Scientific Annals of Economics and Business
71 (4), 2024, 547-582
DOI: 10.47743/saeb-2024-0026

Analysis of Public Debt in the Context of Crises Generated by Socio-Economic Events. Case Study: European Union Countries

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Abstract: In the current geopolitical configuration, generated by socio-economic and political-military events, with an impact on economic development, the public debt dynamics take on new dimensions. Public debt, as an indispensable concept for improving development strategies in an economic and geopolitical context, is influenced by the macroeconomic indicators' variation, but also by the internal and external factors' impact, which generate instability in a dynamic of unpredictable phenomena. Therefore, the study indicates proposals, based on multivariate regression, to capture the most sensitive variations of macroeconomic indicators on sustainable development at the European Union countries level. Moreover, the current European level configuration requires a detailed capture of the connection between public debt and economic growth, by using a VAR model (public debt, a concept that takes on new values in the current context, and economic growth, as the central pillar of sustainable development, analyzed from the perspective of the studied indicators fluctuation). Finally, I analyzed the public debt dynamics for the next period (2000 – 2022) to create a realistic picture, using the ARMA model. The results confirm the direct impact of each event on economic growth and development, and the limitation and elimination of negative effects vary depending on how it is managed and prevented. Also, the link between the economic growth and public debt is confirmed and, at the same time, it constitutes a benchmark that captures the importance of the decisions of the responsible factors regarding the financial-monetary instruments implemented or what is requested to be adopted. In other words, forecasting the public debt dynamics gives a certain stability, but also a strategic vision, offering viable solutions to support sustainable development efforts at European states level.

Keywords: autoregressive integrated moving average (ARMA); autoregressive model (VAR); macroeconomic indicators; public debt; regression.

JEL classification: C33, E44, E60.

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Article history: Received 12 April 2024 | Accepted 10 July 2024 | Published online 18 December 2024

To cite this article: Străchinaru, A. V. (2024). Analysis of Public Debt in the Context of Crises Generated by Socio-Economic Events. Case Study: European Union Countries. *Scientific Annals of Economics and Business*, 71(4), 547-582. https://doi.org/10.47743/saeb-2024-0026.

1. INTRODUCTION

Approaching the public debt concept, at the European Union countries level, requires a thorough and rational analysis of both factors and phenomena. They are characterized by a high degree of unpredictability, further amplifying the effect on the economy. In this sense, a special emphasis is placed both on forecasting future fluctuations of macroeconomic indicators, and on the objective assessment of public policies that need to be adopted. The last decades have highlighted, as research in the field also supports, the numerous syncopes that must be accepted, prevented and, not least, managed with even greater responsibility, on the part of the decision-makers. In this sense, it can be stated that a concept, like that of public debt, is not fully defined only by a more theoretical analysis. But, as can be seen from everyday activity, it takes various forms of manifestation. These are influenced by the nature of the phenomena, which create insecurity, a certain instability at the community level, generating periods of crisis. Therefore, the analysis captures the impact of public debt on the entire economic circuit, in a dynamic context, even of overlapping crises. This is evidenced by the impact of fiscal measures, monetary policies and implemented strategies, by the perception of investors and last but not least by the response of the working population.

Another element that is becoming more and more current is represented by the investments depreciation, which in the current geopolitical context, takes on two forms of manifestation. Thus, it is considered, on the one hand, the orientation of financial resources towards those strategic sectors, also analyzed from the perspective of government securities, with attractive interest rates in the medium and long term, and on the other hand, the realization of a significant profit, in the long term short. This last detail is due to the uncertainty of the business environment, which in turn comes with high and assumed risks. The implementation of successful strategies depends very much on the analysis, down to the smallest detail, of the events and especially of the impact they have. Examples, in the sense of the mentioned, are represented by the financial crisis with its lack of liquidity, by the COVID 19 pandemic, by socio-economic expenses, and last but not least by the armed conflict in Eastern Europe, with its uncertain outcome. In other words, the influence of the mentioned events gives rise to concern through the way of manifestation and perception regarding the durability and uncertainty installed. At the same time, it must be remembered that the economies of the less developed countries feel and cope with the new challenges more and more difficult, which involve assumed costs, far above the forecasted ones. A temporary solution was to resort to loans, but as is well known, in the long term, these also create other costs, which further forces the economy to respond promptly and well-argued. In other words, the macroeconomic indicators reflect, at a given moment, the state of health of the economy.

In other words, the promotion of a healthy, even linear economic growth is the central pillar on which the continuation of reforms, the stability of jobs and the population's income depends, as well as the provision of solid investments in realistic infrastructure projects, based on studies, with a visible impact on economic development. Their management is influenced by the evolution of the capital market at the European and even global level. Therefore, in order to optimally manage resources, a self-assessment of one's own economic and investment potential is required, also reflected in the degree of affordability of the economy. In another way, through the allocated funds, within the implemented programs, the aim is to increase productivity and increase the degree of trust. Last but not least, I want

to put into practice those viable strategies, capable of preventing the occurrence of similar phenomena, with a harmful impact on economic development.

Regarding the public debt, as database and dynamics, it is worth remembering that in the last two decades, Spain (a member country of the European Union since 1986), was among the few countries that managed to significantly reduce it. Concretely, in the mid-2000s he managed to reduce the public debt from approx. 65% of G.D.P. (1996) at approx. 35% of G.D.P. (2007).

The public debt data base, at the European Union countries level, is captured in Figure no. 1.

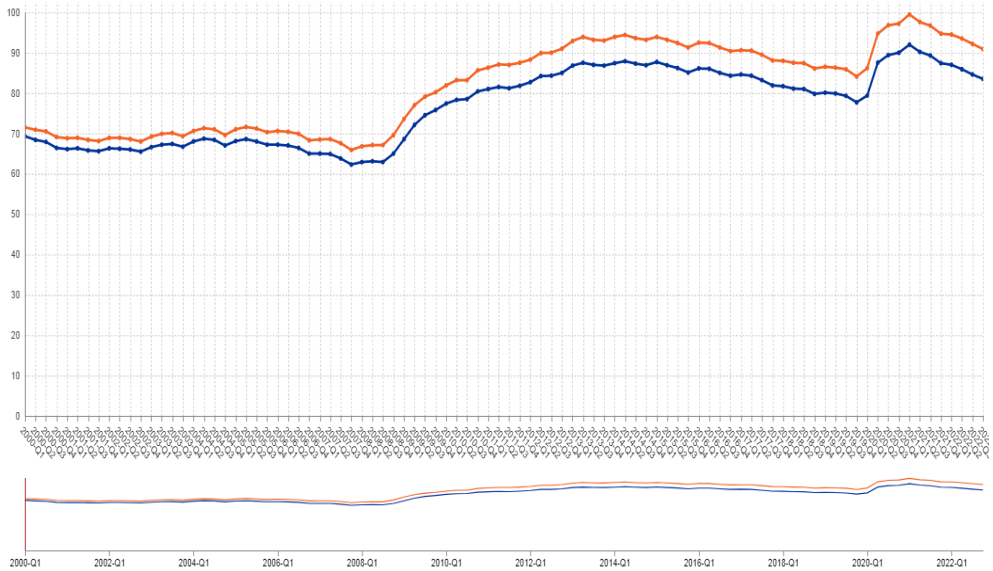


Figure no. 1 – Public debt at the European Union level (2000-2022)
Source: European Union, respectively Euro area

According to them (Eurostat) the public debt at the European Union level reflects an average threshold of approx. 83% of G.D.P. Greece remains the most indebted country in Europe with a percentage of approx. 172.6%, followed by Italy (141.7%), and at the opposite pole is Estonia with approx. 18.5%, followed by Bulgaria (22.6%) and Luxembourg (24.7%). These data confirm the existence of a variation, not necessarily linear (regardless of the period and the phenomena that have characterized the last decades) and in this sense, an analysis of the evolution of the debt is all the more necessary as it can provide clear information, realistic solutions regarding the impact policies, strategies adopted at the level of the analyzed countries.

2. LITERATURE REVIEW

Considering the events dynamics, the strategies implementation, with a pronounced impact on economic growth, has aroused real interest at the European and global level, taking into account the size and complexity of the phenomena, from the last decades, with their

influence on economic development. Moreover, scientists analyze the problem of public debt not necessarily from the point of view of the threshold mentioned in the Maastricht Treaty, but more recently they try to find answers regarding those optimal thresholds and whether they exist in terms of the percentage of G.D.P. intended for investment, research, development, innovation, etc. In the end, there should be a direct relationship between the human factor and the financial one, fully connected to the realities of the time, able to bring added value, in the current context, ground by various turmoil, fueled by less justified decisions. The studies in the field are vast, and they present different syntheses and interpretations depending on the existing and less foreseen situations. At the same time, it should be noted that a special emphasis must be placed on those detailed situations (e.g.: the increase in budget expenditures fueled by social imbalances, etc.) generating risk and implicitly crisis periods which, in turn, cause a significant fluctuation of the indicators macroeconomics.

The deepening of the specialized literature also requires an analysis of the truly major events that have marked the last decades. They are based, on the one hand, on the assessment, the most realistic interpretation of the fluctuation of the indicators, which show the health of the economy at a given moment, reflected in G.D.P. On the other hand, it is necessary to deepen the existing relationship between public debt and economic growth in order to outline a clearer picture of the real development prospects. Under this aspect, it is clear that it (economic growth) represents the central pillar of sustainable development.

Thus, Heimberger (2023) analyzes the impact of public debt on economic growth. The research used regression (meta-regression) on 816 estimates, considering 47 primary studies. The analyzed period includes the interval 1982-2019, highlighting two very important aspects. So, to what extent can the high levels of public debt support economic growth, considering the manifestation of some phenomena in the analyzed period (1982-2019). On the other hand, to what extent the "unification" of fiscal policies, taking into account the events of nature, represented an asset, or rather the lack of adaptability, of a government, taking into account the unpredictability of events. It should be noted that there is a "balance dose" between countries that are owed is below the threshold of 60% of GDP. Maastricht Treaty - 13 countries and states whose economy reports a debt above the mentioned threshold - 14 countries (annual data, https://www.worldbank.org). The research results highlight, as a measure in the development of future policies, prudence because these (public policies high levels of indebtedness) must have an open relationship, carefully monitored, in order not to endanger economic stability. At the same time, it is shown in the practices of the last years that there is a not so significant interest, on the part of the population, regarding the current level of contracted loans, of debts already accumulated. But how can this mentioned aspect be observed? To understand this detail even better, the perception of the population is analyzed at the level of developed economies (for example: Great Britain and Germany).

Therefore, a much more in-depth analysis is necessary regarding these mentioned aspects, because the last decades have been loaded with socio-economic phenomena that have destabilized the economies of European countries (not only those analyzed in the study) and imposed a new relocation of ideas, a new approach to growth strategies and sustainable development.

