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FISCAL RISK ANALYSIS TOOLS AT THE LEVEL OF THE EUROPEAN UNION

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Abstract

The fiscal balance is an indicator of the health of public finances and a result of the fiscal policy that differs from one state to another, even in similar macroeconomic conditions. Especially after the Covid-19 crisis which showed that governments need a more permissive fiscal space for adjustments and a good knowledge of the fiscal vulnerabilities to which they are exposed, budget deficit or surplus can be used as a tool to measure fiscal risk or fiscal security, respectively. Based on data from Eurostat and World Bank databases, our analysis concerns the current 27 European Union member states between 2000 and 2021.

Our study demonstrates that general government debt, foreign direct investments, military and unemployment expenditures negatively impact the budget balance, while economic growth and pension expenditures are revealed as positive determinants of the budget balance. Considering the calculated coefficients, economic growth stands out as the most important source of competing fiscal risks and improving budget balance, proved by all the statistical methodologies employed in the study.

Keywords: budget balance, fiscal risk, EU, fiscal policy.

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1. Introduction

Fiscal balance (or 'budget balance') is the equality of government revenues and expenditures in a year. The budget balance is a reference economic indicator that reflects the ability of governments to correlate expenditures with public revenues. The study of the determinants of the budget balance started in the 1970s, because similar states, subject to the same types of economic shocks, differentiate themselves by obtaining different fiscal outcomes. The economic model of Barro (1979) or Lucas and Stokey (1983), which showed that keeping the level of taxation constant over time helps to avoid shocks in the level of public revenues and expenditures, by compensating deficits with surpluses, were not sufficient to explain this variation in budget balances between countries. The value of the budget balance, correlated with the level of government debt are indicators that illustrate fiscal sustainability and whose size also influences the fiscal space available to governments (Zahariev *et al*., 2021).

Fiscal risks consist of 'a source of fiscal stress that a government could face in the future' (Polackova Brixi and Schick, 2002) or are explained as 'events or circumstances that could cause short- to medium-term variability in the overall level of revenues, spending, the fiscal balance, and the value of assets and liabilities' (Petrie, 2013). For a better understanding of the factors that can lead to fiscal risk, it is useful to analyze the variables that have the ability to influence fiscal balance. Panizza (2020) considers that fiscal risk can be measured by the variation of the budget balance, or of the level of public debt in gross domestic product ('GDP') and empirically demonstrates that unrealistic ('optimistic') forecasts regarding these variables lead to a greater exposure to fiscal risk.

The study of fiscal risks has grown in importance in recent years, especially in the context of the Covid-19 pandemic, which led to an overall difficult macroeconomic situation. Economic agents were forced to rethink and restructure their way of fulfilling their objectives (Terziev, 2019). For governments, the Covid-19 crisis produced a sudden need to finance increasing expenses, in conditions of a considerable decrease in public revenues. Analyzing and managing fiscal risks is also a condition of fiscal transparency and has the ability to 'decrease the deviations from budgetary forecasts in developing countries' (ElBerry and Goeminne, 2021), or to foster 'government accountability and credibility' (Siksamat and Wanitthanankun, 2015).

The present study aims to verify whether economic growth, inflation, government debt, foreign direct investments, governance, unemployment expenses, as well as pensions and military ones influence the budget balance of the current 27 European Union member states. Data frequency is annual, corresponding to the 2000–2021 period and is organized as panel data. By the instrumentality of regressive models (POLS, fixed effects, random effects models), of vector autoregressive model (VAR) and of Granger causality, the objective of the analysis is to measure the sign, the value and the statistically significance of the endogenous variables impact on the budget balance.

2. Review of previous literature

Previous studies concerning the impact of different variables on the budget deficit/surplus can be divided into three main categories: (a) studies focused on political factors; (b) studies centered on institutional aspects; and (c) studies focused on the influence of macroeconomic variables. It is obvious that the fiscal results of the governments depend on many variables: taxation decisions, public spending according to the social and political priorities, the business environment, but also on the economic situation. Economic theory alone is ineffective in explaining fiscal results (Alesina and Perotti, 1995), so political and institutional aspects should be also included. Concerning the methodology used, it is not very different from one study to another: researchers usually use the panel database, cross-country time series and the method of least squares (Bayar and Smeets, 2009).

A negative budget balance concretely shows how much of government spending is not covered by revenues collected in that year and what is the need for financing. In order to obtain the amounts necessary to cover the budget deficit, three different methods are used: 'taxation (additional taxation), public debt and monetization' (Akintunde and Arumona, 2020), and Gaber (2010) finds that the most used method is the issue of state bonds.

Within a synthesis of the most recent studies upon the determinants of the fiscal balance it is summarized that 'economic growth, debt, unemployment rates, trade openness, level of development (GDP per capita), level of urbanization, extreme weather events, current account balances, inflation, aid, military spending, as well as political factors, and quality of budgetary institutions' (Mawejje and Odhiambo, 2020) are the most recurring variables which have an empirically proven influence on the budget balance.

A study carried out on 22 OECD countries for the period 1970–2002 by Tujula and Wolswijk (2007) demonstrates that budget balance is explained by the fiscal position at the beginning of the year (public debt already entailed), by macroeconomic factors (through fiscal stabilizers and fiscal policies adopted) and political reasons (increase of the budget deficit in the years in which the electoral elections take place). Beetsma and Bovengerg (1999) also explained that during election years, governments implement expansive fiscal measures in order to reach the sympathy of the voters and to limit the room available to new expenditures of the upcoming government. Maltritz and Wuste (2015) also observed that for the 27 EU countries, the main method of achieving budget balance is to increase public debt, and that fiscal deficit is larger in election years or when the unemployment rate rises. The authors did not identify effects on the budget balance generated by GDP growth, bond yields or political orientation, and their general recommendation is to apply fiscal rules as a way to significantly reduce fiscal deficits.

