECM model is suitable for time series that are integrated of the same order and characterized by cointegration relationships, capturing the mechanisms of short-term disequilibrium adjustment and long-term equilibrium maintenance.

The following figure presents a perspective on the forecasted trajectories of the economic variables for the 2024–2028 period, based on the estimations provided by the VECM model used in our analysis. These forecasts enable an understanding of the economic dynamics of the analyzed variables over both the short and medium term. Due to the limited number of observations available in the dataset, forecasts were considered plausible only for the 2024–2028 interval. This reduced time horizon was chosen to preserve the accuracy and relevance of the projections, avoiding the significant uncertainties that would arise over a longer-term period. Thus, the model was used to estimate short- and medium-term developments, taking into account the constraints related to the sample size and its integration into the econometric structure. This approach ensures that the forecasts realistically reflect the relationships among the economic variables included in the model, without compromising the reliability of the results due to an extended forecast horizon or methodological overreach.

RGDPG_F_V4 shows a sharp decline in 2025, followed by a strong recovery in 2026, suggesting an initial disruption followed by a moderate economic rebound. The subsequent decline in 2027 and 2028 reflects a more tempered growth rate, potentially caused by structural factors or a reduction in economic stimuli. NLB_F_V4 indicates significant volatility, with a widening deficit in 2025 followed by gradual improvement through 2028. This evolution reflects progressive fiscal adjustments and a medium-term effort toward budgetary consolidation. FISC_PRESS_F_V4 follows a steadily upward trajectory, suggesting an increase in fiscal revenues as a percentage of GDP. This trend reflects efforts to mobilize public resources and implement fiscal adjustments, possibly supported by improved tax compliance. GFCF_GDP_F_V4 displays a volatile trend, with a decline in the first part of the interval followed by gradual growth after 2026. This evolution may signal political or economic prioritizations in the allocation of public resources, as well as potential responses to fiscal adjustment requirements. GOVEXP_F_V4 shows a significant contraction in 2025, followed by a gradual recovery and stabilization over the 2026–2028 period. This dynamic reflects the dependency of public investment on macroeconomic stability and the availability of public financial resources. TAXREV_F_V4 exhibits short-term volatility, with a sharp decline in 2025 followed by stabilization in the following years. This pattern suggests a potential temporary fiscal relaxation, followed by efforts to strengthen the tax base and increase fiscal revenues.


**Figure 4.** Economic Forecasts – V4

**Source**: Author’s elaboration based on the research methodology

The forecasts reflect an economic system undergoing adjustment, with divergent developments between fiscal and economic variables. In the short term, the economy faces shocks and instability, followed by trends of recovery and stabilization in the subsequent period. These forecasts help identify potential economic imbalances or financial instabilities. For instance, the trends observed in fiscal pressure or government expenditure dynamics may signal the need for fiscal adjustments before issues become critical. By offering a forward-looking perspective on economic developments, the forecasts support strategic decision-making related to resource allocation, investment, and development policies. They can guide governments and institutions toward pathways that promote sustainable economic growth. At the same time, the forecasts allow for a more detailed evaluation of the impact of economic and fiscal policies, contributing to the optimization of interventions. The forecasting results can highlight how well the economy is prepared to respond to external or internal shocks. In the case of variables such as GDP or investment, they can indicate the economy's capacity to maintain stability and adapt in the face of uncertainty. Through the use of rigorous econometric models such as the VECM, the forecasts contribute to grounding economic decisions in solid data and analysis, enhancing confidence in proposed measures. In conclusion, economic forecasts not only support the decision-making process in a macroeconomic context but also contribute to reducing uncertainty, guiding economic and fiscal interventions toward achieving long-term growth and stability objectives.

**Table 9**. Descriptive Statistics for the Forecasted Economic Variables

| | RGDPG_F_V4 | NLB_F_V4 | FISC_PRESS _F_V4 | GFCF_GDP _F_V4 | GOVEXP _F_V4 | TAXREV _F_V |
|---|---|---|---|---|---|---|
| Mean | 3.751706 | -3.455562 | 27.32789 | 17.61637 | 25.87117 | 15.63610 |
| Median | 4.508010 | -3.609196 | 27.29450 | 17.61526 | 26.05871 | 15.58849 |
| Maximum | 5.565292 | -2.436976 | 27.48958 | 18.04459 | 26.57471 | 16.06240 |
| Minimum | 0.722233 | -4.163233 | 27.20642 | 17.17343 | 24.50266 | 15.37561 |
| Std. Dev. | 1.956016 | 0.630709 | 0.109204 | 0.313792 | 0.850099 | 0.267058 |
| Observations | 5 | 5 | 5 | 5 | 5 | 5 |

**Source:** Author's elaboration based on the research methodology

Table 9 presents descriptive statistics for the forecasts of the analyzed economic variables. The mean value for the variable RGDPG_F_V4 is 3.75, indicating a positive long-term forecast for economic growth, while NLB_F_V4 registers a negative mean value of -3.46, suggesting a general trend of net borrowing or negative savings in the future. The variable FISC_PRESS_F_V4 has a mean of 27.33, indicating a consistently high fiscal pressure throughout the forecast period. Additionally, GFCF_GDP_F_V4 and GOVEXP_F_V4 are relatively stable, with means of 17.62 and 25.87, respectively, suggesting a continued moderate pace of government expenditure and gross capital formation. TAXREV_F_V4 stands at 15.64, reflecting stable fiscal revenues over the forecast horizon. Analyzing the dispersion of these variables using the standard deviation, we observe that RGDPG_F_V4 and GOVEXP_F_V4 have higher standard deviations (1.96 and 0.85, respectively), suggesting significant variability in their forecasts. In contrast, FISC_PRESS_F_V4 shows a relatively low standard deviation (0.11), indicating greater precision in the forecast of fiscal pressure.