In other words, Rommerskirchen and van der Heide (2023), in his research, argues that public debt management rarely attracts real public interest. At the same time, it is also mentioned that the political factor has its own influence in the management of public

finances and available resources. From here two other currents "depart", which seem to contribute to a political calm, at least: on the one hand, there is low interest towards the threshold reached and, in the same mentioned context, the dominance of "market discipline" prevents the modification of rates interest and costs. In other words, there are two studied factors that reflect the way public debt is managed (from the authors' point of view). Looking at things from another angle, silence facilitates the creation of a space of cooperation between states but also between them and the banking system. As a detail, it is also mentioned that both the banks and the state are dependent on each other due to their capacities to act on economic sustainability at the European level. Another element of detail, subject to analysis, but with uncertain results, "talks" about the fact that countries with a level of public debt below the threshold of 60% of GDP. It does not succeed with certain competitive advantages, to reach the economic situation like this (example: Bulgaria, even Romania), while countries with a debt level, above the mentioned one (example: 80-90% of GDP) report positive evolution, even in the short term (e.g. Croatia, France, Portugal). There are situations, slightly paradoxical, but which clearly and concisely present the way in which the available resources must be reached, so that the management of the population experiences positive developments, materialized in decent incomes. On the other hand, the economic analysis viewed from the perspective of the public deficit, associated with expenses of any kind, in relation to the public debt, shows an imbalance at the European level. Thus, there are countries whose debt is below 20% of GDP. the case of Estonia (18.5%) and the debt countries exceeds the threshold of 100% of G.D.P. (example: Greece, which holds the last position with 172.6%). Basically, the last decades have surprised by the nature of the phenomena, which has led to hasty and less documented analyses. Or the current context, requires the study of even the smallest details, able to provide the necessary levers, the factors of responsibility in the development of the best strategies for growth and sustainable development at the European level.

The case of the last of them, of Greece, of the economy that defines it, is analyzed in detail by Revuelta (2021) who analyzes the period 2010-2015, with reference also to the events that marked the economy, both before and after the mentioned period. Concretely, the three economic aid programs (E.P.E.) implemented at the country level, severely affected by the financial crisis, by social turmoil after the 2000s, are analyzed, the SCM study application. The culminating point was represented by the COVID 19 pandemic, which amplified the economic situation even more, placing it in last place, as public debt at the level of the European Union.

Thus, through the initiated and political surveillance mechanisms, which included the entire economic environment, as well as the social protection measures of the population, the objectives of stability could only be achieved in some places. Well, even more so in the years before the outbreak of the COVID 19 pandemic, as a result of the strategies implemented, in the analyzed period 2010 - 2015, an unemployment level of over 15% of G.D.P. was recorded. (17%, year 2019). On the one hand, Greece was dependent on assistance and financial support, and on the other hand, the country's economy had to comply with certain rules, imposed, which even led to a decrease in G.D.P. per capita. The 2013-2014 period represented, both for Greece and for most states, a certain flexibility in terms of identifying the policies adopted, but at the population level in terms of income. In general, the austerity measures did nothing but make it more difficult for the business environment. The long-awaited effect was not at the proposed level, a fact recognized by specialists in the field. Of course, not only in the case of

the Greek state it can be said that the expenses, as the main harmful factor, had a harmful effect on the economy, but also in the case of Romania, which felt both the shock of the economic crisis, in the context in which the country's economy presented a high level of confidence (with an increase of approx. 8.5%, year 2008), as well as the shock of the COVID 19 pandemic. Basically, from a public debt of 12.8% of G.D.P. in 2008, it reached 36.8% at the end of 2012, and after the first year of the pandemic (2021), it is around the threshold of 50% (48.6%) of G.D.P. There are aspects of interest that must be correlated and always updated considering the unpredictability of the phenomena but also the economic stability in the region.

These mentioned aspects, regarding the case of Romania, a country with a remarkable capacity for recovery and economic development, are analyzed by the authors Popescu and Diaconu (Maxim) (2021). The research analyzes, based on regression, two theories, that of Wagner, respectively that of Keynes. The studied period includes the interval: 1995-2018, half-yearly data. The first claims that the increase in spending can also be attributed to economic growth and development, while the second theory that, in managing the function as it is, can also represent an important tool to stimulate it. Therefore, there is a close, direct link between public spending and economic growth (real G.D.P.). Based on the Granger test, it is stated that only in the short run can a double causality relationship be supported and that in the long run, the test does not indicate the existence of cointegrating vectors. According to the same study, it is stated that economic growth attracts additional, but their less responsible allocation can lead to inefficiency, also felt in the incomes of the population. Of course, in the dynamic geopolitical public context, greater attention must be paid to finances and policies, as well as fiscal measures. Because, they create the conditions for a sustainable development capable of supporting the economy with notable results in the medium and long term. The last few decades have been littered with more responsible decisions by decision-makers regarding the resizing of available resources. Thinking too lightly (sometimes) of public money has determined a certain instability that must be prevented (in the future) and managed (responsibly) based on measures and public policies characterized by recognized flexibility and adaptability.

A pronounced analysis of the impact is supported by the authors Onofrei *et al.* (2021) who emphasize the importance and implications of such policies and rules on the fiscal behaviors of governments. Panel data were used for the developing countries of the European Union, and the reference period falls within the range: 2000 - 2014. Thus, by creating the control and risk management mechanism, the achievement of the performance of the public sector and more is aimed at. It is also important to strengthen the interactions between the legal and the institutional framework, in order to respect the stability commitments and achieve the proposed objectives. They can also be achieved by creating independent fiscal institutions, capable of improving the budget preparation process, ensuring a real process of fiscal consolidation. The specified rules were introduced with the aim of ensuring fiscal sustainability, which is characterized primarily by stability and transparency. In the case of discretionary fiscal-budgetary policies, it is stated that they suffer from two major disadvantages. These refer, first of all, to the tendency to increase budget deficits, and secondly, a budget deficit implies higher expenses than revenues, generating instability and crisis. Looking at things from another angle, it can be stated that economic development, thought at the European level, was affected by various disturbances, which alternated, fueled the uncertainty regarding the strategies implemented, requiring a rearrangement of ideas and

realization of economic growth prospects at the European community level. Thus, future sustainable development strategies must take into account every aspect analyzed and at the same time provide security and confidence in investment trust, as the main axis of sustainable economic growth.

The history of the last decades has highlighted the need to pay special attention to digitization, the IT industry and their effects. Thus, the authors Toader *et al.* (2021) emphasize the alternative measures thought and implemented in relation to the ill effects of the pandemic (2019-2021). The purpose of the research is to examine the log-run association between higher education in OECD countries based on the Solow endogenous growth model. At the same time, econometric methods related to ARD were considered for the use of different unit tests in order to verify the stationarity of the involved series. Even if the economic activity was interrupted, for a period of time, it required a reconfiguration and at the same time it will have, which was realized through technology and readjustment according to the evolution of the pandemic values. The effect was found to be beneficial, as it creates much more viable and realistic premises for development. This, digitization was not necessarily new, not even for higher education, but emerging situations, generated by the pandemic and not only, have emphasized the importance, usefulness and at the same time require the development of such programs, optimal for development. By fulfilling the established objectives, the reduction of the effect of isolation among students and the development of interactions between people was achieved. In conclusion, the analysis attests to the positive impact of digitization on education and beyond, with a direct effect on economic development.

The specialized literature includes analyzes that succinctly, realistically and dynamically present the impact of the turmoil that marked the last decades. The evolution of the market through mechanisms of monitoring, correction and recovery surprised even the strongest European economies. The fluctuation of macroeconomic indicators fueled by socio-economic instability, but also politics in the region, further amplified the economic decline, raising real problems at the level of the analyzed countries. The impact of factors, both internal and external, combined with the fluctuation of some of the most sensitive macroeconomic indicators (inflation, deficit, etc.) had a direct impact, interpreted differently by the governments of European countries, whether we are strictly speaking of those of the European Union or countries from Central and Eastern Europe (not part of the community). Even if events such as the pandemic, the financial crisis and, more recently, the war have had a negative impact, it must be remembered that part of the given situation also depends on how the available resources are managed. The analysis of the macroeconomic situation reflected in the level of public debt arouses real interest, and the levers and reforms used in this sense come to the support of governments. In all this context, it is necessary to comply with some directives, as a recommendation, capable of revitalizing, where appropriate, the business environment. At the level of the European community, there are countries with a debt level below 60% of GDP. - 13 countries (annual data) but also countries whose debt threshold varies greatly, being above the mentioned level. This last category includes a number of 14 countries, with a debt level between approx. 66%, the case of Germany, respectively Greece with its level of approx. 172.6% of G.D.P. The way of understanding, preventing and responding to existing challenges differentiates these countries, but at the same time, sustained efforts are being made to reduce the level reached, through a realistic allocation of funds so as not to affect economic stability in the area. At the same time, a favorable evolution is observed, from an economic point of view, after the first year of the

COVID19 pandemic with official data, whose values give confidence and security. In order to capture the most sensitive variations of economic indicators, in a dynamic context of socio-economic, but also political-military events, I present the methodological framework. Thus, I propose to highlight the mentioned aspects, together with viable measures for recovery, growth and economic development at the level of the countries studied.

3. METHODOLOGY AND DATA USED

3.1 Multivariate regression

As the first analysis method, within the study, I opted for multivariate regression. This model aims to study economic growth, from the events perspective that "characterized" it, based on the macroeconomic indicators past data series, which proved to be significant (in explaining it) and stationary (level), being expressed as a percentage.

So, I used panel data and the method of least squares (OLS) in Eviews software. The panel data model equation is:

$$y_{it} = \alpha + X'_{it}\beta + \mu_{it} + \vartheta_{it}, \qquad \text{i=1, ... ,N; t=1,...,T} \tag{1}$$

where: i = cross-section size, t= time series size; α, β= coefficients of the equation, X'_{it} = observation *it* of the explanatory variables, μ_{it} = the effect specific-individual unobservable and ϑ_{it}= residue (the remainder disturbance).

The econometric method may estimate two types of models: the fixed effect model or the random effect model. By using Hausman test (H0: the random effect model is appropriate; H1: the fixed effect model is appropriate), I select the appropriate model. Thus, if the "p-value" registers a statistically significant value, e.g. < 5%, I will choose the fixed effect model, otherwise I will take into account the random effect model. In order to capture the impact of the independent variables on the dependent variable, I analyzed the correlation between the indicators.

The data base and relationships description (multivariate regression)

In order to capture, in dynamics, the evolution of the most volatile indicators, with a pronounced impact on economic growth, I considered the reference period: 2000 - 2022, official data, with an annual frequency. Data were taken from specialized websites of European and world financial institutions, such as Eurostat, OECD, Wordbank and IMF respectively.