However, the existence of fiscal laws (rules) seems insufficient in the long run to guarantee compliant budget balances, because political decision-makers tend to violate them in order to achieve their political objectives (Wyplosz, 2012). On the contrary, Maltritz and Wuste (2015), demonstrate empirically that there is a positive and significant link between fiscal rules and the budget balance. Moreover, they confirm that the enforcement of

(domestic) fiscal laws and the presence of independent fiscal councils are complementary (and not substitutable) elements in avoiding excessive deficits.

Following a synthesis of works on the impact of macroeconomic variables on the budget deficit, Saleh and Harvie (2005) conclude that both the source of financing and the components of public spending can have different effects on the budget balance. They advise governments to distinguish between consumption and investment spending and to be cautious when cutting public spending, so as not to forego spending that in the long run actually increases welfare. Regarding the relationship between the budget deficit and inflation, Saleh and Harvie (2005) show that, as a rule, financing the deficit through monetization and increasing money supply leads to an increase in inflation.

Combes and Saadi-Sedik (2006) used the method of generalized moments to estimate the impact of trade openness on budget balance, using panel data of 66 developed countries, from 1974 to 1998. The estimation results show that trade openness increases the vulnerability of an economy because shocks and instability in terms of trade also affect the budget balance. Moreover, when GDP per capita and the level of urbanization increase, the budget surplus also increases.

Lis and Nickel (2010) conducted an analysis of 138 countries grouped differently: developing economies, OECD countries, European Union member states; the period is from 1985 to 2007, with the main objective of identifying whether extreme weather phenomena affect the budget balance. Their results indicated that the effect differs from each group of countries to another, depending also on macroeconomic aspects and fiscal policy. States whose budget balance is affected by the consequences of extreme weather events are generally those whose economies are developing, with weak democracies and weak public institutions. OECD countries or EU member states do not have extreme weather phenomena among the determinants of the budget deficit. Also, the share of public debt in GDP, real GDP growth and inflation are statistically significant and evolve in the same direction as the budget balance.

Blais, Kim and Foucault (2010) show that when a government is formed by only one political party, the budget is easier to be balanced: those governments have more flexibility, especially in reducing government spending. On the contrary, in the case of governing coalitions, the tendency is to accentuate the budget deficit: the modification of budget expenditures is more difficult to achieve, since each member of the coalition has the right of veto. The results confirm the conclusions of Roubini and Sachs (1989) who identified that after 1973 the fiscal budgets barely increased, due to the 'difficulties of political management of governing coalitions'. Roubini also concluded two years later, in 1991, that budget deficits are favored by political instability and that the 'fiscal balance failure' of many countries is due in part to political factors. A similar conclusion is reached by Lane (2003), mentioning that in countries where political power is shared between several political parties, the implemented fiscal policies are usually pro-cyclical and favor the increasing budget deficits.

Studies focused on the influence of political factors on the budget deficit have also verified whether there is a correlation between the size of the government (number

of ministries) and the budget balance; Volkerink and De Haan (2001) and Perotti and Kontopoulos (2002) agree that as the cabinet has more members, the fiscal deficit increases. Another factor analyzed in relation to the budget balance, also from the political sphere, is political ideology, where the empirical results do not converge and do not confirm the expectation that right-wing political parties apply a stricter fiscal policy, and left-wing political parties a more relaxed fiscal policy. So, Alesina, Roubini and Cohen (1997) show that the dynamic between political and economic is much more complex and cannot be reduced to political ideology. Other elements such as the timing of elections, competition between political parties, electoral laws or even the opportunity to adopt economic measures to gain voter sympathy can influence the results of fiscal policy, and never political ideology per se. These ideas are in line with those of the authors Franzese Jr. (2002) and De Haan and Mink (2005), who prove that budget deficits are not associated with a certain political ideology, but 'opportunistic governments', i.e. without entrenched ideological characteristics, are more likely to increase the fiscal deficit because they aim to gain popularity for the next elections through the implemented measures.

Bayar and Smeets (2009) investigated the political, economic and institutional determinants of the budget deficit for 15 EU member countries between 1971 and 2006. The clear presence of large budget deficits in election years denotes an 'opportunistic behavior of governments', an aspect confirmed primarily by the reduction of the deficit in the first year following the elections. Political ideology turns out to have an insignificant effect over time, with the tendency for left-wing governments to be associated with a smaller budget deficit in the later years of the analysis; as well as political stability (a rather weak effect, however, and statistically insignificant). The most important conclusion of the study, however, is the fact that 'the ratification of the Maastricht Treaty led to the considerable reduction of deficits (...), a stronger effect than the effects of other institutional changes implemented later'.

Another study conducted by the method of generalized moments on 125 countries in the period 1980-2006 demonstrated that democracy helps to decrease the volatility of the budget deficit, and political instability, hyperinflation and trade openness are positively correlated with the volatility of the budget deficit (Agnello and Sousa, 2009).

So, the link between the quality of institutions and economic activity at the macroeconomic level has been a topical subject for studies since the 1990s and up to now. Alesina and Perotti (1995), Persson and Tabellini (1997), Woo (2003) or Henisz (2004) are just some of the authors whose studies are of reference in this regard.

Alesina and Perotti (1995) showed that several OECD countries, with comparable levels of GDP per capita, all democratic systems, advanced and highly industrialized economies, presented differences in terms of the results of the fiscal policy implemented. Therefore, the premise from which they started is that the aspects related to the institutions of these states ('electoral laws, the structure of political parties, budget laws, central bank laws, the degree of decentralization, political stability, polarization of society') lead

to differences in matters of 'budget deficits, in particular, and fiscal policies, in general'. They explain that budgetary results are effects of fiscal policy and, having confirmed the influence of political and institutional variables, institutional reforms are needed to be able to improve these fiscal results.