The VECM model will be re-estimated using a fifth specification (V5), taking into account the presence of three cointegration relationships.

**Table 10.** VECM Model Estimates – Specification V5

| | | | | | |
|---|---|---|---|---|---|
| Vector Error Correction Estimates | | | | | |
| Sample (adjusted): 2001 2023 | | | | | |
| Included observations: 23 after adjustments | | | | | |
| t-statistics in * | | | | | |
| Cointegrating Eq: | CointEq1 | CointEq2 | CointEq3 | | |
| RGDPG(-1) | 1.000000 | 0.000000 | 0.000000 | | |
| NLB(-1) | 0.000000 | 1.000000 | 0.000000 | | |
| FISC_PRESS(-1) | 0.000000 | 0.000000 | 1.000000 | | |
| GFCF_GDP(-1) | -1.950321*** | 3.920846*** | -0.691146*** | | |
| GOVEXP(-1) | -0.014561 | 1.025181*** | 0.127829*** | | |
| TAXREV(-1) | -2.119345*** | 0.704861 | -0.848711*** | | |
| @TREND(95) | -0.017429 | -0.438139 | 0.058467 | | |
| C | 62.80283 | -87.37968 | -6.931072 | | |
| | | | | | |
| Error Correction: | D(RGDPG) | D(NLB) | D(FISC_PRESS) | D(GFCF_GDP) | D(GOVEXP) |
| CointEq1 | -1.826919*** | -0.010088 | 0.115394 | 0.189737* | -0.187685 |
| CointEq2 | -0.285054 | -0.458368 | 0.016910 | -0.172918* | 0.126401 |
| CointEq3 | 3.713726* | 1.917012 | -1.259794* | -0.612301 | -0.459113 |
| D(RGDPG (-1)) | 0.569604** | -0.087882 | -0.061072 | -0.110052 | 0.020379 |
| D(NLB(-1)) | -1.351746** | 0.476797 | 0.055304 | 0.176619 | -0.217277 |
| D(FISC_PRESS(-1)) | 2.696507* | -2.812053* | 0.639675 | -0.084788 | 2.728744** |
| D(GFCF_GDP(-1)) | 0.894227 | 1.106418 | -0.654334* | 0.014524 | -0.243273 |
| D(GOVEXP(-1)) | -1.361565* | 0.531343 | -0.020834 | 0.287876 | 0.106056 |
| D(TAXREV(-1)) | -3.254458** | 1.475641 | -0.247764 | 0.073515 | -1.651952* |
| C | 5.695208** | -3.173367 | -0.319922 | -1.040997 | 3.417581* |
| @TREND(95) | -0.293480** | 0.149833 | 0.017963 | 0.054807 | -0.168518* |
| | | | | | |
| R-squared | 0.915381 | 0.567104 | 0.582723 | 0.678342 | 0.629364 |
| Adj. R-squared | 0.844865 | 0.206357 | 0.234993 | 0.410293 | 0.320500 |
| Sum sq. resids | 54.32811 | 54.59572 | 5.570099 | 6.464055 | 36.85515 |
| S.E. equation | 2.127755 | 2.132989 | 0.681304 | 0.733942 | 1.752502 |
| F-statistic | 12.98123 | 1.572028 | 1.675790 | 2.530669 | 2.037675 |
| Log likelihood | -42.52038 | -42.57689 | -16.32765 | -18.03936 | -38.05785 |
| Akaike AIC | 4.653946 | 4.658860 | 2.376317 | 2.525161 | 4.265900 |
| Schwarz SC | 5.197009 | 5.201923 | 2.919380 | 3.068224 | 4.808962 |
| Mean dependent | -0.013478 | -0.047826 | -0.130435 | 0.002609 | 0.260435 |
| S.D. dependent | 5.402158 | 2.394287 | 0.778947 | 0.955749 | 2.126002 |

| | | | | |
|---|---|---|---|---|
| Determinant resid covariance (dof adj.) | 0.038743 | | | |
| Determinant resid covariance | 0.000781 | | | |
| Log likelihood | -113.5388 | | | |
| Akaike information criterion | 17.17728 | | | |
| Schwarz criterion | 21.32431 | | | |
| Number of coefficients | 84 | | | |

**Source:** Author's elaboration based on the research methodology

Long-term relationships (cointegration). In the first cointegration equation, where RGDPG is the reference variable, GFCF_GDP, TAXREV, and FISC_PRESS have statistically significant coefficients, while GOVEXP does not significantly influence the equilibrium relationship. Thus, in the long run, economic growth is explained by the dynamics of public investment, fiscal policy, and fiscal pressure, whereas current government expenditure plays a negligible role in this relationship. In the second equation (with NLB as the reference variable), GFCF_GDP and GOVEXP are significant, while TAXREV is not. This indicates that net lending/borrowing is more sensitive to the dynamics of expenditures than to the evolution of fiscal revenues. In the third equation (with FISC_PRESS as the dependent variable), all coefficients are statistically significant, suggesting a well-defined relationship between fiscal pressure and the set of explanatory variables. Hence, long-term fiscal pressure is significantly determined by investment, government spending, and budget revenues.