Table no. 1 – The correlation matrix

	C.A.	EXP	E.B.	F.D.I.	F.D.O	GDP_A	GDP_C	IND	INF	POP_A	T_REV	UNEM
C.A.	1.000	-0.076	**0.668**	-0.062	0.001	-0.174	-0.225	-0.142	-0.345	-0.345	-0.038	-0.186
EXP.	-0.076	1.000	-0.179	0.018	-0.008	-0.050	-0.004	-0.122	-0.045	-0.051	**0.980**	0.190
E.B.	**0.668**	-0.179	1.000	0.008	0.056	-0.016	-0.136	-0.183	-0.240	-0.045	-0.133	-0.296
F.D.I.	-0.062	0.018	0.008	1.000	**0.822**	0.020	-0.014	-0.195	-0.030	0.237	0.054	-0.038
F.D.O.	0.001	-0.008	0.056	**0.822**	1.000	-0.040	-0.062	-0.161	-0.055	0.196	0.015	-0.005
GDP_A	-0.174	-0.050	-0.016	0.020	-0.040	1.000	**0.972**	0.208	0.272	0.124	-0.001	-0.144
GDP_C	-0.225	-0.004	-0.136	-0.014	-0.062	**0.972**	1.000	0.266	0.311	0.089	0.027	-0.060
IND.	-0.142	-0.122	-0.183	-0.195	-0.161	0.208	0.266	1.000	0.211	0.205	-0.164	-0.100

	C.A.	EXP	E.B.	F.D.I.	F.D.O	GDP_A	GDP_C	IND	INF	POP_A	T_REV	UNEM
INF	-0.345	-0.045	-0.240	-0.030	-0.055	0.272	0.311	0.211	1.000	0.066	-0.036	-0.194
POP_A	-0.345	-0.051	-0.045	0.237	0.196	0.124	0.089	0.205	0.066	1.000	-0.077	0.086
T_REV	-0.038	**0.980**	-0.133	0.054	0.015	-0.001	0.027	-0.164	-0.036	-0.077	1.000	0.116
UNEMP	-0.186	0.190	-0.296	-0.038	-0.005	-0.144	-0.060	-0.100	-0.194	0.086	0.116	1.000

Note: C.A. - CURRENT_ACCOUNT; EXP - EXPENSE_OF_GDP; E.B. - EXTERNAL_BALANCE; F.D.I. - FOREIGN_DIRECT_INFLOWS; F.D.O. - FOREIGN_DIRECT_OUTFLOWS; G.D.P._A. - GDP_GROWTH_ANNUAL; G.D.P._C. - GDP_PER_CAPITA_GROWTH; IND – INDUSTRY; INF - INFLATION; POP_A - POPULATION_AGE; T_REV - TAX_REVENUES; UNEMP - UNEMPLOYMENT

Source: author's calculations, with Eviews software

Taking into account the proposed confidence interval (-0.7; 0.7), I applied the *correlation matrix* in order to obtain valid results, for a clearer picture of the economic situation. They are presented in Table no. 1.

The recorded values fall within the proposed range (-0.7; 0.7). Redundant indicators of economic significance are eliminated, including: GDP_per_capita_growth, Foreign_direct_outflows, External balance, Expense of GDP etc.

The correlation matrix, presented in Table no. 2 verify indicators with their impact on economic growth.

Table no. 2 – The correlation matrix

	GDP__A	C.A.	IND.	INF	POP_A
GDP_A	1				
C.A.	-0.17393	1			
IND.	0.207746	-0.14177	1		
INF.	0.271629	-0.34451	0.211008	1	
POP_A.	0.124115	-0.34466	0.205451	0.065601	1

Source: author's calculations, with Eviews software

Considering the aforementioned, I opted for updating the database with new indicators, including the "updating" of the dependent variable, *real G.D.P*.

These are presented in Table no. 3.

Table no. 3 – Presentation of variables

Variables	Specification	Data source
The dependent variable		
REAL_GDP	*REAL G.D.P. GROWTH, annual %*	International Monetary Fund
The independent variables		
CAB	Current account balance (% of G.D.P.)	Eurostast
ICP	Inflation consumer prices (annual %)	*The World Bank*
GCF	Gross capital formation (% of G.D.P.)	The World Bank
GRE	Guvernment revenue, expenditure (% of G.D.P.)	Eurostast
UNE	Unemployment, total (% of total labor force)	The World Bank
TRA	Trade (% of G.D.P.)	The World Bank
INC	Industry (including construction) (% of G.D.P.)	The World Bank
FDI_I	Foreign direct investment, net inflows (% G.D.P.)	The World Bank
FDI_O	Foreign directinvestment, net outflows(% of G.D.P.)	The World Bank
POP	Population 15 - 64 age (% of population)	*The World Bank*

Source: author's representation

Given the current economic and geopolitical context, a much more responsible analysis of disruptive factors, of macroeconomic indicators, really significant for the economy of a country, of a community that currently includes 27 states, is required. Besides, the last decades are sprinkled with significant phenomena that imposed more or less assumed decisions, and the results were not always the expectations. So, one of the questions that needs to be clarified is the analysis of the most representative indicators. In other words, the presented indicators can have a positive or negative impact on economic growth. The studies (specialized literature) show significant variations of these indicators, over time, decision-making functions of the responsibility factors, but also of unpredictability that characterize the socio-economic and political phenomena of the analyzed period. Therefore, in an "accredited" description, both in the specialized literature and as required by the evolution, for a sustainable development it is necessary to describe them alongside the hypotheses (positive/negative impact) that are taken into account. The mentioned can be found in Table no. 4.

Table no. 4 – Description of variables used

Variable	Description	Hypotheses
	The dependent variable	
REAL GDP	*It represents the real growth of the economy (P.I.B. real)*	-
	The independent variables	
CAB	- provides information on a country's transactions; - covers those transactions (other than those in financial elements) with goods, services, income (primary/secondary)	**H_0**
FDI_I	- foreign direct investments, net inflows, into the economy	**H_0**
FDI_O	- foreign direct investment, net outflow.	H_0 / **H_1**
GCF	looks at those expenditures for the addition of fixed assets of the economy, even net changes in the level of stocks.	**H_0** / H_1
GRE	- captures a ratio of government revenues to expenditures as a percentage of GDP	**H_0** / H_1
INC	- includes effectively, production, added value.	**H_0**
ICP	reflects the annual cost change for the average consumer (purchasing a shopping basket that can be fixed/changed with different impact on economic growth).	**H_0** / **H_1**
POP	describes the population aged 15-64, as a percentage of the total population, which counts all residents, regardless of legal status or citizenship.	**H_0**
TRA	- trade is the sum of exports and imports (goods, services).	**H_0**
UNE	characterizes the share of the labor force, without work, but available and looking for a job.	H_0 / **H_1**

Source: author's representation

Legend: General assumptions, from which they "start":

H_0 (**H_0** / H_1) - positive impact (rather positive) on the dependent variable;

H_1 (H_0 / **H_1**) - negative impact (rather negative) on the dependent variable.

The following correlation matrix (Table no. 5) reflects the importance and degree of correlation of the analyzed indicators, in a dynamic of phenomena, sometimes difficult to anticipate (with accuracy).

Table no. 5 – The correlation matrix

	CAB	FDI	GCF	GRE	ICP	INC	POP	TRA	UNE
CAB	1.0000	-0.0769	-0.4987	0.2611	-0.3107	-0.1587	-0.3417	0.2055	-0.1836
FDI	-0.0769	1.0000	-0.0203	-0.0971	-0.0523	-0.1399	0.1987	0.1724	-0.0209
GCF	-0.4987	-0.0203	1.0000	-0.3189	0.2868	0.4821	0.1194	-0.0055	-0.3073
GRE	0.2611	-0.0971	-0.3189	1.0000	-0.2078	-0.2746	-0.3776	-0.3389	0.1075
ICP	-0.3107	-0.0523	0.2868	-0.2078	1.0000	0.2157	0.0920	-0.0277	-0.1326
INC	-0.1587	-0.1399	0.4821	-0.2746	0.2157	1.0000	0.2047	-0.2470	-0.0966
POP	-0.3417	0.1987	0.1194	-0.3776	0.0920	0.2047	1.0000	0.2326	0.0918
TRA	0.2055	0.1724	-0.0055	-0.3389	-0.0277	-0.2470	0.2326	1.0000	-0.3115
UNE	-0.1836	-0.0209	-0.3073	0.1075	-0.1326	-0.0966	0.0918	-0.3115	1.0000

Source: author's calculations, with Eviews software

The correlation matrix showed that there is a not so significant correlation between the individual variables.

Estimating and testing the significance of the analyzed parameters

For the estimation, as realistic as possible and at the same time testing the significance of the analyzed parameters, I applied the Hausman Test, obtaining (Table no. 6):

Table no. 6 – The results of the indicators estimation

Correlated Random Effects - Hausman Test

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	51.956839	10	0.0000

Source: author's calculations, with Eviews software

The probability associated with the Hausman test: $p<0,05$. In this case, according to the test and taking into account the probability value, the null hypothesis cannot be rejected, so the appropriate model for estimation is the fixed-effects model. In other words, the term "fixed effects" refers to the fact that even though the intercept may vary across the variables, the intercept of each factor is time-invariant.

Their representation (*fixed effects*) are highlighted in the following table (Table no. 7):

Table no. 7 – Fixed effects

Dependent Variable: ***REAL_GDP***
Sample: 2000 - 2022

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.283235	0.086885	3.259860	0.0012
CAB	0.002867	0.054673	0.052439	0.9582
FDI	0.000507	0.003361	0.150917	0.8801
GCF	0.244247	0.065561	3.725473	0.0002
GRE	-0.478061	0.047472	-10.07046	0.0000
ICP	0.060925	0.039574	1.539504	0.1242

INC	-0.008220	0.073349	-0.112066	0.9108
POP	-0.198025	0.112441	-1.761150	0.0787
TRA	0.016121	0.007747	2.081032	0.0379
UNE	0.154282	0.049772	3.099775	0.0020
Effects Specification				
Cross-section fixed (dummy variables)				
R-squared	*0.371761*	Mean dependent var		0.024918
Adjusted R-squared	*0.334175*	S.D. dependent var		0.038303
F-statistic	9.890712	*Durbin-Watson stat*		*1.881369*
Prob (F-statistic)	*0.000000*			

Source: author's calculations, with Eviews software

I eliminated, again, the statistically insignificant indicators, they have a probability >0.5, respectively 0.10. Thus, the final regression is obtained - with fixed effects (Table no. 8).

Table no. 8 – The final regression (*equation*)

Dependent Variable: ***REAL_GDP***
Sample: 2000 - 2022

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.283981	0.077275	3.674950	0.0003
GCF	0.241065	0.043380	5.557027	0.0000
GRE	-0.477042	0.042236	-11.29455	0.0000
ICP	0.060296	0.038906	1.549767	0.1217
POP	-0.201916	0.103450	-1.951825	0.0514
TRA	0.016253	0.007277	2.233408	0.0259
UNE	0.155199	0.049301	3.147989	0.0017
Effects Specification				
Cross-section fixed (dummy variables)				
R-squared	*0.371722*	Mean dependent var		0.024918
Adjusted R-squared	*0.337530*	S.D. dependent var		0.038303
S.E. of regression	0.031176	Akaike info criterion		-4.046667
Sum squared resid	0.571498	Schwarz criterion		-3.811186
Log likelihood	1289.490	Hannan-Quinn criter.		-3.955141
F-statistic	10.87161	*Durbin-Watson stat*		*1.882029*
Prob(F-statistic)	*0.000000*			

Source: author's calculations, with Eviews software

Thus, the equation that "defines" the model used has the following form:

$$\textbf{\textit{REAL\_G.D.P.}} = 0.283980730692 + 0.24106518718*GCF - 0.477042278069*GRE + 0.0602957346444*ICP - 0.201915727904*POP + 0.0162526384547*TRA + 0.155199483764*UNE + C$$

Analyzing the above equation, it can be seen that there are indicators with a positive but also a negative impact on the dependent variable. Among those with a positive impact are: GCF (gross capital formation), TRA (trade), UNE (unemployment rate) and last but not least ICP (inflation). In other words, at a 1 pp (percentage point) increase in G.C.F. a change in the same direction (increase) is observed in the dependent variable (real GDP) with approx. 24.1%. On the other hand, there is also a negative influence on the dependent variable, and here we find the population (POP), respectively of G.R.E. (government revenues, expenses, etc.). Basically, at a 1 pp (percentage point) increase in G.R.E. a change in the opposite direction (decrease) of the dependent variable (real GDP) is observed by approx. 47.7%.