Woo (2003) studied both developing and advanced economies during 1970–1990 and proved that 'sociopolitical instability, income inequality, size of government (large number of ministries), and lack of centralization of authority over budget decisions' are conclusive variables in explaining budget deficits. The polarization of society is another factor that explains the differences between fiscal results from one country to another, with effects on the budget balance being smaller in states with strong, well-regulated institutions. This aspect is demonstrated through sensitivity analyzes and robust estimation methods. Henisz (2004) also states that the volatility of public expenditures and revenues can be reduced by fiscal rules, and proves empirically that the volatility of the budget balance depends on political institutions.

This is why governance indicators are recently employed in the studies related to budget balance. They arose from the need of foreign investors to be 'guided about the economic, political and administrative efficiency of countries of interest' (Malik, 2002), and the idea has also been encouraged in research, so we can count today an 'inventory' of over 150 governance indicators. Governance include the 'processes by which governments are selected, monitored, and changed, the government's ability to formulate and implement viable policies, and the respect of citizens and the state for the institutions that govern their social and economic interactions' (Kaufmann, Kraay and Zoido-Lobatón, 1999).

3. Methodology and data used

This article aims to identify if economic growth, inflation, government debt, foreign direct investments, governance, unemployment expenses, as well as pensions and military ones lead to budget deficit/ surplus in the current 27 European Union countries. The study verifies the impact of the independent variables towards budget balance by the means of regression models, and the interdependencies between all the variables (still with an emphasis on budget balance) by using vector autoregressive model and Granger causality test. The collected data have an annual frequency (from 2000 to 2021) and are organized as panel data. The dependent variable is the budget balance, while the independent variables chosen for the study are economic growth, inflation, government debt, foreign investments, unemployment expenses, pensions and military ones, as well as governance. The description of the variables used, as well as the source of the data are presented in Annex 1.

3.1. Hypothesis development

Institutional quality was revealed by many studies as an important determinant of budget balance and therefore, the governance indicators are expected to be in a positive

relationship with the dependent variable. Since the 6 Worldwide Governance Indicators are strongly interconnected and, from a statistical point of view, affected by multicollinearity, they have been replaced in the current paper by a general governance indicator. In this regard, (H_1) in our analysis explores if increasing institutional quality measured by governance leads to an increased budget balance.

Macroeconomic conditions also influence the accumulation of budget surplus or deficit, and our study aims to examine whether general government debt, economic growth, foreign direct investments or inflation are statistically significant determinants of the fiscal balance and which is the sign of the relationship created. As economic growth supposes a better supply of public goods and services to the population of a state, it is mainly expected that there is strong positive relationship between GDP growth and fiscal balance (H_2).

As budget balance represents the difference between public revenues and public expenditures, it is also important to analyze the way that several social expenditures (for pensions and unemployment) and military ones impact the budget balance. It is expected that military expenses harm the budget surplus as they do not consequently bring improved economic situation, and that the pension expenses evolve in opposite sign with budget balance as many studies reveal actual pension systems as a threat to sustainability in the long run (H_3).

3.2. Research methodology employed

The methodology used includes both regressive models, as well as the Vector Autoregressive model (henceforth 'VAR'). To measure how the explanatory variables lead to changes in the dependent variable, we estimated regressions using POLS, with fixed effects and random effects, analyzing the sign of the coefficients and their level of significance. Through the Likelihood test, we checked whether the POLS model or the one with fixed effects is more suitable, and the Hausman test indicated which of the models with fixed or random effects is preferable.

The general form of the panel data regression model used is the following:

$$Y_{it} = \alpha_0 + \beta_1 X_{1,it} + \beta_2 X_{2,it} + \beta_3 X_{3,it} + \beta_4 X_{4,it} + \beta_5 X_{5,it} + \beta_6 X_{6,it} + \beta_7 X_{7,it} + \beta_8 X_{8,it} + \varepsilon_{it};$$
$$i = 1, 2 \dots, 27,\ t = 2000, 2001 \dots, 2021 \quad (1)$$

where Y represents the dependent variable, α_0 denotes the constant, $\beta_1 - \beta_8$ stand for the coefficients to be estimated, $X_1 - X_8$ are the exogenous variables presented in Table 1, ε_{it} is the residual term, while *i* signifies the subscript of EU-27 countries and *t* abbreviates the time span.

For capturing the interdependencies between the variables used in the analysis, we employed VAR modeling, which consists of a system of equations where each variable becomes, at its turn, the dependent variable. The equations represent functions of the lagged values of all the variables analyzed. As our study is mainly oriented towards budget balance, our focus will yet be on the VAR equation system having SOLD as explanatory

variable. The general form of the VAR equation is described below:

$$Y_{it} = \alpha_0 + \sum_{i=1}^{k} \beta_1 X_{1,t-1} + \cdots + \sum_{i=1}^{k} \beta_7 X_{7,t-1} + \varepsilon_{it};$$
$$i = 1, 2 \ldots, 27, \; t = 2000, 2001 \ldots, 2021 \qquad (2)$$

where Y represents the dependent variable, α_0 denotes the constant, $\beta_1 - \beta_7$ stand for the coefficients to be estimated, $X_1 - X_8$ are the exogenous variables presented in Table 1, ε_{it} is the residual term, while *i* signifies the subscript of EU-27 countries, *t* abbreviates the time span and *k* stands for the number of lags.