Short-term relationships and adjustment toward equilibrium. The error correction coefficient (CointEq1) is negative and significant for the RGDPG equation, indicating an efficient adjustment process toward the long-run equilibrium. In contrast, the coefficient in the NLB equation (CointEq2) is not significant, suggesting a slow or even absent adjustment in the budgetary position. CointEq3 (for FISC_PRESS) is significant and negative, indicating a clear reversion toward equilibrium. In the short run, in the RGDPG equation, D(GOVEXP) is significant, while D(GFCF_GDP) is not, which contrasts with the long-term relationship and indicates a stronger temporary influence of current expenditures than investment. The D(FISC_PRESS) coefficient is also significant, showing the short-term impact of fiscal pressure on GDP. In the NLB equation, the dynamics of fiscal pressure (D(FISC_PRESS)) significantly influence net lending/borrowing, but in the absence of a significant error correction term, the adjustment toward equilibrium remains weak. For the FISC_PRESS equation, adjustment is clearly present, and the variables GFCF_GDP and GOVEXP contribute to short-term fluctuations. The adjusted R-squared (Adj. $R^2$) is highest in the RGDPG equation (0.8449), indicating strong explanatory power. The equations for NLB and FISC_PRESS show lower values (0.2064 and 0.2349), suggesting greater difficulty in explaining their variability through the current model. Overall, the VECM V5 model confirms the existence of significant cointegration relationships, particularly regarding economic growth and fiscal pressure.

Interpretation of the LM Test for Serial Correlation in VECM.

Residuals Testing hypotheses:

- Null hypothesis ($H_0$): No serial correlation exists at the specified lag (or from lag 1 to h).
- Alternative hypothesis ($H_1$): Serial correlation exists at the specified lag.

**Table 11.** VEC Serial Correlation Tests (LM)

| | | | | | | |
|---|---|---|---|---|---|---|
| VEC Residual Serial Correlation LM Tests | | | | | | |
| Sample: 1995 2023 | | | | | | |
| Included observations: 23 | | | | | | |
| Null hypothesis: No serial correlation at lag h | | | | | | |
| Lag | LRE* stat | df | Prob. | Rao F-stat | df | Prob. |
| 1 | 46.61596 | 36 | 0.1107 | 1.170207 | (36, 7.2) | 0.4473 |
| 2 | 37.54354 | 36 | 0.3983 | 0.741546 | (36, 7.2) | 0.7439 |
| 3 | 46.76133 | 36 | 0.1080 | 1.178471 | (36, 7.2) | 0.4427 |
| 4 | 40.82903 | 36 | 0.2665 | 0.878554 | (36, 7.2) | 0.6382 |
| 5 | 51.38999 | 36 | 0.0463 | 1.469380 | (36, 7.2) | 0.3097 |
| 6 | 42.91806 | 36 | 0.1989 | 0.975877 | (36, 7.2) | 0.5682 |
| 7 | 61.99936 | 36 | 0.0045 | 2.389439 | (36, 7.2) | 0.1127 |
| 8 | 50.03326 | 36 | 0.0601 | 1.378262 | (36, 7.2) | 0.3460 |
| 9 | 41.91214 | 36 | 0.2298 | 0.927962 | (36, 7.2) | 0.6020 |
| 10 | 60.75002 | 36 | 0.0061 | 2.258965 | (36, 7.2) | 0.1284 |
| Null hypothesis: No serial correlation at lags 1 to h | | | | | | |
| Lag | LRE* stat | df | Prob. | Rao F-stat | df | Prob. |
| 1 | 46.61596 | 36 | 0.1107 | 1.170207 | (36, 7.2) | 0.4473 |
| 2 | 914.6127 | 72 | 0.0000 | NA | (72, NA) | NA |
| 3 | NA | 108 | NA | NA | (108, NA) | NA |
| 4 | NA | 144 | NA | NA | (144, NA) | NA |
| 5 | NA | 180 | NA | NA | (180, NA) | NA |
| 6 | NA | 216 | NA | NA | (216, NA) | NA |
| 7 | NA | 252 | NA | NA | (252, NA) | NA |
| 8 | NA | 288 | NA | NA | (288, NA) | NA |
| 9 | NA | 324 | NA | NA | (324, NA) | NA |
| 10 | NA | 360 | NA | NA | (360, NA) | NA |

**Source:** Author's elaboration based on the research methodology

The LM test for serial correlation in the residuals confirms the absence of autocorrelation up to lag 10. All p-values associated with the LRE∗LRE∗ statistic and the Rao F-statistic exceed the 5% significance threshold, except for lag 3, where only the LRE∗LRE∗ statistic indicates serial correlation at the 5% level. However, this result is not confirmed by the Rao F-statistic.

The obtained results show that, in most cases, the p-values associated with both the LRE and Rao F statistics are above the conventional 5% significance level, suggesting no significant evidence of serial correlation in the residuals. The only exception is observed at lag 7 (for the LRE statistic), where the p-value is 0.0045; however, the Rao F-statistic does not confirm this, indicating a higher probability (0.1127).

In the next step of the diagnostic analysis, tests for normality and heteroscedasticity of the residuals are required in order to strengthen the model's validation. These tests are essential to confirm compliance with the fundamental assumptions of econometrics, thus ensuring the robustness of the estimations.

The results of the normality test applied to the residuals of the VEC model confirm that the errors are normally distributed, thus fulfilling one of the fundamental assumptions of econometrics. The normal distribution of residuals is essential for validating the model, as it ensures that statistical inferences and coefficient estimates are reliable, efficient, and unbiased. This result suggests the absence of omitted variables or systematic irregularities in the dataset, thereby validating the model specification and its adequacy in capturing the economic relationships among the analyzed variables. Furthermore, normal distribution implies that the residuals are randomly distributed, without significant trends or distortions that could bias the results or conclusions of the study.