In order to paint a real picture of the economic situation, from the European level, the statistical F Test "coming" and reinforces this by validating the model by its very significance, with a probability of over 95% (Prob = 0.00000 <0.05).

In other words, the independent variables analyzed and included in the model explain the variation of the dependent variable, for the analyzed period: 2000-2022.

Testing the Autocorrelation Hypothesis - The Durbin-Watson Test

DW test captures the autocorrelation errors degree and describes certain limits, which must be taken into account in order to express the results interpretation. In other words, if the value of the test is lower than "2", we can mention that there is a positive autocorrelation, and if it exceeds the mentioned limit, the autocorrelation becomes negative. When the test records a value around the number "2", the errors are not correlated. The estimated value of the Durbin-Watson test is equal to 1.882, and this result certifies, once again, that the model is valid.

Verification/ Testing the normality of the residual - Jarque - Bera test

The test determines to what extent the empirical distribution can be expressed as a normal one (Figure no. 2). Therefore, it takes into account both the flattening coefficient and the asymmetry coefficient. At the same time, the series created by the residuals includes all the errors of the estimated variable

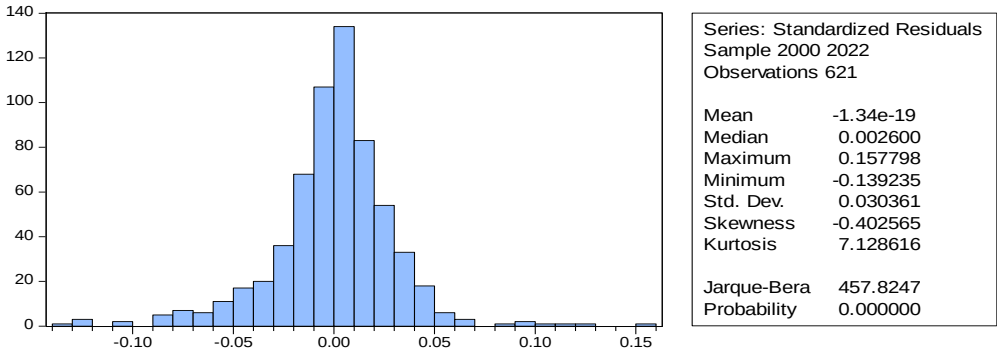


Figure no. 2 – Jarque - Bera test results
Source: author's calculations, with Eviews software

The dynamics of the events determined an important fluctuation of the macroeconomic indicators and due to this fact, the hypotheses (Table no. 4) considered, were or were not confirmed. They are presented in Table no. 8.

Table no. 8 – Confirmation of the assumptions of the model used

Variable	Description	Hypotheses
	Dependent variable: **REAL G.D.P.**	
	Independente variables	
CAB	- Indicator "annihilated" by its own evolution, with a not so significant impact on economic growth of 2.87%, but with a very high probability (>10, approx. 95.82%).	-
FDI_I	- Indicator "annihilated" by its own evolution, with a very high probability (>10, approx. 88.01%).	-
FDI_O	- Indicator "annihilated" by its own evolution, statistically insignificant.	-
GCF	- Positive impact on economic growth (hypothesis confirmed).	**H_0**
GRE	- Negative impact on economic growth (unconfirmed hypothesis).	***H_1***
INC	- Indicator "annihilated" by its own evolution, with a very high probability (>10, approx. 91.08%).	-
ICP	- Positive impact on economic growth (hypothesis confirmed).	**H_0**
POP	- Negative impact on economic growth (unconfirmed hypothesis).	***H_1***
TRA	- Positive impact on economic growth (hypothesis confirmed).	**H_0**
UNE	- Positive impact on economic growth (hypothesis confirmed).	**H_0**

Source: author's representation

Legend: General assumptions, from which they "start":
H_0 (**H_0** / H_1) - positive impact (rather positive) on the dependent variable;
H_1 (H_0 / **H_1**) - negative impact (rather negative) on the dependent variable.

The results reveal an directly proportional relationship between the events produced and the fluctuation of macroeconomic indicators. They "speak" how important the measures are, the public policies that are required to be implemented, characterized by a recognized flexibility, alongside prudent decisions, assumed by the responsible factors.

Interpretation of model results

Economic activity viewed from the perspective of results also shows a dependency relationship between socio-economic events and the fluctuation of macroeconomic indicators.

As the economic reality also certifies, at least in the last years, 2020-2022, even 2023, the income/expenditure ratio seems to be against the first variable (income), determined by the need for additional financial funds, which cannot be covered in totality of the receipts obtained from the state budget. But, on the other hand, it can be observed the need for a continuous, responsible improvement of the personnel, of the population able to work in order to represent a resource capable of facing the new challenges. Even if the technological level has reached a very high level, human capital, for now, cannot be fully substituted. In the same, dynamic context, it can be stated that inflation, as the main publicized indicator (at least in recent years) has come to "play" a double role. On the one hand, to encourage economic growth through "consumption", and on the other hand, it raises serious counter-problems, with medium and long-term impact. At the same time, a positive influence of unemployment can be observed, which in the short term can be associated with a low level of inflation. How can this detail be "translated"? In the short term, a low inflation rate can cause the unemployment rate to increase, and this aspect (low inflation) can stimulate the allocation of substantial investment funds in large-scale projects with a direct impact on sustainable development. Regarding trade, it is clear that it must generate added value in an increasingly fierce competitive environment. As data, I can say that in the first place, as an economy, with a percentage of approx. 393% (2021) is Luxembourg, and the last place is held by Italy with approx. 46% (2003), followed by Greece with 47% (2009).

An obvious thing, after all, but which requires special attention from the responsible factors supported by responsible measures and policies characterized by proven prudence. At the same time, it is intended to increase the degree of awareness, prevention, management of each event along with a transparent allocation of resources, so that future obstacles, regardless of their size and scope, do not cause as important a disruption as that of the financial crisis or the COVID 19 pandemic. There were two events that demonstrated, on the one hand, the weak organization at the government level and the strengthening of the capacities of forces and means, and on the other hand, the subjectivity of the personnel with management positions, with power of decision, to accept the objective point of view of the specialists. With the help of multivariate regression, the most important variations were captured, but also the fact that there is no defined number of indicators that describe reality from all points of view.

In these conditions, studied, both during the listed events and after them, certain aspects can be observed. For example: if the global financial crisis required an update and at the same time a flexibility of decisions lasting 3-4 years in order to be able to observe really positive developments, the COVID 19 pandemic highlighted a certain accumulated "experience", a fact that mattered and contributed to the reduction of the payback period, with visible results even after the first year. Concretely, the most significant economic growth was recorded by the economy of Ireland in 2015 (approx. 24%), and at the opposite pole is the economy of Lithuania with approx. -15% (2009), a not so solid economy, but with real prospects for development.

As a first conclusion, it can be stated that the studied indicators explain the variation of the dependent variable (real G.D.P.). In the sense of what was presented, inflation is distinguished as an impact on the business environment, a sensitive indicator and at the same time, a scourge that can grind any economy, this being analyzed separately in the research: Is: Inflation determined fiscally? (Bazzaoui & Nagayasu, 2021) whose results confirm, once again, that budget deficits, depending on how they are managed, can cause increases or decreases in the inflation rate. In other words, a poorly structured monetary policy, at the level of the country, region, can be assimilated to increased values of the mentioned indicator. The data in this sense highlight a report, which places Romania's economy with a percentage of approx. 45% (2000), and that of Ireland with approx. -4.5% (2009), at opposite poles. At the same time, inflation influences the exchange rate, with an effect on economic growth. And in support of this claim, the study: Exchange rate volatility, inflation and economic growth in developing countries: Panel data approach for SADC (Olamide *et al.*, 2022) investigate in detail this effect and whose results confirm the importance of responsible fiscal-budgetary policies, characterized by increased flexibility.

The data taken into account, as a period, also included the year 2022 (official data), the year of the outbreak of the armed conflict in Eastern Europe, and this has its own implications, at least at the level of expenses and psychological factors, both at the level of the population and at the level of the whole economic system. As is known, unlike the COVID 19 pandemic, the tangible effects of the war are considered to be already felt, but in terms of the level of expenditure and the true implications, they are still far from being fully known. In the sense of the mentioned, there are studies that talk about an increasingly significant fluctuation in the stock market, either as indices, or as tradable commodities, or as a logical correlation between them. At the same time, in the economic environment, a certain recession is brought more and more often at the European and world level. According to some specialists, this, for now, seems to be managed successfully, but in the face of a deepening conflict involving vital economic resources such as oil and gas, alternative sources are being considered that also do not they seem to be inexhaustible. In the conditions of a much more efficient management of resources associated with a recognized prudence, in the decision-making process, it is desired to increase the degree of trust, both on the part of the population and on the part of the investment environment for the continuation of reforms and plans for recovery, growth and development at the level of countries European Union. Analyzing the events from another perspective, it can be stated that the public debt is in a relationship as open as possible with economic growth. Thus, in the following, I submit to the attention, the analysis of the relationship between the two mentioned variables, with the help of the autoregressive model (V.A.R.). The way this report is understood and interpreted depends on the fulfillment of the objectives, the purpose of which is represented by sustainable economic growth and development.

3.2 Autoregressive model (V.A.R.)

Description of data and correlation of indicators used

The data used have a quarterly frequency (GDP_GROWTH and GOVERNMENT_GROSS), for the reference period 2000 - 2022, and their source is Eurostat, O.E.C.D. respectively the World Bank. In order to obtain valid results, data series

were stationary (level, being expressed as a percentage) and seasonally adjusted. Also, I applied the correlation matrix (Table no. 9)

Table no. 9 – The correlation matrix

	GDP_GROWTH	**GUVERNMENT_GROSS**
GDP_GROWTH	1	-0.2683025542191922
GOVERNMENT_GROSS	-0.2683025542191922	1

Source: author's calculations, with Eviews software

Considering the correlation matrix (Table no. 9) we can say that the data are not strongly correlated, so we can base decisions on the findings.

The optimal number of lags is checked.