VAR methodology can be employed only if the variables are stationary integrated of order 0 or 1. As a way to reveal the order of integration of the variables, we applied two unit root tests: Augmented Dickey-Fuller Test (henceforth 'ADF') and Phillips-Perron Test (henceforth 'PP'). The ADF test takes into consideration especially if there is autocorrelation in the series, while PP test is additionally verifying the presence of heteroscedasticity extent within the series (Ben Abdallah, Belloumi and De Wolf, 2013).

After examining the interdependencies between variables using VAR, Granger causality test was applied to verify if there is short term influence from the exogenous variables towards the endogenous one, and whether the independent variables are useful in forecasting the dependent one. This last condition being fulfilled, we proceeded to estimate the impulse response functions in order to graphically capture the way in which the dependent variable responds to a shock produced on each of the variables used in the study.

Table 1 shows the descriptive statistics of the working database for each individual variable. The situation in the member states of the European Union is characterized by variability in terms of social expenditures (but not military-specific ones), variability of the analyzed macroeconomic variables, and the budget balance is negative on average (-2.59% of GDP, -455.80 euro per habitant respectively), so the dependent variable of the study is rather the budget deficit.

Table 1: Descriptive statistics of the variables for the 2000–2021 period

Variables	# Obs.	Mean	Std. Dev.	Min.	Max.
Depending variable					
SOLD	594	-455.80	1,034.75	-11,789.97	3,421.50
Independent variables					
GDPG	594	2.43	3.90	-14.83	24.37
INF	594	2.49	3.25	-4.47	45.66
GGD	594	14,616.21	11,462.41	225.91	47,337.06
FDI	592	2,851.87	10,412.87	-45,072.1	142,067.7
GOV	594	80.16	12.18	46.43	99.75
UNE	554	335.08	319.08	5.23	1,612.93
PEE	572	2,683.95	1,853.53	177.95	8982.3
ME	594	334.58	286.13	31.11	2,434.33

Source: Authors' computation

4. Empirical results

To estimate the regression model that includes the presented variables, we created the correlation matrix (Table 2) which does not suggest strong interdependencies between the variables, they are linked by weak or moderate correlations, so from a statistical point of view, they can be simultaneously included in a regressive model.

Table 2: Correlation matrix

	SOLD	*GDPG*	*INF*	*GGD*	*FDI*	*GOV*	*UNE*	*PEE*	*ME*
SOLD	1.00								
GDPG	0.31**	1.00							
INF	0.11**	0.16**	1.00						
GGD	-0.36**	-0.21**	-0.33**	1.00					
FDI	-0.08*	0.02	-0.07	0.07	1.00				
GOV	0.09*	-0.03	-0.29**	0.39**	0.17**	1.00			
UNE	-0.24**	-0.24**	-0.26**	0.71**	0.18**	0.63**	1.00		
PEE	0.05	-0.19**	-0.28**	0.67**	0.15**	0.70**	0.75**	1.00	
ME	-0.11**	-0.15**	-0.18**	0.45**	-0.01	0.21**	0.31**	0.46**	1.00

** Correlation is significant at the 0.01 level (2-tailed)

* Correlation is significant at the 0.05 level (2-tailed)

Source: Authors' computation

Before proceeding to the estimations, we tested the variables for multicollinearity using Variance Inflation Factors (VIF), the results being reported in Table 4. As the Centered VIF values are all much lower than 10, this demonstrates that no multicollinearity exists in the model.

Table 3: Multicollinearity Test – VIF

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	111,121.9	97.10458	NA
GDPG	88.75403	1.532555	1.162156
INF	124.4725	1.846464	1.201228
GGD	2.55E-05	7.490006	2.788053
FDI	1.06E-05	1.142818	1.060663
GOV	20.80289	120.9145	2.589519
UNE	0.038012	7.105536	3.375881
PEE	0.001304	11.94030	3.840925
ME	0.020678	3.366372	1.388809

Source: Authors' computation

We therefore continue running the regression models, the estimated equation being illustrated below:

$$SOLD_{i,t} = \alpha_o + \beta_1 GDPG_{i,t} + \beta_2 GGD_{i,t} + \beta_3 FDI_{i,t} + \beta_4 INF_{i,t} + \beta_5 GOV_{i,t} + \beta_6 ME_{i,t} + \beta_7 PEE_{i,t} + \beta_8 UNE_{i,t} + \varepsilon_{i,t} \quad (3)$$

The coefficient estimates, the probabilities associated and the information related to the significance of the regression models estimated are presented in Table 4. We can observe that all the three models are significant for 1% confidence level.

Table 4: Panel regression models output: POLS, fixed effects model, random effects model

Variables	POLS	Fixed effects (FEM)	Random effects (REM)
C	-973.038	-848.612	-950.350
(Prob)	0.003	0.008	0.002
GDPG	77.023	23.165	64.805
(Prob)	0.000	0.056	0.000
GGD	-0.042	-0.051	-0.045
(Prob)	0.000	0.000	0.000
FDI	-0.011	-0.008	-0.011
(Prob)	0.000	0.003	0.000
INF	6.579	7.912	7.582
(Prob)	0.555	0.501	0.479
GOV	5.260	6.684	5.707
(Prob)	0.249	0.126	0.179
ME	-0.258	-0.289	-0.265
(Prob)	0.0723	0.033	0.047
PEE	0.409	0.359	0.395
(Prob)	0.000	0.000	0.000
UNE	-1.254	-0.844	-1.128
(Prob)	0.000	0.000	0.000
R^2	0.4205	0.5284	0.3947
R^2Adj.	0.4120	0.5033	0.3858
F statistic	49.441	21.016	44.436
(Prob) F	0.000	0.000	0.000
No obs	554	554	554
Hausman T prob			0.000

Source: Authors' computation

To identify which model is more appropriate, between the least squares model and the fixed effects model, we applied the Likelihood-ratio test. Its probability of 0%, lower than the value of 5%, indicates that the model with fixed effects is appropriate.