**Table 12.** VEC Residual Normality Test

| | | | | |
|---|---|---|---|---|
| VEC Residual Normality Tests | | | | |
| Orthogonalization: Cholesky (Lutkepohl) | | | | |
| Null Hypothesis: Residuals are multivariate normal | | | | |
| Sample: 1995 2023 | | | | |
| Included observations: 23 | | | | |
| Component | Skewness | Chi-sq | df | Prob.* |
| 1 | 0.615477 | 1.452112 | 1 | 0.2282 |
| 2 | 0.028289 | 0.003068 | 1 | 0.9558 |
| 3 | -0.115068 | 0.050756 | 1 | 0.8218 |
| 4 | 0.014851 | 0.000845 | 1 | 0.9768 |
| 5 | 0.136993 | 0.071941 | 1 | 0.7885 |
| 6 | 0.373941 | 0.536022 | 1 | 0.4641 |
| Joint | | 2.114743 | 6 | 0.9088 |
| Component | Kurtosis | Chi-sq | df | Prob. |
| 1 | 2.541083 | 0.201830 | 1 | 0.6532 |
| 2 | 2.449776 | 0.290132 | 1 | 0.5901 |
| 3 | 3.446155 | 0.190761 | 1 | 0.6623 |
| 4 | 2.291903 | 0.480510 | 1 | 0.4882 |
| 5 | 2.234652 | 0.561351 | 1 | 0.4537 |
| 6 | 2.272399 | 0.507344 | 1 | 0.4763 |
| Joint | | 2.231928 | 6 | 0.8972 |
| Component | Jarque-Bera | df | Prob. | |
| 1 | 1.653942 | 2 | 0.4374 | |
| 2 | 0.293199 | 2 | 0.8636 | |
| 3 | 0.241516 | 2 | 0.8862 | |
| 4 | 0.481355 | 2 | 0.7861 | |
| 5 | 0.633292 | 2 | 0.7286 | |
| 6 | 1.043366 | 2 | 0.5935 | |
| Joint | 4.346671 | 12 | 0.9763 | |

**Source:** Author's elaboration based on the research methodology

The results presented in Table 13 include values for skewness, kurtosis, and the Jarque-Bera statistics for both individual components and jointly for all variables. The p-values associated with the skewness and kurtosis tests are all above the 5% significance threshold, indicating no significant deviations from symmetry or excessive variance. Similarly, the Jarque-Bera test reports a joint probability value of 0.9763, confirming that the residuals conform to the null hypothesis of multivariate normality. These results support the essential assumption of normally distributed errors.

**Table 13.** VEC Residual Heteroscedasticity Test

| | | | |
|---|---|---|---|
| VEC Residual Heteroskedasticity Tests (Levels and Squares) | | | |
| Sample: 1995 2023 | | | |
| Included observations: 23 | | | |
| Joint test: | | | |

| Chi-sq | df | Prob. | | | |
|---|---|---|---|---|---|
| 439.4300 | 420 | 0.2472 | | | |

**Source:** Author's elaboration based on the research methodology

Testing hypotheses:

- Null hypothesis ($H_0$): The residuals are homoscedastic (variance is constant);
- Alternative hypothesis ($H_1$): The residuals are heteroscedastic (variance is not constant).

Chi-square (Chi-sq): 439.4300;
Degrees of freedom (df): 420;
Probability (Prob.): 0.2472;
The p-value associated with the test is 0.2472 (> 0.05), which means that the null hypothesis cannot be rejected.

The model residuals are homoscedastic, indicating that the error variance is constant and that the model is well specified in this regard. The VECM model does not exhibit heteroscedasticity issues, which is a favorable outcome. This suggests that the errors have constant variance, contributing to the validity and robustness of the model's estimations. Homoscedasticity of the residuals implies that the coefficient estimates are efficient and not affected by variance-related problems. Therefore, the model can be reliably used for forecasting and analysis without the need for adjustments related to heteroscedasticity. This result, combined with the autocorrelation and normality tests, supports the conclusion that the VECM model is appropriate for analyzing economic dynamics.

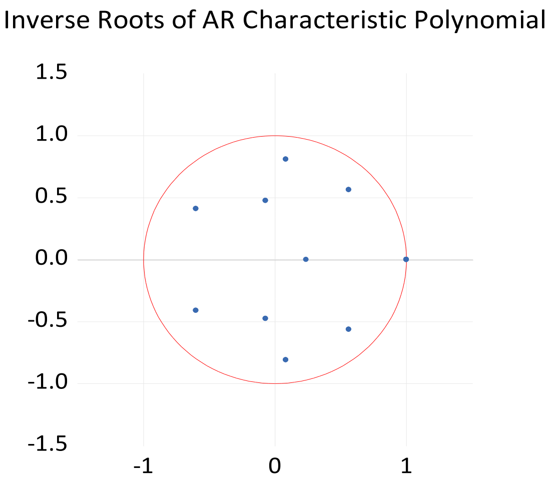


**Figure 5.** Inverse Characteristic Roots of the Autoregressive Polynomial V5
**Source**: Author's elaboration based on the research methodology

Figure 5 illustrates the inverse characteristic roots of the polynomial associated with the VECM V5 model, which are used to assess the model's stability and the behavior of variables within the system. These roots are computed based on the model's coefficient matrix and are essential for determining whether the model is stable and whether its solutions converge to an equilibrium over time. The characteristic polynomial roots are used to evaluate the stability of the VECM model. For the model to be stable, all roots (except those imposed by cointegration) must have a modulus less than 1. The model presents three unit roots with a modulus equal to 1, which are imposed by the VECM specification and indicate the presence of cointegration relationships among the analyzed variables. This result confirms that the series used in the model are integrated of order 1 (I(1)) and that there is a long-term equilibrium among them, consistent with cointegration theory.

