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Determinants of Government Debt in Euro Area Countries

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ABSTRACT

The recent outbreak of a pandemic has placed an unprecedented burden on euro area countries in terms of fiscal policies. This paper aims to identify the main determinants of government debt and how they have changed its level over the last two decades. Using the panel data of 19 euro area countries we estimate the econometric models with the variables from various areas from 2000 to 2020. The findings of our research show the government debt in the previous year, GDP growth, long-term interest rate, net operating balance, trade openness, life expectancy, population, unemployment rate, government effectiveness, democracy, debt crisis, and COVID crisis have an impact on the current levels of government debt. On the contrary, the variable of inflation demonstrates its significance only in a sample of high-income countries. According to our paper, the financial crisis in 2008 does not affect the studied fiscal ratio. In sum, we discuss the importance of the correctly chosen fiscal policy to help the most affected countries within the euro area.

Keywords: government debt, budget deficit, fiscal policy, Covid-19 pandemic, euro area

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INTRODUCTION

Government debt is one of the key indicators of the economic and financial fragility of countries. High debt levels have become a more critical issue since the 2008 financial crisis and even more so since the recent Covid-19 pandemic and the ongoing war in Ukraine (Meredith, 2022) and it can be caused by several factors. One of the reasons could be that governments tend to borrow money on the financial markets during the crisis to support vulnerable sectors or cover deficits, leading them to excessive debt as a percentage of GDP ratios. Therefore, fiscal sustainability is a crucial topic for policy makers in European Union (EU). As reported by IMF (2003), there is no simple rule for resolving whether government debt is sustainable. According to Filip (2019), the government debt has two sides, firstly the bright, which can be a tool for the country's development, and secondly the dark, which can cause problems for creditors and citizens of the borrowing state. Both sides are affected not only by credit conditions but also by external and internal factors that occur during the repayment process and may lead to additional accumulation of government debt.

In the euro area, average government debt increased from 72,27% of GDP in 2019 to 85,81% of GDP in 2020 using IMF data. Understandably, most member states are suffering from budgetary problems such as high deficits and debts during the recessions. Therefore, there are regulations to preserve prudent fiscal policies anchored in the Stability and Growth Pact. But when economies recover sufficiently, important fiscal support provided during the recession will need to be withdrawn and government debt reduced. The challenge for the EU is therefore to maintain price stability and restart the economy, even with the consequences of crises. Recessions can slow GDP growth, increase unemployment, and increase inflation, all of which ultimately lead to higher debt levels.

For that reason, it is of particular interest to investigate the reasons for the growth of the debt-to-GDP ratio. The main research question of this thesis is to identify and analyse the factors that have determined the government debt evolution of the euro area countries, in the last twenty-one years. Using a dynamic panel analysis, we will try to recognize the impact of the various variables we have chosen on the debt-to-GDP ratio.

The structure of the thesis is compiled as follows. Existing studies on the topic of government debt are discussed in the theoretical background and literature review section. In the next section, an explanation of the data and methodology is given. Subsequently, the results are presented, and the graphic analysis and interpretation of the coefficients are provided. We then discussed the results and implications and finally concluded our findings.

THEORETICAL BACKGROUND

The government debt in the euro area

The formation of the European Union as we know it today began more than 70 years ago. Originally it was European Coal and Steel Community and European Economic Community which were then formatted to the EU. In 1992, the forming countries Belgium, France, Italy, Luxembourg, the Netherlands, and Germany signed a Treaty on European Union, also known as the Maastricht Treaty, which became effective in November 1993. The Treaty represents an important milestone in the history of the EU, which sets out clear rules for the future single currency with a view of closer cooperation in the field of justice and home affairs as well as common rules on foreign and security policy. (European Union, 2022)

Thus, the creation of the Euro Area was already defined in the Maastricht Treaty. Euro was first introduced in 1999 after a decade of preparations. The new currency was in the first three years used as "book money", which means only for accounting and electronic payments. Then in 2002, coins and banknotes were put into circulation. The founding states of the Euro Area in 1999 were Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Portugal, and Spain. In 2001, Greece adopted the new European currency followed by Slovenia (2007), Cyprus and Malta (2008), and Slovakia (2009). Another enlargement came with the accession of Estonia (2011), Latvia (2014), and Lithuania (2015). Today, Euro Area consists of 19 states, whose main goal is to maintain price stability (European Commission, 2022a).

There are two relevant fiscal policy rules regarding government debt in the euro area. The first one can be found in Maastricht Treaty which determines convergence criteria, or the so-called Maastricht criteria. The Maastricht criteria aim to ensure stability and economic security when a new country adopts the euro currency. Four criteria should be fulfilled before joining a monetary union. Firstly, the focus is on price stability measured by a harmonised consumer price index. According to convergence criterium, inflation should not exceed 1,5 percentage points above the rate of the three member states with the best performance. Secondly, the EU emphasizes sound and sustainable public finance. This criterion is necessary to understand how much fiscal policy rules play a role in the fiscal discipline of the EU. States desirable to join the euro area should not be under excessive deficit procedure at the time of examination (European Commission, 2022b). According to the Protocol on the excessive deficit procedure attached to the Treaty on European Union (2008), reference values that should not be exceeded are 3% of actual government deficit to GDP at the market price ratio and 60% of government debt-to-GDP at the market price ratio. Another criterium measured by long-term interest rate is to ensure the durability of convergence. The EU tries to secure this by setting the rule that the country should not be more than 2 percentage points above this rate in the three member states with the best results in the terms of price stability. The final criterium refers to exchange rate stability. Before joining a monetary union, the candidate state should take part in the Exchange Rate Mechanism for at least 2 years without devaluing against the euro (European Commission, 2022b).