Table 5: Likelihood ratio test

Effects Test	Statistic	Probability
Cross-section F	6.010	0.000
Cross-section Chi-square	114.214	0.000

Source: Authors' computation

To make the comparison with the random effects model, we applied the Hausman test. The probability obtained, of 0%, leads to the acceptance of the null hypothesis, according to which the model with fixed effects is the most suitable. The value of the coefficient of determination (R squared) is consistently higher in the fixed effects model, therefore 52% of the variation of the budget balance is explained by the evolution of the independent variables. The output equation is as follows:

$$SOLD = -848.61 + 23.165*GDPG - 0.051*GGD - 0.008*FDI + 7.912*INF + 6.684*GOV - 0.289*ME + 0.359*PEE - 0.844*UNE \quad (4)$$

As the fixed effects model shows, the variables included in the analysis but with no statistical significance are INF and GOV. GGD, FDI and UNE are significant for a 1% confidence level and exert negative influence on SOLD, PEE is significant for a 1% confidence level and its impact is positive, whilst ME is significant for a 5% confidence level and exert negative influence on SOLD. Among the variables, GDPG shows the greatest influence on the budget balance, having a positive associated coefficient of 23.165, but statistically significant only for a 10% confidence level.

The output of the fixed effects model presents a negative and statistically significant coefficient of ME. This aspect is explained by the fact that the expenses for a better defense of the country serve a national security objective but do not lead to a specific improvement of the economy. In other words, it is an expense that does not generate public revenues, unlike, for example, spending on pensions and other forms of social support, which lead to an increase in consumption, and therefore can affect the budget balance.

The fact that the GGD is inversely related to the budget balance and statistically significant confirms empirically that the government debt is an instrument for financing the public deficit, but the coefficient has a low value. However, given the large differences at the EU level regarding the level of government debt of each state, it is preferable to analyze this relationship separately depending on the country.

The fixed effects model shows that PEE is in a positive relationship with the budget balance and is statistically significant. This confirms that the pensions that the beneficiaries receive increase consumption and help improve the economic situation. As expected, the increase in unemployment (UNE) is reflected in a deterioration of the budget balance, the relationship being statistically significant. Finally, although it exceeds the 10% threshold of statistical significance, GOV evolves in a positive sense with the budget balance, which explains the fact that increasing the value of governance indicators is not only an objective of social welfare, but also affects the economic situation.

We will continue the analysis of the variables by estimating a VAR model that captures the interdependencies between these variables, but we will still focus especially on the effect on the budget balance. UNE was excluded from the VAR model because stationarity tests reveal that this variable is integrated of order 2. The results of the stationarity ADF test are revealed in Annex 2, but those of the PP test show similar results. Given the fact that all other variables except UNE are stationary (integrated of order 0), the VAR model can be estimated.

In order to identify which number of lags should be used in estimating the model, we applied the lag length determination test (Annex 3). The AIC criterion indicates that the appropriate number of lags is 3, so that the estimated VAR system has 200 coefficients. The probabilities associated with the first 25 coefficients, the ones included in the equation having SOLD as dependent variable, are shown in Annex 4.

The equation of the estimated VAR system whose dependent variable is the budget balance is reproduced in Table 6, and the coefficients C(2) and C(10) show that GDPG is the independent variable with the largest weight on the budget balance and is also statistically significant.

Table 6: VAR system equation estimation concerning SOLD as dependent variable

Equation:

SOLD = C(1)*SOLD(-1) + C(2)*GDPG(-1) + C(3)*GGD(-1) + C(4)*FDI(-1) + C(5)*INF(-1) + C(6)*GOV(-1) + C(7)*PEE(-1) + C(8)*ME(-1) + C(9)*SOLD(-2) + C(10)*GDPG(-2) + C(11)*GGD(-2) + C(12)*FDI(-2) + C(13)*INF(-2) + C(14)*GOV(-2) + C(15)*PEE(-2) + C(16)*ME(-2) + C(17)*SOLD(-3) + C(18)*GDPG(-3) + C(19)*GGD(-3) + C(20)*FDI(-3) + C(21)*INF(-3) + C(22)*GOV(-3) + C(23)*PEE(-3) + C(24)*ME(-3) + C(25)

SOLD = 0.55*SOLD(-1) + 36.79*GDPG(-1) − 0.02*GGD(-1) + 0.00*FDI(-1) + 8.95*INF(-1) + 0.89*GOV(-1) + 0.13*PEE(-1) + 0.39*ME(-1) + 0.01*SOLD(-2) − 26.83*GDPG(-2) − 0.00*GGD(-2) + 0.00*FDI(-2) − 18.51*INF(-2) −3.20*GOV(-2) − 0.00*PEE(-2) − 0.79*ME(-2) − 0.00*SOLD(-3) − 12.85*GDPG(-3) + 0.00*GGD(-3) + 0.00*FDI(-3) − 5.73*INF(-3) − 1.84*GOV(-3) − 0.02*PEE(-3) + 0.15*ME(-3) + 205.07

Observations: 551

R-squared	0.465852	Mean dependent var	-479.5913
Adjusted R-squared	0.441480	S.D. dependent var	1064.955
S.E. of regression	795.8849	Sum squared resid	3.33E+08
Durbin-Watson stat	2.015696		

Source: Authors' computation

Considering the probabilities associated with each of the coefficients, we note that the budget balance itself and economic growth (GDPG) are the only statistically significant variables whose previous values influence the budget balance. The fixed effects model indicated a positive coefficient for GDPG, but statistically significant for 10% confidence level.

As in the case of the model with fixed effects, GDPG has a positive and statistically significant relationship with the budget balance, confirming the fact that economic growth

implies higher public revenues and a larger budget balance. That is why economic growth is also an objective of sustainable public finances.