All other roots have a subunit modulus, suggesting that short-term adjustments are convergent and that the model is stable, ensuring that the variables return to their long-run equilibrium following exogenous shocks. The VECM model is stable, with all roots—except those associated with cointegration relationships—having a modulus less than one, indicating system convergence toward equilibrium over time. The model can therefore be safely used for economic simulations and forecasts without the risk of explosive divergence. Both short- and long-term relationships estimated by the model can be interpreted reliably. The results are in line with econometric requirements, reinforcing the validity of the conclusions. With the stability of the VECM model confirmed through the analysis of the characteristic roots, the next step is to examine the mechanisms through which shocks propagate within the system. In this regard, forecast error variance decomposition offers a quantitative perspective on the relative influence exerted by each variable on the fluctuations of the others in the model, as well as a clear view of the contributions of different economic variables to the volatility of the analyzed macroeconomic indicators. The following section discusses the main findings regarding the role of each variable, using the definitions previously introduced.

In the initial period, the variation in RGDPG is explained entirely by its own dynamics (100%), which is consistent with economic theory and the inertial behavior of activity indicators. Starting from the second period, the influence of net lending/borrowing (NLB) emerges, eventually accounting for over 33% of the variation in RGDPG, signaling a clear connection between fiscal policy and economic growth. Subsequently, government expenditure (GFCF_GDP) becomes increasingly relevant, reaching a contribution of over 24% in period 5 and stabilizing around 20%. Fiscal pressure (FISC_PRESS) begins to exert influence from period 6 onward, reaching nearly 19% in period 10. The contribution of TAXREV and GOVEXP remains modest but consistent (around 5–7%), suggesting a secondary yet persistent influence.

Initially, NLB is explained by its own variation by more than 88%, but as time progresses, the contribution of RGDPG and GFCF_GDP increases significantly. By period 10, economic growth accounts for approximately 17% of the variation in NLB, while government spending contributes over 27%. This distribution indicates a strong relationship between economic dynamics, spending policies, and the state's budgetary position. Fiscal pressure reaches nearly 12% in period 10, showing that efficiency in tax revenue collection becomes an increasingly important determinant over the long term.

In the short term, FISC_PRESS is determined almost exclusively by its own variations (94.6%). However, the influence of NLB gradually becomes dominant, reaching over 45% by period 10, signaling a strong link between budgetary balance and overall fiscal pressure. RGDPG contributes approximately 6%, while spending-related variables (GFCF_GDP, GOVEXP) have modest contributions (4–5%). This result indicates a dynamic in which fiscal sustainability more clearly determines the level of fiscal pressure than the pace of economic growth.

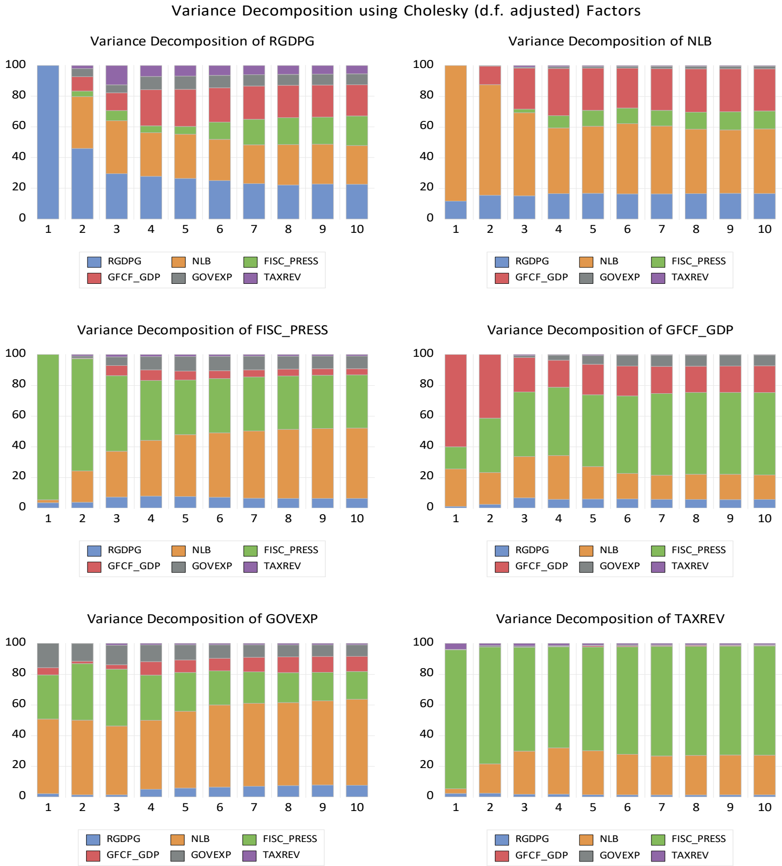


**Figure 6**. Variance Decomposition Using Cholesky-Adjusted Factors V5
**Source**: Author's elaboration based on the research methodology

Public investment is initially explained by its own dynamics (60%). In the long run, the role of fiscal pressure (FISC_PRESS) becomes dominant, accounting for over 53% of the variation in GFCF_GDP by period 10. This transition reflects the fact that, in a fiscal consolidation context, public investment decisions are closely tied to available fiscal resources. NLB maintains a contribution between 15% and 25% throughout the period, suggesting a significant dependence on the budgetary position.