VAR Lag Order Selection Criteria
Sample: *2000 - 2022*

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-3185.800	NA	23540.23	15.74222	15.76199	15.75005
1	***-2350.400***	***1658.424***	***387.9158***	***11.63654***	***11.69586****	***11.66002****
2	-2344.691	11.27569	384.6578	11.62811	11.72697	11.66724
3	-2336.676	15.75306*	377.1077	11.60828	11.74668	11.66306
4	-2333.293	6.616313	378.2608	11.61132	11.78927	11.68176
5	-2329.338	7.694359	378.3502	11.61155	11.82904	11.69764
6	-2324.481	9.402417	376.7587*	11.60731*	11.86435	11.70906
7	-2323.454	1.978349	382.3395	11.62200	11.91858	11.73939
8	-2319.527	7.524869	382.4887	11.62235	11.95848	11.75540

Source: author's calculations, with Eviews software

According to the table above, it can be seen that the maximum number of lags is "1".

Estimation of indicators based on the autoregressive model V.A.R.

Table no. 10 shows the results of the estimation of the V.A.R. model:

Table no. 10 – Estimation results of the V.A.R. model equation

Vector Autoregression Estimates
Sample (adjusted): 2001 2022

	GDP_GROWTH	***GOVERNMENT_GROSS***
GDP_GROWTH(-1)	0.239336	-0.352440
	(0.04070)	(0.06392)
	[5.88050]	[-5.51346]
GOVERNMENT_GROSS(-1)	-0.009273	0.988723
	(0.00453)	(0.00711)
	[-2.04847]	[139.064]

C	2.369390	2.523846
	(0.35223)	(0.55322)
	[6.72677]	[4.56211]
R-squared	0.078434	**0.973513**
Adj. R-squared	0.075315	*0.973424*
Sum sq. resids	8116.552	20021.96
S.E. equation	3.705886	5.820491
F-statistic	25.14980	10861.12
Log likelihood	-1619.440	-1887.608
Akaike AIC	5.462759	6.365684
Schwarz SC	5.484915	6.387840
Mean dependent	2.392963	61.46786
S.D. dependent	3.853853	35.70372
Determinant resid covariance (dof adj.)		261.2776
Determinant resid covariance		258.6451
Log likelihood		-3335.670
Akaike information criterion		11.25141
Schwarz criterion		11.29572

Source: author's calculations, with Eviews software

The table above shows that statistically, the most appropriate model would be the one with R-squared = 0.973513 (dependent variable: public debt). Regarding the mentioned indicator, an inertia effect can be noted in its evolution (Table no. 10).

At the same time, an effect opposite to economic growth can also be observed. Following the estimation of the equation V.A.R. with a significance threshold greater than 0.7 (R squared: 0.973513), the following formula is obtained:

GOVERNMENT_GROSS *(public debt)* = - 0.352439977357*GDP_GROWTH(-1) + 0.988723149565*GOVERNMENT_GROSS(-1) + 2.52384630199

Practically, this equation supports the idea that public debt is directly influenced by economic growth. Therefore, the efforts to support the environment of business, can only have a favorable effect on economic development, with a direct impact on the public debt.

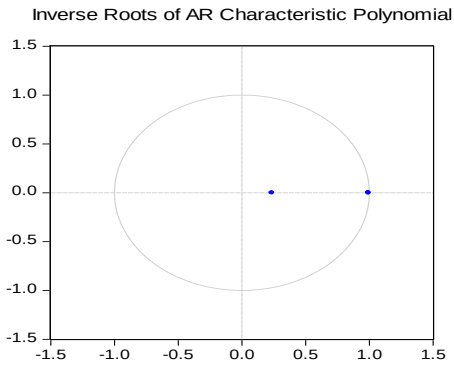


Figure no. 3 – The roots of the polynomial
Source: author`s calculations, with Eviews software

According to Figure no. 3, the roots of the polynomial are subunit, so the model can be considered as a valid one. The next stage, of the model used, involves the analysis of the "variance decomposition" that is reflected in Figure no.4.

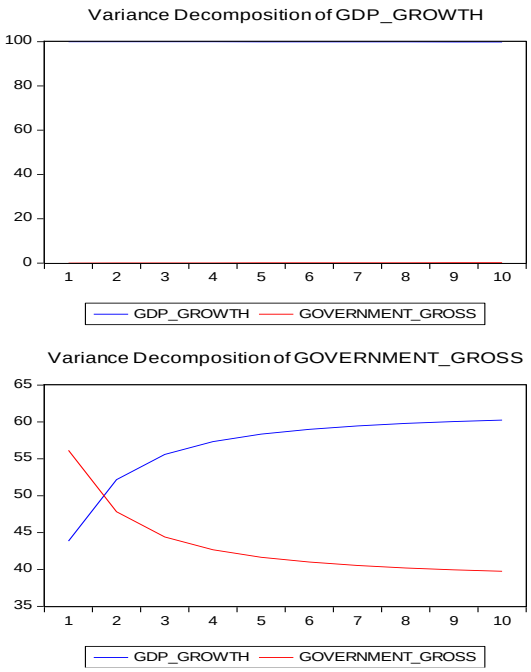


Figure nr. 4 – Variance decomposition
Source: author`s calculations, with Eviews software

This confirms the existence of an inverse relationship, the percentage being 100% (one taking the place of the other in weight/proportion). According to Figure no. 4, the dynamics

of the public debt is explained, proportional to approx. 54 - 55% of its own variation, and starting with the second lag, the effect being a decreasing one of up to approx. 40%.

In explaining the other variable "public debt", the effect of "economic growth" is more visible, also with the second lag, reaching values of up to 60%

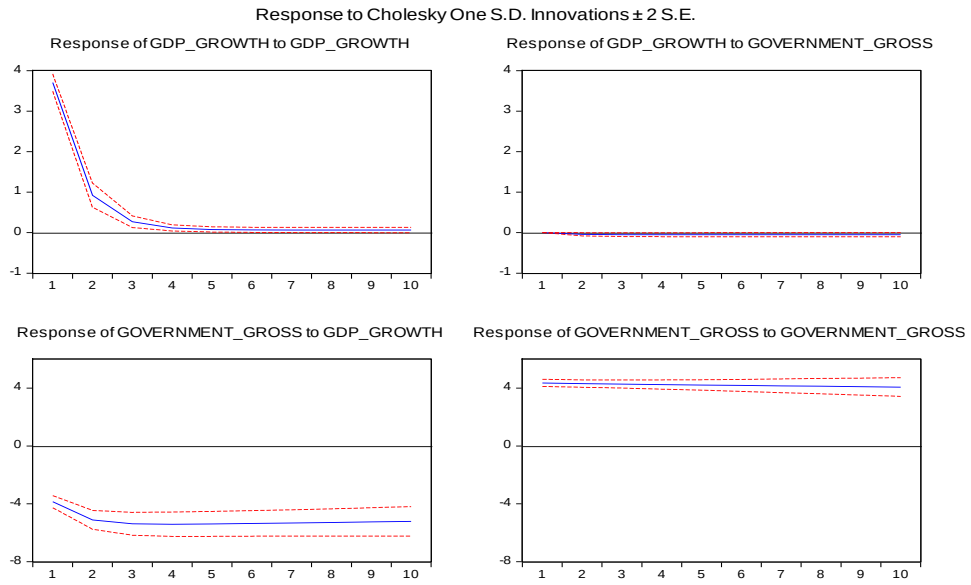


Figure no. 5 – Impulse response functions
Source: author`s calculations, with Eviews software

Analyzing in detail Figure no. 5, which analyzes the impulse response functions, we can see that the significant variations are more relevant in the last 2 (two) representations.

Therefore, an inversely proportional relationship can be observed between the two mentioned variables (public debt, respectively economic growth), which can be explained by the fact that a sustainable economic growth can cause a stagnation and even a reduction of the already accumulated public debt. On another note, the last Figure (bottom right) reinforces the economic reality, according to which the increase in public debt determines a more constant trend for the next forecast period.

Testing for GRANGER causality relationships (the same data series of GDP GROWTH and PUBLIC DEBT)

The hypotheses proposed in this test are:

H0: G.D.P._GROWTH does not influence PUBLIC_DEBT

H1: G.D.P._GROWTH influences PUBLIC_DEBT

The significance thresholds "talk" with and about the validity of the test used. Therefore, considering a significance threshold of 5%, one can support the idea that public debt influences this GDP and because the probability associated with the Granger test does not exceed the confidence interval (Table no. 11).

Table no. 11 – GRANGER test results

VAR Granger Causality/Block Exogeneity Wald Tests
Sample: 2000 - 2022
Dependent variable: *GDP_GROWTH*

Excluded	Chi-sq	df	Prob.
GOVERNMENT_GROSS	4.196223	1	0.0405
All	4.196223	1	0.0405

Dependent variable: *GOVERNMENT_GROSS*

Excluded	Chi-sq	df	Prob.
GDP_GROWTH	30.39823	1	0.0000
All	30.39823	1	0.0000

Source: author`s calculations, with Eviews software

Analyzing the second probability, associated with the test, (prob < 0.01) it can be concluded that G.D.P. influences PUBLIC_DEBT, as the associated probability does not exceed 1%. Interpreting these results, it can be stated that the influence of economic growth on public debt is more pronounced, at a lower threshold of significance (1% < 5%). Practically, the impact of the envisaged reforms can also be interpreted through a stronger ability to repay an important part of the contracted loans.

Interpretation of model results

The analysis of the correlation between the two analyzed variables represents a first landmark that has special implications on economic development. At the same time, analyzing the impact of public debt represents an important step in terms of harmonizing and homogenizing long-term development plans and strategies. Of course, as can be seen from the specialized literature, which presents V.A.R. as an evaluation method. public debt influences economic growth. On the other hand, it is found that each factor has its own influence and there is no certain social, economic or political event that does not affect its evolution. In this sense, I believe that there is a need for even greater responsibility that must be assumed and not "passed" from one to another, because every decision has its own repercussions, at least in the short term. An approach to public debt, from a different angle, but which confirms the results, is presented in the study: Debt overhang, gazelles' growth, and fiscal policy: A note from the quantile regression approach (Anton *et al.*, 2021). It examines the relationship between leverage and business growth, companies and the impact of fiscal policy. The period includes the interval 2006 - 2014, and the results show that the level of public debt has a negative impact on vital resources (Example: energy, otherwise a current problem). Also, on production and its transport, much more obvious at the level of not so developed countries, with low incomes. In the same context, it is mentioned that the impact of debts on the growth of companies is positive and pronounced. This analysis

certifies how important fiscal policies are, which must be continuously evaluated, updated, always adapted to society's problems.

In the sense of what has been stated, special attention must be paid to public finances and, at the same time, to monetary policies that truly support the efforts of recovery, growth and development at the level of European countries. At the same time, a much deeper analysis is required in terms of budget expenditures and more, which directly support the business environment. In another way, the cyclical nature of the phenomena determines certain episodes of well-being, embodied in the credits that can be accessed or the non-refundable funds made available. Of major importance is the realization of a budget as balanced as possible with revenues and expenses that will encourage economic growth efforts, this also by encouraging the investment environment, through concrete, viable measures with long-term applicability.

Another conclusion that emerges, regarding the evolution of macroeconomic indicators, which present the state of health of the economy at a given moment, as trends in the following years, is dependent, on the one hand, on the measures and policies implemented and which require a high degree of flexibility. But, on the other hand, this evolution also depends on financial resources that, through innovation, research and development, can bring added value to the economic environment.