The results of the Granger causality test are shown in Table 7. The short run, GDPG, GGD and even PEE are the variables that Granger causes SOLD, as their probabilities are less or equal to 5%. All the other independent variables do not Granger cause SOLD, as their probabilities are higher than 5%. Nevertheless, all the independent variables put together can Granger cause the SOLD, as their probability is 0%.

Table 7: Granger causality test output

AR Granger Causality/Block Exogeneity Wald Tests			
Sample: 2000 2021			
Included observations: 516			
Dependent variable: SOLD			
Excluded	**Chi-sq**	**Df**	**Prob.**
GDPG	18.61595	3	0.0003
GGD	15.48053	3	0.0014
FDI	6.121343	3	0.1059
GOV	0.677411	3	0.8785
INF	1.983575	3	0.5758
ME	4.515083	3	0.2109
PEE	7.450149	3	0.0589
All	56.73181	21	**0.0000**

Source: Authors' computation

Figure 1 shows the impulse-response graphs that reveal how the balance changes in the event of a shock at the level of each of the independent variables.

In the short term, a shock to the GDPG produces a sudden increase in the budget balance, but after T2, SOLD decreases until T5 where the minimum value is reached (negative one), afterwards increases slowly and starting from T9 the response moves into the neutral zone. A shock on the government debt generates in the short term a decrease in the budget balance, with the lowest value at the end of T3 and the response remaining in the negative zone throughout the whole analyzed period. The explanatory variables whose shock produces a strictly positive response of the budget balance are, in order of the amplitude of the responses: FDI, PEE and INF. In the case of a shock on foreign direct investments, after T6 the response fades, but remains in the positive towards neutral area. As for INF and PEE, the answer is positive for the entire analyzed period of 10 years. A shock on the military expenditure generates in the very short term an increase in the budget balance, but after T2 the SOLD is decreasing and starting from T3 it drops and remains in the negative zone throughout the analyzed period. A change produced in the level of inflation is reflected in the budget balance with a negative sign effect after T2 to T6, following that the answer goes into the positive area, but its value is barely perceptible.

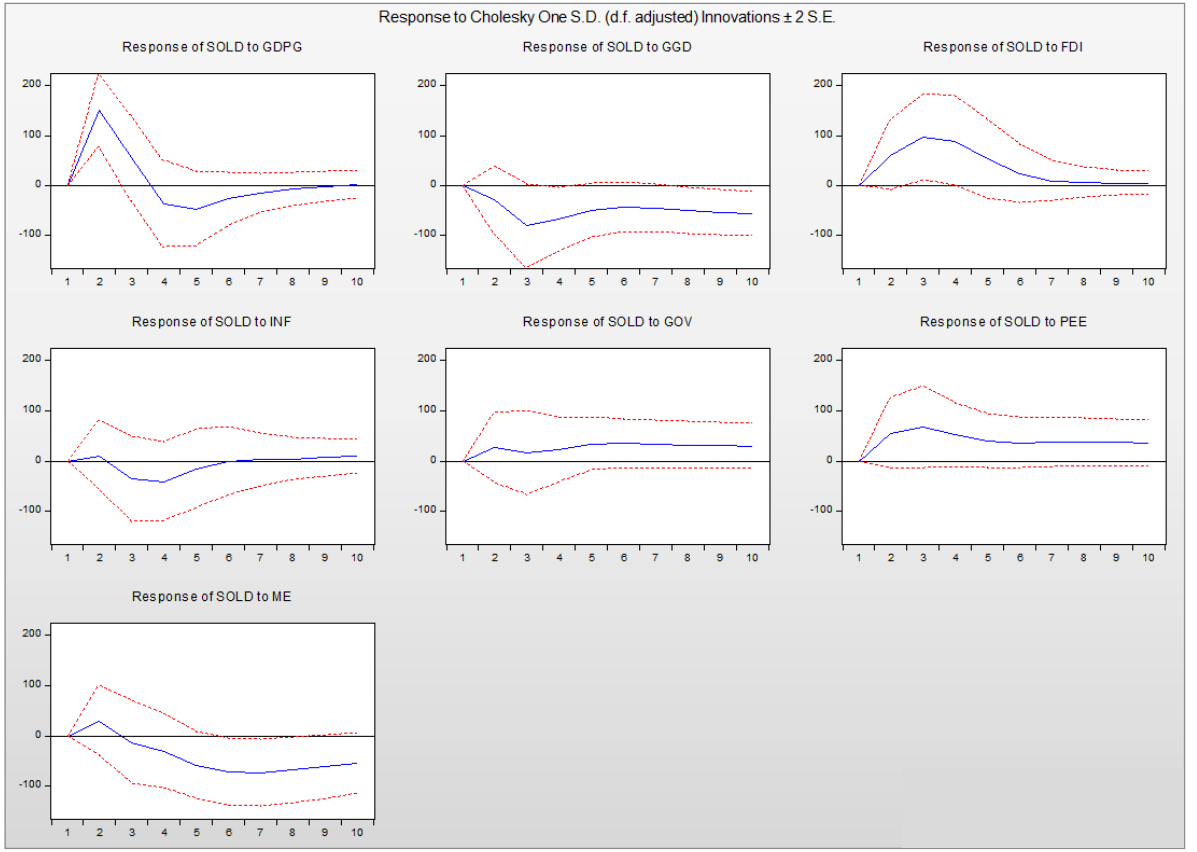

Figure 1: Impulse response functions from the independent variables towards SOLD

Source: Authors' computation

5. Conclusions

Although the fiscal balance has been carefully observed over time as it is a barometer of the health of public finances, it can also be a tool for measuring fiscal risk (Petrie, 2013). For a better knowledge of fiscal vulnerabilities at the level of the European Union states, it is necessary to study the variables that can influence the level of the budget balance.