The variation in GOVEXP is strongly driven by NLB across the entire forecast horizon (over 56% in period 10). The contribution of FISC_PRESS remains relevant (18%), while the influence of GFCF_GDP increases slightly in later periods. This suggests that the structure of public expenditure is primarily sensitive to the budgetary balance, rather than external pressures or the economic cycle.

TAXREV is initially explained by FISC_PRESS in a proportion exceeding 90%, which validates the model's internal consistency. This influence remains dominant throughout the horizon (71% in period 10). The contribution of NLB gradually increases to 25%, reflecting the importance of fiscal balance in generating public revenues. The other variables have marginal effects, supporting the notion that tax revenues are primarily determined by fiscal policy and collection performance.

The variance decomposition within the VECM (V5) model confirms the importance of net lending/borrowing and fiscal pressure in explaining the dynamics of macroeconomic variables. In the long term, spending policies and fiscal pressure significantly influence not only economic growth but also the budgetary position and the level of collected revenues. Thus, the results support the importance of coordination between fiscal policy and sustainable economic development goals.

The variance decomposition analysis highlights the complexity of interdependencies among macroeconomic variables. Fiscal policies—represented by net borrowing, tax revenues, and fiscal pressure—are central in shaping economic dynamics, while government spending and investment are essential for stimulating long-term growth. Economic growth is primarily influenced by fiscal policy, emphasizing the importance of prudent public resource management and a coherent economic development strategy. The variance decomposition results underscore the role of both fiscal and economic variables in driving the fluctuations of the analyzed indicators.

To gain a more detailed understanding of the mechanisms through which these variables influence the economic system, the next stage of the analysis involves examining the impulse response function, which allows for the identification of the dynamic effects of exogenous shocks on the model's variables.

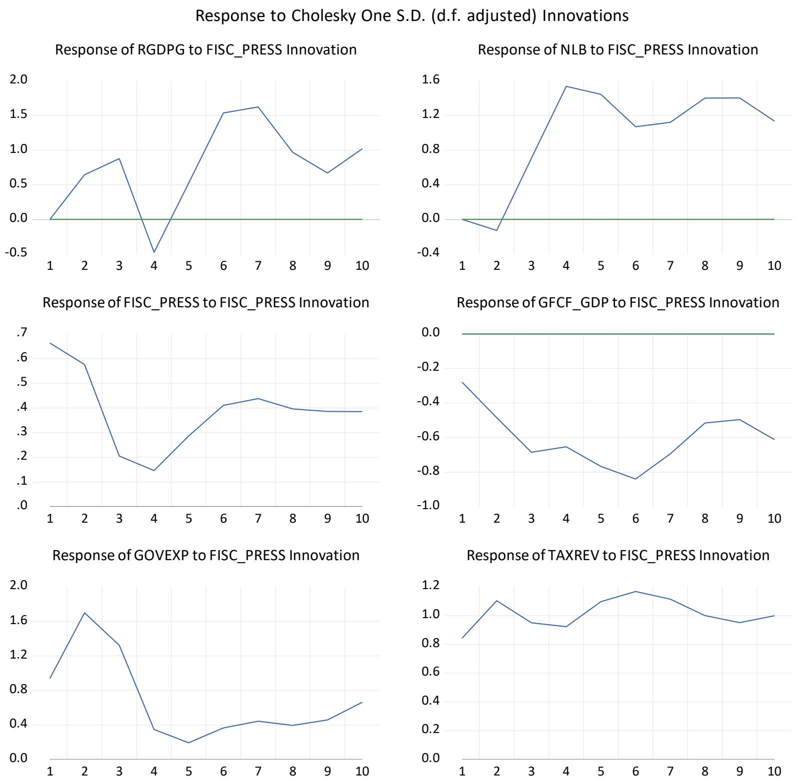


**Figure 7.** Impulse Response – Specification V5

**Source**: Author's elaboration based on the research methodology

The results of the impulse response functions indicate a dynamic that is generally similar to that obtained under the initial specification, but with differences in the amplitude and timing of effects. The response of RGDPG is positive and significant, although with a more pronounced time lag, with peak effects occurring from period four onwards. NLB also reacts positively, showing a sustained increase throughout the forecast horizon, suggesting progressive fiscal consolidation.

In contrast, GFCF_GDP and GOVEXP exhibit a more pronounced negative response compared to the previous specification, indicating a contraction in capital and current expenditures following the increase in fiscal pressure. This adjustment may reflect a budgetary rebalancing effort through the rationalization of public spending. Consistently, TAXREV responds positively and rapidly to the shock, confirming the theoretical coherence of fiscal transmission. Overall, the results confirm the robustness of the direction of previously estimated effects, while also highlighting that variations in the model structure can influence the magnitude and timing of economic responses.


**Figure 8**. Economic Forecasts V5

**Source**: Author's elaboration based on the research methodology

RGDPG_F_V5 shows a decline in 2025, followed by a medium-term recovery, suggesting a gradual rebound after an initial shock. NLB_F_V5 reflects high volatility, with a marked improvement toward the end of the period, which may indicate fiscal adjustments. FISC_PRESS_F_V5 follows a steady upward trajectory, suggesting a progressive increase in fiscal burden, while GFCF_GDP_F_V5 displays a fluctuating pattern, with a sharp rise after 2026, potentially reflecting political or economic prioritizations. GOVEXP_F_V5 indicates a consistent decline, highlighting potential difficulties in sustaining public investment, whereas TAXREV_F_V5 shows short-term volatility but relative stabilization in the long run, suggesting a more balanced management of fiscal resources.