3.3 Autoregressive Integrated Moving Average (A.R.M.A.)

In order to achieve a more complete picture, it is necessary to forecast the evolution of the public debt, at the level of European countries. As expected, this analysis requires, in the current geopolitical context, much more attention. This, at the level of the studied countries, presents values that fall within a not negligible range. Specifically, the smallest public debt is held by the Estonian economy (approx. 18.5% of GDP), and the most indebted country is Greece (approx. 172.6% of GDP). In what follows, I propose, based on the ARMA model, to analyze the evolution of public debt, both for countries whose debt exceeds the threshold of 60% of G.D.P. as well as at the level of countries with a debt below the mentioned threshold

This forecasting model (p,d,q) represents a generalization of the moving average autoregressive models, where:

p = the number of lags of the dependent variable AR;

d = the number of differentiations needed to transform the series into a stationary one;

q= the number of lags of the residual term (MA terms).

A. Countries with a level of public debt above 60% of GDP (14 countries)

Description and verification of data stationarity

In developing the ARMA model, annual series of public debt data were used, expressed as a percentage (%) of GDP. for European Union countries. The data were collected from the OECD, respectively the World Bank for the period 2000-2022. Modeling a variable using the Box-Jenkins methodology (ARMA models). To make an ARMA forecast, the Box-Jenkins Methodology is followed, which involves testing the stationarity of the data series.

In this sense, we used the Augmented Dickey-Fuller (ADF) test (Table no. 12), starting from the following assumptions:

a) Null hypothesis: the public debt has a unit root, the series is non-stationary,

b) alternative hypothesis: the series is stationary

Table no. 12 – Augmented Dickey-Fuller test

Null Hypothesis: *HIGH_GOVERNMENT*
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=16)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.715605	**0.0042**
Test critical values:	1% level	-3.450617	
	5% level	-2.870359	
	10% level	-2.571538	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: (HIGH_GOVERNMENT)
Method: Least Squares

Variable	Coefficient	Std. Error	t-Statistic	Prob.
HIGH_GOVERNMENT(-1)	-0.071281	0.019136	-3.725056	0.0002
D(HIGH_GOVERNMENT(-1)	0.172373	0.055260	3.119341	0.0020
C	-0.022459	0.010033	-2.238607	0.0259

R-squared	0.060009	Mean dependent var	-0.000994
Adjusted R-squared	0.054079	S.D. dependent var	0.150628
S.E. of regression	0.146499	Akaike info criterion	-0.994272
Sum squared resid	6.803396	Schwarz criterion	-0.958944
Log likelihood	162.0835	Hannan-Quinn criter.	-0.980165
F-statistic	10.11867	Durbin-Watson stat	2.036208
Prob(F-statistic)	0.000055		

Source: author`s calculations, with Eviews software

Analyzing the results of the stationarity test, reflected in the table above, it can be seen that the probability associated with it falls within the 5% confidence interval (prob: 0.0042).

In other words, the test presents sufficient arguments to continue the analysis, the series being stationary by logarithmization (natural logarithm - Figure no. 6).

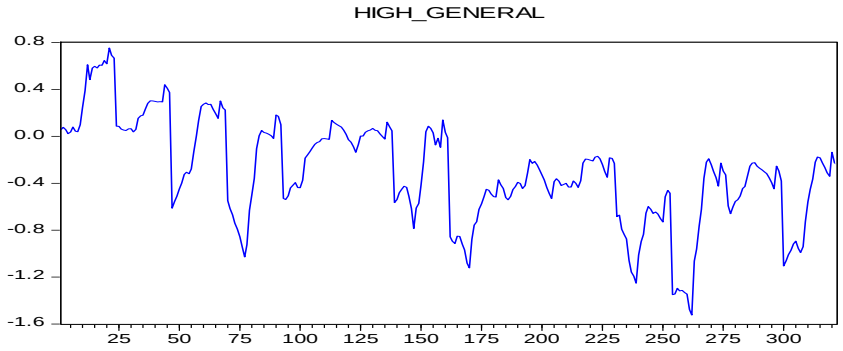
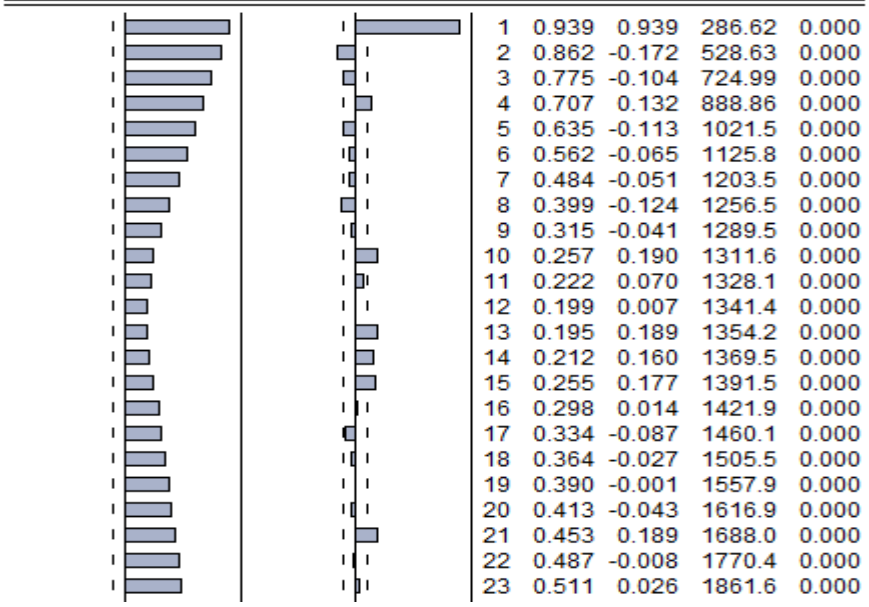


Figure no. 6 – Stationary series - public debt
Source: author`s calculations, with Eviews software

Identifying the type of ARMA model, using a correlogram, by determining the optimal values for p and q for the AR(p) and MA(q) models, based on the characteristics of the autocorrelation function (FAC) as well as the partial autocorrelation function (FACP).

Sample: 1 322
Included observations: 322



Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.939	0.939	286.62	0.000
		2	0.862	-0.172	528.63	0.000
		3	0.775	-0.104	724.99	0.000
		4	0.707	0.132	888.86	0.000
		5	0.635	-0.113	1021.5	0.000
		6	0.562	-0.065	1125.8	0.000
		7	0.484	-0.051	1203.5	0.000
		8	0.399	-0.124	1256.5	0.000
		9	0.315	-0.041	1289.5	0.000
		10	0.257	0.190	1311.6	0.000
		11	0.222	0.070	1328.1	0.000
		12	0.199	0.007	1341.4	0.000
		13	0.195	0.189	1354.2	0.000
		14	0.212	0.160	1369.5	0.000
		15	0.255	0.177	1391.5	0.000
		16	0.298	0.014	1421.9	0.000
		17	0.334	-0.087	1460.1	0.000
		18	0.364	-0.027	1505.5	0.000
		19	0.390	-0.001	1557.9	0.000
		20	0.413	-0.043	1616.9	0.000
		21	0.453	0.189	1688.0	0.000
		22	0.487	-0.008	1770.4	0.000
		23	0.511	0.026	1861.6	0.000

Figure no. 7 – Correlogram of the data series
Source: author`s calculations, with Eviews software

AR variables appear as lags of the dependent variable, and MA variables are defined as MA(x), where x represents the order (Codirlaşu and Chidesciuc, 2008). With the help of the

autocorrelation coefficients, identified based on the autocorrelation function (FAC) and the partial correlation coefficients, identified on the basis of the partial autocorrelation function (FACP), the type of autoregressive model is determined in order to analyze the time series.

So, as we can see in the figure above, the most suitable ARMA model is (1,1,1)

Estimation of the public debt dynamics

Estimation of the identified model, using various methods such as: method of moments, maximum likelihood, O.L.S. (Table no. 13).

Table no. 13 – Representation of the ARMA model (1,1,1)

Dependent Variable: **HIGH_GOVERNMENT**
Method: Least Squares

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.317942	0.124038	-2.563262	0.0108
AR(1)	0.923816	0.022745	40.61624	0.0000
MA(1)	0.143185	0.059222	2.417743	0.0162

R-squared	**0.887602**	Mean dependent var	-0.303929
Adjusted R-squared	**0.886720**	S.D. dependent var	0.436922
S.E. of regression	0.147132	Akaike info criterion	-0.985559
Sum squared resid	6.797388	Schwarz criterion	-0.949986
Log likelihood	159.2111	Hannan-Quinn criter.	-0.971349
F-statistic	1236.325	*Durbin-Watson stat*	**1.965054**
Prob(F-statistic)	0.000000		

Inverted AR Roots	.92
Inverted MA Roots	-.14

Source: author`s calculations, with Eviews software

The value of the Durbin Watson statistic, respectively *1.965054*, is close to 2 and we can conclude that there is sufficient evidence to attest to the lack of serial correlation between residuals, a fundamental feature in explaining the characteristics of a model.

Another test that reinforces this statement is the Serial Correlation LM Test, with which we check the residuals (Table no. 14).

Table no. 14 – Residue check

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	9.026372	Prob. F(1,313)	0.0029
Obs*R-squared	8.885478	Prob. Chi-Square(1)	0.0029

Source: author`s calculations, with Eviews software

Testing the characteristics of estimated autoregressive models

In order to ensure the validity of the model that will be used in the forecast, we analyzed its structure, according to the Box-Jenkins methodology (Figure no. 8).

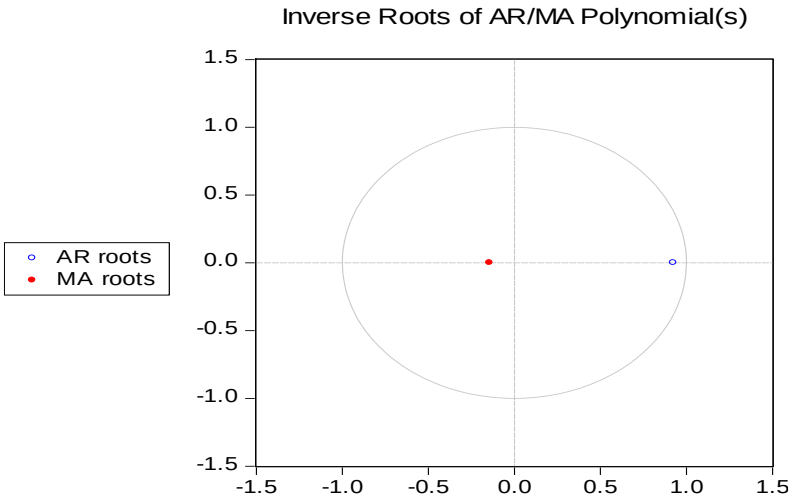


Figure no. 8 – Evaluation of the model
Source: author`s calculations, with Eviews software

Thus, Figure no. 8 certifies that the model is *stable* and *suitable* for forecasting.