In our analysis, carried out on 27 current member states of the European Union, in the 2000–2021 period, we used both the regressive and VAR methodologies to study the effects of several variables on the budget balance. The first part of this study, where regression models were employed, confirms that economic growth, general government debt, foreign direct investments, military expenditures, pension expenditures and the unemployment expenditures exert influence on the budget balance, as they are also statistically significant. Economic growth and pension expenditures are positively related to the budget balance, while the other four variables are negatively linked to the endogenous variable.

Fixed effects model shows that economic growth has the strongest influence on the budget balance, the variable revealed to be statistically significant by both random and fixed models (and also by the VAR), unlike Maltritz and Wüste (2015) who did not find a significant effect of this variable. Then correlating with the impulse response functions projected over a period of 10 years, we observe how the budget balance increases considerably in the short term following a shock of economic growth, then it decreases but in the long run the response becomes almost neutral.

The governance evolves in the same direction as the budget balance, which would confirm the conclusions that 'improved institutional setup of the economy' is key to avoid high deficits (Arif and Hussain, 2018). Nevertheless, the coefficients are not statistically significant, neither in the regression nor in the VAR models. This result denies the assumption of H_1.

As for the third hypothesis we observe that the expenditures supposed by all types of pensions are an exogenous variable revealed as statistically significant by regression, while the VAR model indicates it as not significant. In the short run, Granger causality test also pointed out a causal link from pension expenditures to budget balance (for a 10% significance threshold). Additionally, the impulse response function shows that both in the short term and in the long term, a shock produced on pension expenses leads to an increase in the budget balance, and the positive response becomes a constant one. This image comes to confirm that, even if the population aging weakens public spending (Honda and Miyamoto, 2020) and represents a challenge for the sustainability of public finances (Sánchez-Romero *et al*., 2019), bigger pension expenditures will however improve overall budget balance. Similarly, unemployment-related expenses have a negative relationship with the budget balance and are statistically significant (in all estimated regression models). That is why these social expenses (pensions and unemployment expenditures) must be carefully monitored and adjusted according to the demographic and work conditions – characterized by three major phenomena: 'reducing mortality, reducing birth rates and external migration' (Rangelova and Bilyanski, 2019). Thus, EU-27 countries

should continue the actual social protection programs, because the effective spending on unemployment will be reflected in time in better employment, while spending on pensions will prevent the socio-economic polarization of citizens. However, it is advisable that the sources of financing these expenses are not based on the increase of the public debt, to avoid the tightening of the fiscal space.

The coefficient associated with military expenditures in the regression, corroborated with its statistical significance at a 5% significance level, as well as the graphic illustration of the response functions on the budget balance as a result of an impulse on military expenditures, shows that a shock in these expenses decreases the budget balance in the long run, and the effect is persistent. Therefore, even if strictly from the point of view of public finances, a reduction of military expenditures would be advisable, these expenses justify themselves by national defense reasons and provide security conditions for the development of socio-economic life. In the current conditions, under the pressure of the war in Europe at the border of the European Union, the reduction of military expenses cannot be recommended, especially since the period under analysis was not marked by a similar context of armed conflict.

General government debt is in the opposite sign relationship with the budget balance, aspect also proven empirically by Maltritz and Wüste (2015) which showed how a higher debt reduces the public deficit, and in accordance with the observation that the most frequently used method of covering the budget deficit is obtaining credits.

However, we must be cautious in formulating conclusions. Considering the fact that the budget balance itself is not a variable that has wide values, therefore the evolution of any variable that has the ability to influence the budget balance must be carefully analyzed.

Beyond the fact that economic growth is a universal macroeconomic objective, the results of this analysis bring an additional argument for the importance of GDP growth measures. A positive economic growth leads the long run to a positive budget balance (confirming), to a fiscal space that governments can use to counteract potential unforeseen situations and cover additional expenses. Among the analyzed variables, from the perspective of minimizing fiscal risk and ensuring a positive budget balance, economic growth stands out as the most important source of fiscal security.

Nevertheless, a limitation of this research ensues from the fact that European Union member states were not considered distinctly as advanced economies/emerging and developing economies. This could lead to different results. The study could be carried out also at the level of each European Union member state, or comparing the Eurozone to the non-Eurozone countries, including also new independent variables proved by the literature as being statistically significant: trade openness, tax revenues or exchange rate. For future research, this analysis can be extended to verify if preexistent levels of economic development, the pre and post elections period, the existence and activity of national Fiscal Councils or the political parties have influence on the budget deficit/ surplus in the European Union or in Europe, in general.

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Annex 1: Description of the variables