**Table 14**. Descriptive Statistics for Forecasts V5

| | RGDPG_F_V5 | NLB F_V5 | FISC_PRESS_F_V5 | GFCF_GDP_F_V5 | GOVEXP _F_V5 | TAXREV_F_V5 |
|---|---|---|---|---|---|---|
| Mean | 4.351696 | 0.153035 | 27.77475 | 17.60743 | 19.98299 | 15.62592 |
| Median | 5.228868 | 0.110066 | 27.93726 | 17.54845 | 19.85371 | 15.77078 |
| Maximum | 6.804465 | 1.719335 | 28.46478 | 18.40705 | 23.74677 | 15.81139 |
| Minimum | -0.725645 | -1.756128 | 26.95920 | 17.02381 | 17.22244 | 15.32143 |
| Std. Dev. | 2.925261 | 1.273448 | 0.646763 | 0.503778 | 2.377892 | 0.229685 |
| Observations | 5 | 5 | 5 | 5 | 5 | 5 |

**Source:** Author's elaboration based on the research methodology

The average forecasted value for RGDPG is 4.35%, indicating a moderate pace of economic growth. However, the high standard deviation (2.92%) and the negative minimum value (-0.72%) suggest significant uncertainties regarding economic activity over the forecasted years. For NLB, the average forecast is slightly positive (0.15% of GDP), but with high variability (1.27%), reflecting the volatility of the budgetary position. The extreme values, both positive (1.72%) and negative (-1.75%), underscore the sensitivity of this indicator to fiscal and economic shocks. FISC_PRESS remains relatively stable, with an average value of 27.77% and a low standard deviation (0.65%), indicating the model's strong ability to generate consistent forecasts for this indicator. Similarly, total tax revenues exhibit low variability (0.23%), confirming their predictable and inertial behavior over the short term. The forecasts for GFCF_GDP show an average of 17.61% of GDP with moderate variability (0.50%). The values are relatively close to each other, suggesting a stable behavior of this fiscal aggregate within the model. In contrast, GOVEXP shows greater dispersion (2.37%), with variations ranging between 17.22% and 23.75%, reflecting uncertainties regarding general budgetary policy.

The descriptive statistics of the VECM V5 forecasts indicate strong consistency in the estimations of fiscal and structural variables, while economic growth and the budgetary position exhibit higher levels of volatility, reflecting increased uncertainty in the analyzed economic context. These findings may serve as a starting point for alternative scenario analysis and fiscal risk assessment over the forecast horizon.

## 5. Conclusions

This research, based on the application of the VECM model, has highlighted significant interdependencies between economic growth, fiscal policies, and physical capital investment. The existence of cointegration relationships among the variables suggests that they evolve in a common long-term equilibrium, despite short-term fluctuations. From an economic policy perspective, the results underscore the contribution of public expenditures and tax revenues in supporting a sustainable trajectory for real GDP. The impulse response and variance decomposition analyses confirmed the existence of causal linkages among macroeconomic variables. Shocks to fiscal pressure generate propagated effects on other economic components, including GDP and investment, demonstrating the systemic nature of fiscal transmission. The variance decomposition further revealed the substantial role of fiscal variables in explaining the evolution of net lending and fiscal pressure, underscoring their importance in macroeconomic dynamics.

Short-term results revealed that adjustment toward equilibrium is more rapid for certain variables, such as economic growth (GDP), indicating a higher degree of resilience to economic shocks. In contrast, variables such as government expenditures or investments tend to adjust more slowly, suggesting the need for better-targeted economic policies to accelerate the return to equilibrium. The research found that variables influencing long-term economic growth are statistically significant—particularly investment and tax revenues—while fiscal pressure has a considerable impact on both. These results suggest that to stimulate economic growth, effective management of fiscal resources through efficient government spending is essential.

Regarding fiscal pressure, the analysis shows it is significantly determined by all other economic variables, indicating a strong interdependence between fiscal conditions and the overall state of the economy. The indicator adjusts rapidly in the short term, reflecting its relevance in assessing economic stability. This finding highlights the importance of fiscal policy and public resource management in maintaining economic balance and avoiding excesses that could lead to instability. As for tax revenues, their influence is not significant in certain cointegration equations, suggesting that tax revenues do not affect all long-term economic relationships. However, in the short term, fluctuations in tax revenues are important for economic adjustments. Nonetheless, the results imply that an efficient tax system alone is not sufficient to support sustainable economic development; rather, a balance between taxation, public spending, and capital infrastructure investment is required.

Another key aspect revealed by the VECM analysis is the behavior of short-term adjustments. In many cases, economic variables are influenced by shocks and may adjust either quickly or slowly relative to the long-term equilibrium. For example, the annual growth rate of real GDP adjusts quickly to deviations from equilibrium, suggesting the economy is sensitive to short-term changes in government spending and revenues. In contrast, other variables such as NLB adjust more slowly, potentially reflecting their dependence on long-term fiscal policy and macroeconomic stability. With regard to borrowing, it is observed that tax revenues do not significantly influence net lending in the long run, while fluctuations in fiscal pressure are more relevant for short-term adjustments in liquidity. This suggests that although net liquidity is affected by fiscal dynamics, the short-term impact is less pronounced than that of fiscal pressure and government spending.

We argue that effective economic policymaking must take into account the complexity of relationships among economic variables. A balance between taxation, government spending, and investment in physical capital is essential for ensuring sustainable economic growth. Furthermore, fiscal policy should be adaptable in order to respond quickly to economic shocks and help maintain long-term macroeconomic stability.