Making forecasts, based on the selected model

In this sense, we tried to capture the evolution of the public debt over a period of four years (Figure no. 9)

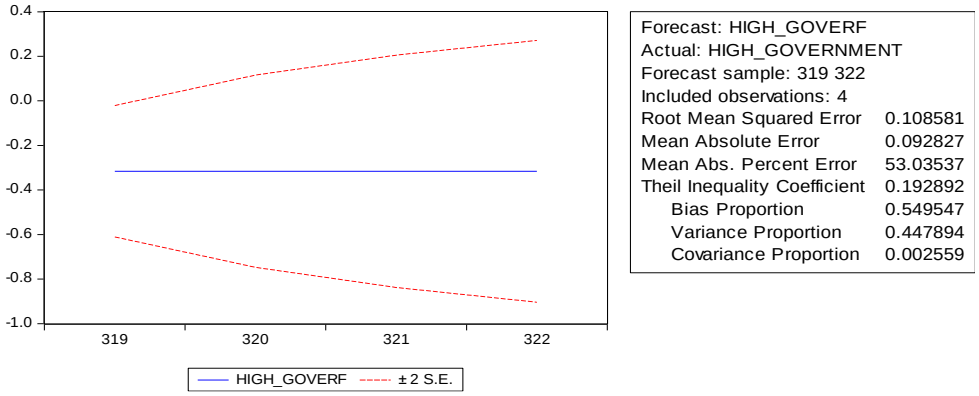


Figure no. 9 – The public debt dynamics
Source: author`s calculations, with Eviews software

The figure above shows the forecast range for public debt at a significance threshold of 5%. The forecast was made based on the ARMA (1,1,1) model.

As can be seen the blue line represents the forecast for the next period. This indicates a linear trend - continuous and without major oscillations, as a whole.

B. Countries with a level of public debt below 60% of G.D.P. (13 countries)

Description and verification of data stationarity

In developing the ARMA model, annual data series of the public debt, expressed as a percentage (%) of GDP, were used. for European Union countries. The data were collected from the OECD, respectively the World Bank for the period 2000-2022. One variable modeling using the Box-Jenkins methodology (ARMA models). In order to make an ARMA forecast, the Box-Jenkins Methodology is followed, which involves the following steps:

Testing the stationarity of the time series and its stationarity in case it turns out to be non-stationary. In this sense, we used the Augmented Dickey-Fuller (ADF) test (Table no. 15), starting from the following assumptions:

a) Null hypothesis: the public debt has a unit root, the series is non-stationary,

b) alternative hypothesis: the series is stationary.

Table no. 15 – Augmented Dickey-Fuller test

Null Hypothesis: *LOW_GOVERNMENT*
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=15)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.256548	**0.0179**
Test critical values:	1% level	-3.452141	
	5% level	-2.871029	
	10% level	-2.571897	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: (LOW_GOVERNMENT)
Method: Least Squares

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOW_GOVERNMENT(-1)	-0.069705	0.021405	-3.256548	0.0013
C	-0.074339	0.027844	-2.669879	0.0080

R-squared	0.034589	Mean dependent var	0.003097
Adjusted R-squared	0.031327	S.D. dependent var	0.254076
S.E. of regression	0.250065	Akaike info criterion	0.072498
Sum squared resid	18.50963	Schwarz criterion	0.097310

Log likelihood	-8.802135	Hannan-Quinn criter.	0.082430
F-statistic	10.60510	Durbin-Watson stat	1.745536
Prob(F-statistic)	0.001259		

Source: author`s calculations, with Eviews software

Analyzing the results of the stationarity test, reflected in the table above, it can be seen that the probability associated with it falls within the 5%. (prob: 0.0179).

In other words, the test presents sufficient arguments to continue the analysis, the series being stationary by logarithm (natural logarithm - Figure no. 10).

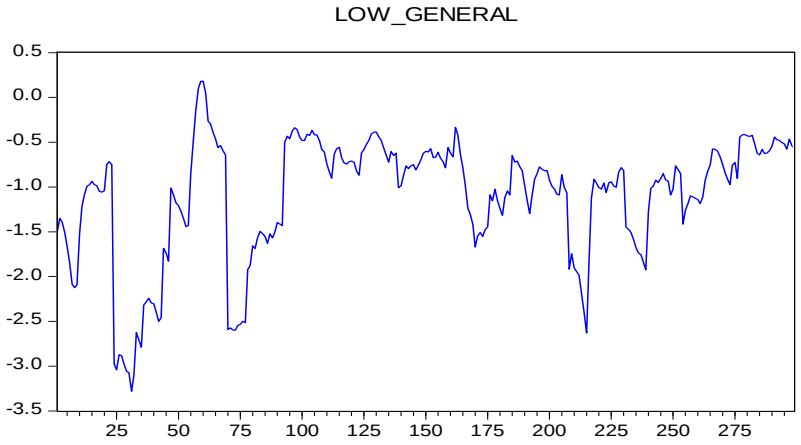


Figure no. 10 – Stationary series - public debt
Source: author`s calculations, with Eviews software

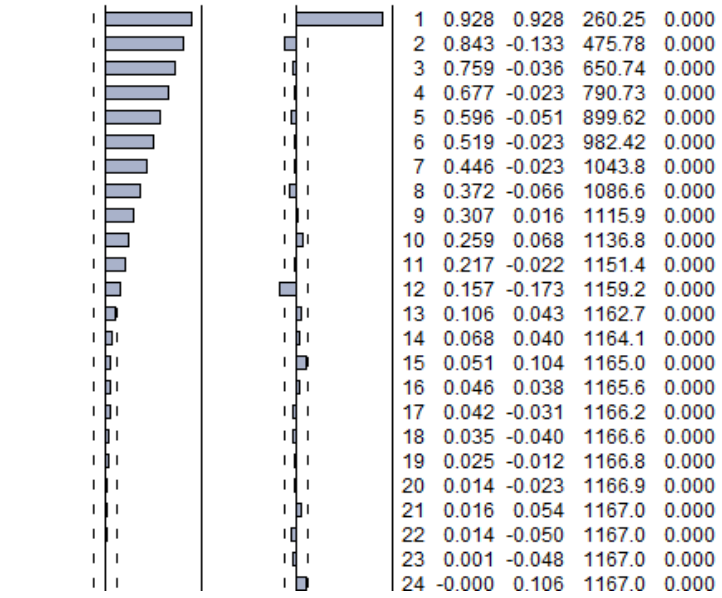
Identifying the type of ARMA model, using a correlogram, by determining the optimal values for p and q for the AR(p) and MA(q) models, based on the characteristics of the autocorrelation function (FAC) as well as the partial autocorrelation function (FACP).

AR variables appear as lags of the dependent variable, and MA variables are defined as MA(x), where x represents the order (Codirlașu and Chidesciuc, 2008.

With the help of the autocorrelation coefficients, identified based on the autocorrelation function (FAC) and the partial correlation coefficients, identified on the basis of the partial autocorrelation function (FACP), the type of autoregressive model is determined in order to analyze the time series.

So, as we can see in the Figure no. 11, the most suitable ARMA model is (1,1,1)

Sample: 1 299
Included observations: 299



Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.928	0.928	260.25	0.000
		2	0.843	-0.133	475.78	0.000
		3	0.759	-0.036	650.74	0.000
		4	0.677	-0.023	790.73	0.000
		5	0.596	-0.051	899.62	0.000
		6	0.519	-0.023	982.42	0.000
		7	0.446	-0.023	1043.8	0.000
		8	0.372	-0.066	1086.6	0.000
		9	0.307	0.016	1115.9	0.000
		10	0.259	0.068	1136.8	0.000
		11	0.217	-0.022	1151.4	0.000
		12	0.157	-0.173	1159.2	0.000
		13	0.106	0.043	1162.7	0.000
		14	0.068	0.040	1164.1	0.000
		15	0.051	0.104	1165.0	0.000
		16	0.046	0.038	1165.6	0.000
		17	0.042	-0.031	1166.2	0.000
		18	0.035	-0.040	1166.6	0.000
		19	0.025	-0.012	1166.8	0.000
		20	0.014	-0.023	1166.9	0.000
		21	0.016	0.054	1167.0	0.000
		22	0.014	-0.050	1167.0	0.000
		23	0.001	-0.048	1167.0	0.000
		24	-0.000	0.106	1167.0	0.000

Figure no. 11 – Correlogram of the data series
Source: author`s calculations, with Eviews software

Estimation of the public debt dynamics

Estimation of the identified model, using various methods such as: method of moments, maximum likelihood, OLS (Table no. 16).

Table no. 16 – Representation of the ARMA model (1,1,1)

Dependent Variable: **LOW_GOVERNMENT**
Method: Least Squares

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.080808	0.187657	-5.759495	0.0000
AR(1)	0.911599	0.025975	35.09567	0.0000
MA(1)	0.136938	0.062323	2.197232	0.0288

R-squared	**0.875657**	Mean dependent var	-1.115580
Adjusted R-squared	**0.868843**	S.D. dependent var	0.679549
S.E. of regression	0.249836	Akaike info criterion	0.074127
Sum squared resid	18.16363	Schwarz criterion	0.111714
Log likelihood	-7.896641	Hannan-Quinn criter.	0.089179
F-statistic	938.3509	*Durbin-Watson stat*	**1.989120**

Prob(F-statistic)	0.000000
Inverted AR Roots	.91
Inverted MA Roots	-.14

Source: author`s calculations, with Eviews software

The value of the Durbin Watson statistic, respectively 1.989120, is close to 2 and we can conclude that there is sufficient evidence to attest to the lack of serial correlation between residuals, a fundamental feature in explaining the characteristics of a model.

Another test that reinforces this statement is the Serial Correlation LM Test, with which we check the residuals (Table no. 17).

Table no. 17 – Residue check

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	9.026372	Prob. F(1,313)	0.0029
Obs*R-squared	8.885478	Prob. Chi-Square(1)	0.0029

Source: author`s calculations, with Eviews software

Testing the characteristics of estimated autoregressive models

In order to ensure the validity of the model that will be used in the forecast, we analyzed its structure, according to the Box-Jenkins methodology (Figure no. 12).

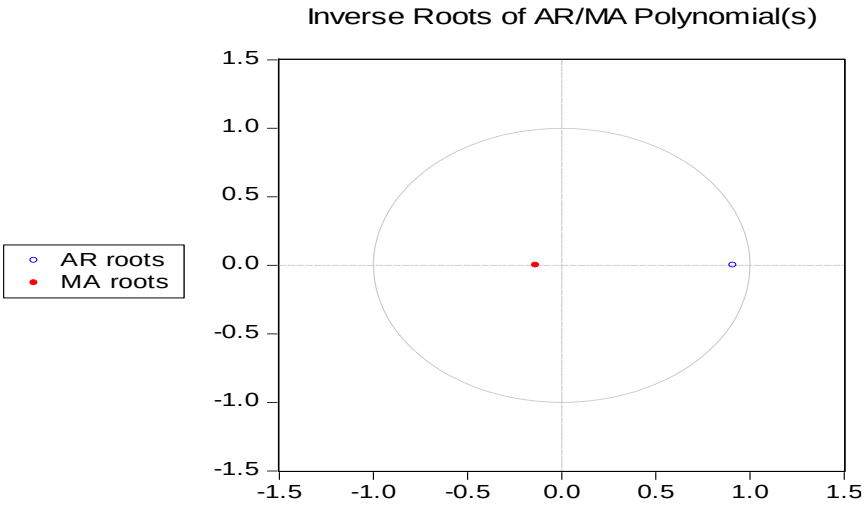


Figure no. 12 – Description of the model

Source: author`s calculations, with Eviews software

Thus, Figure no. 12 certifies that the model is *stable* and *suitable* for forecasting.