Variables	Definition	Unit of measure	Data source
Dependent variable			
SOLD	Budgetary balance, representing the government deficit or surplus.	Euro per inhabitant	Eurostat Database
Independent variables			
GDPG	Economic growth consists of the growth rate of GDP at market prices based on constant local currency. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products.	Annual percentage growth rate of GDP (%)	World Bank Database
INF	Inflation reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, such as yearly.	Consumer prices (annual %)	World Bank Database
GGD	General government gross debt is the indicator described within The Treaty on the Functioning of the European Union as the ratio of government debt outstanding at the end of the year to gross domestic product at current market prices (%). It is calculated as the total consolidated gross debt at nominal value of: currency and deposits, debt securities and loans.	Euro per inhabitant	Eurostat Database
FDI	Foreign direct investment represents net inflows of investment to reach a lasting management interest (at least 10 percent voting stock) in an enterprise based in an economy different from the investor's one. It is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital as shown in the balance of payments. This series shows net inflows (new investment inflows less disinvestment) in the reporting economy from foreign investors.	Euro per inhabitant	World Bank Database
GOV	Governance indicator is calculated as the arithmetic mean of the 6 dimensions of Worldwide Governance Indicators - Voice and Accountability, Political Stability and Absence of Violence/Terrorism, Government Effectiveness, Regulatory Quality, Rule of Law, Control of Corruption.	Percentile Ranks (1-100)	World Bank Database
UNE	Unemployment expenditure refers to public expenditure on the available, unemployed and job-seeking workforce benefiting from a form of social protection, namely unemployment benefits.	Euro per inhabitant	Eurostat Database
PEE	Pension expenditure is an indicator related to the expenditure on social benefits related to pensions and includes all 7 categories of pensions identified at the European Union level (disability pension, early pension for limited work capacity, old-age pension, survivor's pension, partial pension, early retirement, early retirement for reasons attributable to the labor market).	Euro per inhabitant	Eurostat Database
ME	It represents military expenditure i.e. total current and capital expenditure for armed forces, for peacekeeping forces, for defense projects, military, paramilitary and military space activities. This indicator includes military personnel expenses (including retired military personnel's services), research and development expenditures, military procurement, operation, and maintenance expenditures.	Euro per inhabitant	World Bank Database

Source: Authors' work based on the definitions offered by the database used

Annex 2: ADF stationarity test output

Variables	Augmented Dickey Fuller Test	At level	
		Intercept	Trend and intercept
SOLD	t-statistic	-11.57160	-11.60027
	1% level	-3.441148	-3.973606
	5% level	-2.866195	-3.417415
	10% level	-2.569308	-3.131114
GDPG	t-statistic	-7.531183	-7.529283
	1% level	-3.441376	-3.973929
	5% level	-2.866296	-3.417573
	10% level	-2.569362	-3.131208
GGD	t-statistic	-5.141012	-5.154741
	1% level	-3.441148	-3.973606
	5% level	-2.866195	-3.417415
	10% level	-2.569308	-3.131114
FDI	t-statistic	-6.531276	-6.527419
	1% level	-3.441223	-3.973712
	5% level	-2.866228	-3.417467
	10% level	-2.569326	-3.131145
INF	t-statistic	-11.52714	-11.55576
	1% level	-3.441148	-3.973606
	5% level	-2.866195	-3.417415
	10% level	-2.569308	-3.131114
GOV	t-statistic	-3.875516	-3.933176
	1% level	-3.441148	-3.973606
	5% level	-2.866195	-3.417415
	10% level	-2.569308	-3.131114
ME	t-statistic	-5.807537	-5.822957
	1% level	-3.441148	-3.973606
	5% level	-2.866195	-3.417415
	10% level	-2.569308	-3.131114
PEE	t-statistic	-3.561266	-3.558804
	1% level	-3.441757	-3.974469
	5% level	-2.866464	-3.417836
	10% level	-2.569452	-3.131363
UNE	t-statistic	1.490355	1.617113
	1% level	-3.455685	-3.994167
	5% level	-2.872586	-3.427407
	10% level	-2.572730	-3.137018

Source: Authors' computation

Annex 3: Lag length determination test

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-26,648.06	NA	1.58e+37	108.3580	108.4262	108.3848
1	-24,119.92	4,963.786	7.07e+32	98.34113	98.95554*	98.58239
2	-23,998.71	234.0329	5.60e+32	98.10859	99.26915	98.56431*
3	-23,934.52	121.8685	5.60e+32*	98.10780*	99.81449	98.77796
4	-23,874.62	111.7518	5.70e+32	98.12449	100.3773	99.00911
5	-23,821.50	97.39748	5.97e+32	98.16869	100.9677	99.26777
6	-23,782.92	69.47503	6.63e+32	98.27203	101.6172	99.58555
7	-23,711.38	126.5061	6.45e+32	98.24137	102.1326	99.76935
8	-23,661.68	86.26570*	6.86e+32	98.29951	102.7369	100.0419

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

Source: Authors' computation

Annex 4: Coefficients associated to the variables employed within VAR system

Estimation Method: Least Squares Total system (unbalanced) observations 4399				
Coefficient		Std. Error	t-Statistic	Prob.
C(1)	0.552757	0.053342	10.36249	0.0000
C(2)	36.79048	10.97913	3.350948	0.0008
C(3)	-0.023157	0.015207	-1.522765	0.1279
C(4)	0.005467	0.003499	1.562412	0.1183
C(5)	8.951492	16.48498	0.543009	0.5872
C(6)	0.899836	13.74514	0.065466	0.9478
C(7)	0.133391	0.113183	1.178543	0.2386
C(8)	0.391577	0.422523	0.926760	0.3541
C(9)	0.014936	0.063413	0.235543	0.8138
C(10)	-26.83229	11.66956	-2.299341	0.0215
C(11)	-0.006460	0.019560	-0.330277	0.7412
C(12)	0.003550	0.003807	0.932598	0.3511
C(13)	-18.51406	20.11127	-0.920581	0.3573
C(14)	-3.200704	19.01506	-0.168325	0.8663
C(15)	-0.007264	0.150002	-0.048427	0.9614
C(16)	-0.790925	0.638592	-1.238544	0.2156
C(17)	-0.063492	0.052240	-1.215393	0.2243
C(18)	-12.85508	11.06557	-1.161719	0.2454
C(19)	0.009618	0.014228	0.676012	0.4991
C(20)	0.002408	0.003886	0.619596	0.5356
C(21)	-5.736416	15.49644	-0.370176	0.7113
C(22)	-1.840826	13.44133	-0.136953	0.8911
C(23)	-0.022365	0.102117	-0.219014	0.8266
C(24)	0.159503	0.430545	0.370467	0.7111
C(25)	205.0763	328.5632	0.624161	0.5326

Source: Authors' computation