The forecasts generated by the VECM model provided important insights into future economic trends. These suggest that, under a balanced mix of fiscal policies and increased investment, the economy may experience sustainable growth accompanied by long-term fiscal stability. Moreover, the forecasts indicate that strategic management of public spending and prudent fiscal policy can reduce the risks of economic instability and improve development prospects. Additionally, the results show a strong correlation between economic growth and net lending. The decline in net liquidity through 2025 coincides with a decrease in economic growth, underscoring the importance of access to financial resources for sustainable development. Fiscal pressure and tax revenues are also correlated. The observed trends suggest that austerity or fiscal relaxation measures affect the dynamics of investment, which necessitates careful allocation of resources to stimulate long-term investment. The relationship between revenues and net liquidity suggests that an initial reduction in tax revenues may decrease public sector liquidity, while a subsequent increase contributes to financial recovery. Achieving a balance between short-term fiscal stimulus and long-term consolidation is essential for supporting durable economic growth. Initial fiscal stimulus measures must be followed by effective fiscal consolidation to ensure macroeconomic stability.

After 2025, the allocation of government spending toward structural investments is crucial for sustaining long-term growth and reducing fiscal pressure. Strategies aimed at supporting liquidity and easing the fiscal burden can significantly contribute to overall economic stability, creating favorable conditions for sustainable development. After 2026, most economic variables appear to stabilize, indicating a period of equilibrium. The research findings allow for the formulation of policy recommendations for future economic planning. First, it is necessary to maintain a balanced fiscal policy that stimulates investment and supports economic growth without placing additional strain on the budget deficit. Second, investments in physical capital must be well-targeted toward sectors with high economic multiplier potential in order to ensure maximum impact on the economy. Finally, continuous monitoring of the relationships among key economic variables is important in order to identify potential imbalances in a timely manner and to adapt policies accordingly.

The conducted research and the results obtained demonstrate that using advanced econometric tools such as the VECM model can offer deep insights into economic dynamics and guide public policy toward supporting sustainable development. As such, integrating econometric analysis into the decision-making process can significantly contribute to achieving long-term economic goals such as stability, sustainable growth, and overall welfare.

Although this research has provided relevant conclusions regarding the economic interdependencies among the analyzed variables using the VECM model, some methodological and contextual limitations must be acknowledged. First, the limited size of the dataset constrained both the time horizon of the analysis and the forecasts. Furthermore, the conclusions are primarily relevant to the specific context of the analyzed period. Their applicability to other periods depends on the continuation of similar economic conditions. Structural changes or new economic policies could affect the dynamics of economic relationships and, consequently, the applicability of the results. Moreover, the forecasts produced by the VECM model depend on the stability of relationships among the variables. In the event of significant structural changes, the forecasted outcomes may deviate from actual developments.

## 6. References

Chakraborty, S., Aktar, S. (2023). *Effect of Income Inequality on Economic Growth: Evidence from Bangladesh.* International Journal of Ecology & Development, 38(2), 15-25.

Davtyan, K. (2015). *Interrelation among Economic Growth, Income Inequality, and Fiscal Performance: Evidence from Anglo-Saxon Countries.* AQR Research Group-IREA, University of Barcelona.

Ehrhart, C. (2009). *The effects of inequality on growth: a survey of the theoretical and empirical literature*. ECINEQ Working Paper, 2009-107.

Eicher, T., Turnovsky, S. (2003). *Inequality and Growth: Theory and Policy Implications.* Business & Economics, MIT Press.

Ilesanmi, KD, Tewari, DD (2017) *Energy consumption, human capital investment and economic growth in South Africa: a vector error correction model analysis,* OPEC Energy Review, 41(1), pp. 55–70. doi: 10.1111/opec.12094.

Kuznets, S. (1955). *Economic Growth and Income Inequality.* American Economic Review, 45, pp. 1–28.

Larch, M. (2012). *Fiscal Performance and Income Inequality: Are Unequal Societies More Deficit-Prone? Some Cross-Country Evidence.* KYKLOS, International Review for Social Sciences, 65(1), pp. 53–80.

Neves, P., Silva, S. (2014). *Inequality and Growth: Uncovering the Main Conclusions from the Empirics.* Journal of Development Studies, 50(1), pp. 1–21.

Seabela, M., Ogujiuba, K., Eggink, M. (2024). *Determinants of Income Inequality in South Africa: A Vector Error Correction Model Approach.* Economies, 12(7), Article 169. https://doi.org/10.3390/economies12070169

Sehrawat, M., Giri, A.K. (2017). *Income inequality on poverty: evidence from India*. Springer-Verlag GmbH Germany. Published online: 30 August 2017.

Shin, I. (2012). *Income inequality and economic growth. Department of Economics,* Asia University, 5-24-10 Sakai Musashino, Tokyo 180-8629, Japan.

https://data.worldbank.org/indicator/GC.TAX.TOTL.GD.ZS?end=2022&locations=RO&skipRedirection=true&start=1972&view=chart&year=1972 (acc. June 21, 2024).

https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?locations=RO&skipRedirection=true (acc. June 21, 2024).

https://data.worldbank.org/indicator/NE.CON.GOVT.ZS?locations=RO&skipRedirection=true (acc. June 21, 2024).

https://data.worldbank.org/indicator/NE.GDI.TOTL.ZS?skipRedirection=true (acc. June 21, 2024).

https://data.worldbank.org/indicator/GC.NLD.TOTL.GD.ZS?locations=RO&skipRedirection=true (acc. June 21, 2024).

https://ec.europa.eu/eurostat/databrowser/view/GOV_10A_TAXAG/default/table?lang=en (acc. June 21, 2024).