Making forecasts, based on the selected model. In this sense, we tried to capture the evolution of the public debt over a period of four years (Figure no. 13).

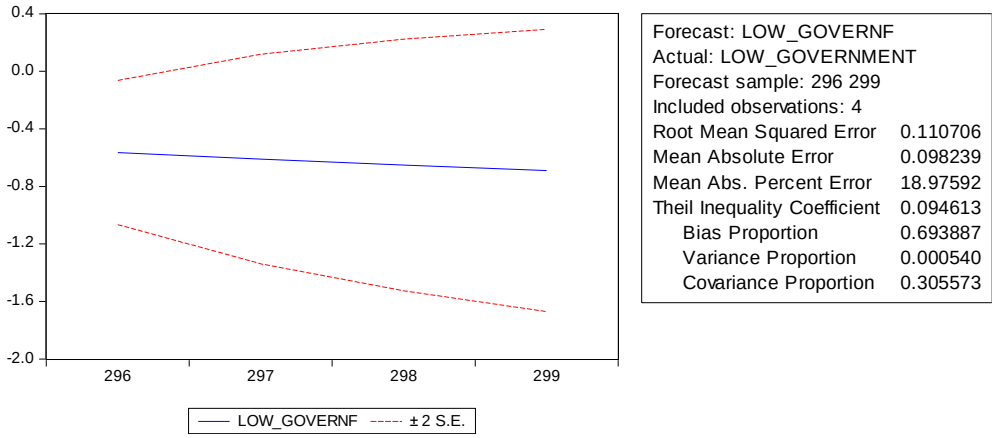


Figure no. 13 – The public debt forecasting
Source: author`s calculations, with Eviews software

The figure above shows the forecast range for public debt at a significance threshold of 5%. The forecast was made based on the ARMA (1,1,1) model. As can be seen the blue line represents the forecast for the next period. This indicates a slightly downward trend, without major oscillations during the forecasted period.

4. RESULTS AND DISCUSSION

Public debt, from analysis to management, as a macroeconomic indicator with a pronounced impact on economic development, includes a set of studies, principles and measures that, by nature and objective approach, create the premises for sustainable development at the level of the countries studied. Considering the results obtained, following the estimation of the two categories of data, two large "classes" can be distinguished. On the one hand, countries whose economy complies with the provisions of the Maastricht Treaty regarding the threshold of 60% of G.D.P. and countries whose economic state does not fall within the respective mentioned provisions. This detail is analyzed from the perspective of the fact that the measures thought at a strategic and then decision-making level do not "fit" into a clear understanding at the level of the business environment and even the population, either because of the existing geopolitical context or because of perception, interpretation of the events that follow, at an alert pace. Moreover, reference is made to that link, which would provide, on the one hand, confidence and stability to the economic environment and implicitly to investors (investments are absolutely necessary for sustainable development), and on the other hand, to ensure the income of the population, at a level decent and increasing confidence in the existing development potential, dependent on the optimal allocation of financial, human and material resources.

At the same time, the same data confirm, as a forecast, the fact that for the next period the public debt seems to follow a linear and even decreasing trend, more pronounced at the

level of those states whose debt does not exceed the threshold ratified in the Treaty signed in February 1992. Practically, the same confusion comes to the fore: *What effect, impact does public debt have or can have*? Certainly, sustained efforts are being made regarding the optimal management of resources in relation to their own economic potential and the unpredictability of the phenomena. The governments' concerns are encouraging, but analyzing in detail the results obtained, it seems that it was not possible to stop the public debt, as a pronounced effect on economic development, but rather to mitigate its impact on the business environment. It is a noteworthy aspect and the continuation of reforms and public policies whose goal is the self-sustainability of one's own economy is encouraged. At the same time, we must not forget the external support, received with great openness by the governments of the member states. But even this, in order to be accessed, requires certain recommendations, obligations to be respected, which for some countries seems like a difficult obstacle to reach. Even in these uncertain conditions of the market economy there is availability, flexibility that must be respected and exploited, so that the economy can "breathe" and contribute, as a basic pillar, to a sustainable economic development.

The results of the analysis can be analyzed from 3 perspectives ("angles"). First, based on the regression, an interdependence with immediate impact is observed between the macroeconomic indicators, which show the health of the economy at a given moment, and the current development prospects. In other words, it is confirmed that each event has its own influence on the well-being of the economy, depending on how it is prevented, perceived, interpreted and managed. Second, the same results certify an open, carefully monitored relationship between public debt and economic growth. The analysis of the interdependence of the two analyzed variables (the autoregressive V.A.R. model) constitutes a benchmark that evaluates the importance of monetary policy decisions able to support the economic growth of European countries. Last but not least, considering the ARMA model, the public debt dynamics for the next period were evaluated. The latter is analyzed from two other perspectives, the first targeting countries whose debt is below the threshold of 60% of GDP, and the other at the level of countries with a debt "starting" from the mentioned threshold. They are analyzed in stages, specific to each economy at the level of the European community, because depending on how each event is interpreted, the central bank's resources and policies can be characterized by a different degree of flexibility

Just as economic growth is rightly considered the central pillar of sustainable economic development, it in turn depends on investments in large-scale projects with real economic impact. This is the positive part, which in the last decades, (economic development) has experienced different stages. However, the negative impact should not be neglected, which, in addition to the fluctuation of macroeconomic indicators fueled by socio-economic imbalances, was fueled by the need for funds, increased financial resources, associated with ever-increasing expenses. Their impact, of spending on the level of public debt, is also confirmed by the authors Butkus *et al.* (2021). On the other hand, the correlation between public debt and economic growth is also evaluated by the authors Yamin *et al.* (2023) who claim that the two mentioned variables are dependent "on each other" and each measure, in the current geopolitical configuration, must be "weighed", with a and greater responsibility. The latter must be supported by two other components, flexibility and prudence, so that the events that have substantially affected economic growth (the financial crisis, the COVID 19 pandemic) do not repeat themselves, at least at the same level.

The results of the analysis capture another aspect, as "a complement and at the same time confirmation" of the research: The economy and the pandemic. What's next? (Daianu, 2021). In other words, the business environment "responded faster" after the shock of the pandemic than after the financial crisis (most analysts were skeptical, with forecasts between 3-4% of GDP). Practically, after the first year of the COVID 19 pandemic (2021), an economic growth of approx. 5.5% of G.D.P. (as an average of the European Union). However, what followed, starting from February 2022 (whose data was included in the study), negatively affected economic growth and development, forcing policymakers to re-scale and re-examine economic development strategies for the coming period. Moreover, as reported and in support of the efforts initiated by member countries (whether we consider all 27 states or only those in the euro area - 20 countries, starting from 2023), they must make sustained efforts of awareness, prevention, preparation and management of future events, which do not affect long-term economic stability. So, these approaches initiated by the governments of the countries through the fiscal policies, supported by the financial institutions, must determine, with tangible results, towards a homogenization, standardization of growth and sustainable development strategies. In this sense, banking consortia, together with firm policies and practices from the government, can support such measures, with attractive "offers" to induce investors to allocate significant sums in those strategic sectors of the economy. This detail can be observed, more visibly, at the level of not so developed countries, and in support of this statement the authors Shaukat *et al.* (2019) confirm the importance such an approach. As another conclusion, the economy depends on the word "depends". In other words, the unpredictability of events that have characterized the last decades and caused countless "damages" requires an approach "charged" with prudence (which is recommended, even from the central level), responsibility and not least the awareness that every decision has its own effect.

5. CONCLUSIONS

The economic and geopolitical context of the European level can be characterized as dynamic but also unpredictable. This leads to certain interpretations (sometimes sensitive from the business environment) in terms of the results in relation to the proposed objectives.

As the economic reality also confirms, they are analyzed from several perspectives, and the conclusions prove that "it is not enough to want, but also to be able". In support of these statements, the plans initiated at the European Union level come and support the efforts of governments for economic recovery, growth and development. On the other hand, the acceptance of political influence in the economy must be analyzed in a much more responsible context, more reasoned in relation to the plans and decisions undertaken.

In the same context, the idea is accepted that there must be a direct, much closer connection between financial resources, investments and human capital, from the point of view of the reforms and strategies implemented. At the same time, the competition and uncertainty of investments, from the point of view of their depreciation, could be transformed into an asset with beneficial implications for healthy economic growth as a central pillar of sustainable development. Moreover, it is observed that this existing link - both between macroeconomic indicators that express the state of health and balance of the economy (at a given moment), as well as between economic growth and public data - has determined, in recent years, a reduction in its level, not only at the level of the analyzed countries, but also as an "average" of the European community. For the following years, according to the forecast (2024-2025), this is "slightly" over 83% of G.D.P. (83.1%, 2022).

In the same context, it must be accepted that the public debt cannot increase indefinitely, and its evolution depends on the way public finances are managed, and the need for financial resources must be interpreted only in a constructive sense. A reduction or at least a stagnation of the dynamics of its evolution is also due to the fact that most governments have understood, have accumulated "experience" (from the economic, social, but also political-military events that have characterized the last decades). This detail is more visible at the level of countries whose threshold does not exceed the limit specified in the Maastricht Treaty (60% of G.D.P.) And not because these countries do not need additional funds to develop, but because the management of reserves, resources available provide enough opportunities for development, but at an acceptable level. It is one of the arguments supporting these results, but on the other hand, the other countries whose debt exceeds the mentioned threshold, have accumulated this debt in the sense of reaping the fruits of the market. In the end, no government became insolvent in the long run.

From another perspective, analyzing the economy, the mentioned report explains, as another solid argument, the difference between the truly developed countries (example: the countries that are part of the G7 group and have a debt above the mentioned level, except for Greece) and the countries on who want to align themselves with the standards imposed by the most developed states. In all this amalgam of improbable situations, also characterized by a divergence of opinions, a reanalysis of ideas is required, a delimitation of requirements and at the same time of responsibilities, reflected in a harmonious development. This is the final objective, but its achievement requires the optimal allocation of financial and material resources to those strategic branches of the economy, such as: research, development, innovation, etc. Along with these, the development of relations is required, the result of which must be concretized in bilateral (multilateral) treaties and agreements concluded, aimed at increasing security in the area, providing resources, essential products and last but not least, increasing the degree of trust.

6. LIMITATIONS AND FUTURE RESEARCH

The conclusions that emerge, following the analysis carried out, attest that the mentioned events were characterized by a high degree of unpredictability, uncertainty and present some limitations. First, it targets the states of the European Union, which, even if there are 27 of them, cannot cover the entire range of countries that can be analyzed, with the implications, mechanisms and strategies that are implemented as a result of the events and conflicts analyzed.

Secondly, the analysis focuses on the period 2000-2022, and including a longer period could provide more concrete results. In this context, a much more detailed analysis in terms of the number of countries, factors and indicators that can be considered, would lead to more solid results that can be exploited, both by the economic and the academic environment.

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