The second rule with a focus on government deficit is stated in the Stability and Growth Pact. The goal of this agreement is to avoid fiscal policies heading in potentially problematic directions and also to correct excessive budget deficits or excessive public debt burdens within the member states of the EU (European Commission, 2022c). In other words, the purpose of the Stability and Growth Pact is to ensure sound public finance and coordination of fiscal policies of European Union member states. To fulfil this purpose, there is a regulation called Excessive Deficit Procedure or the corrective arm as we mentioned in the previous paragraph. This action is initiated by the European Commission (EC) against any EU member state that exceeds budgetary deficits stated in the Stability and Growth Pact. It starts when the two criteria of the Protocol on the excessive deficit procedure are violated. The declaration of Excessive Deficit Procedure is followed by steps such as sanctions to encourage an EU member state to get its budget deficit under control (the sanctions do not apply to states outside of the euro area). At the time of writing the thesis, the ongoing excessive deficit procedure is only in Romania. The recommendation issued by the Council of the European Union establishes that Romania should settle its excessive deficit by 2024 at the latest. After the Covid-19 pandemic, this could help kick-start the country's economy (European Commission, 2022d).

Another procedure, except for the Excessive Deficit Procedure defined in the Stability and Growth Pact is the preventive arm. The aim is to ensure sound budgetary policies regarding the ups and downs of the economic cycle. It is done by the determination of parameters for fiscal planning and policies of the member states during normal economic times. Table 1 presents mentioned specifically required adjustments for the given economic situation in the countries and the amount of debt according to the Maastricht Treaty reference value. The output gap represents the difference between real GDP and potential output (European Commission, 2022e).

Table 1 Matrix for specifying the annual fiscal adjustment towards the medium-termobjective

| | | Required annual fiscal adjustment | | | | | | |
|--|---------------------------------------|--|---|--|--|--|--|--|
| | Condition | Debt < 60 and no sustainability risk | Debt > 60 or sustainability risk | | | | | |
| Exceptionally bad times | real growth < 0 or output gap < -4 | No adjustment needed | | | | | | |
| Very bad times | -4 ≤ output gap < -3 | 0 | 0,25 | | | | | |
| Bad times | -3 ≤ output gap < -1,5 | 0 if growth below potential, 0,25 if above potential | 0,25 if growth below potential, 0,5 if growth above potential | | | | | |
| Normal times | -1,5 ≤ output gap < 1,5 | 0,5 | > 0,5 | | | | | |
| Good times output gap $\ge 1,5$ | | > 0,5 if growth below potential, \geq 0,75 if growth above potential | \geq 0,75 if growth below potential, \geq 1 if growth above potential | | | | | |

Note: all figures are in percentage points of GDP

Source: adapted from the Economic and Financial Committee (2016), own processing

Government debt during the Covid-19 pandemic

The problem of increasing government debt in the euro area has become even stronger with the advent of the pandemic at the start of 2020 (WHO, 2020). According to macroeconomic projections by Eurosystem staff, the aggregate debt-to-GDP ratio increased to 98,4% of GDP which represents an increase of 14,5 percentage points compared to 2019 (European Central Bank, 2020).

In the deteriorating economic situation of the global pandemic, the European Commission may use fiscal interventions. Two clauses anchored in the Stability and Growth Pact can be activated in exceptional circumstances. The first one called the unusual events clause is used when an unusual event with a high impact on the general government's financial position takes place. The second known as a general escape clause, on the other hand, can be activated during a severe economic downturn in the euro area or across the Union. Put simply, both clauses can be adopted by the Commission during severe economic shocks to prevent an even greater economic downturn (European Parliament, 2020).

Figure 1 represents general government debt as a percentage of GDP in the year before the pandemic and 2020 in euro area countries separately. Luxembourg experienced the highest percentage increase in debt as a share of GDP, with an increase of almost 116% between 2019 and 2020. Conversely, Ireland recorded an increase of the same

indicator by only 2,16%. According to the International Monetary Fund data, the average percentage change in debt in all euro area countries reached almost 24% in the observed years. The threshold of 60% of government debt-to-GDP following the Stability and Growth Pact in 2020 was exceeded by Finland, Germany, and the Slovak Republic as shown in Figure 1.



Figure 1 General Government Debt in euro area countries

Source: Data from IMF, own processing

In March 2020, the European Commission announced the activation of a general escape clause as part of a rapid response to the crisis. It allowed the member states a deviation from the budgetary objective including members in the assessment and implementation of Stability or Convergence Programmes. In addition, within the corrective arm of the Pact, they allowed an extension of the deadline to fix their excessive deficits under the excessive deficit procedure (European Parliament, 2020). As a result, no member state other than Romania is currently subject to the excessive deficit procedure.

In the 2020 annual report, European Central Bank (ECB) declares that there is no need for questioning the sustainability of public debt. This estimate was based on more favourable recovery expectations in 2021, particularly after progress with the development of Covid-19 vaccines, and also on financing conditions ensuring support in the near future (European Central Bank, 2020). On the other hand, Briceño and Perote (2020) argue that public debt management needs to be reformed to make debt sustainable. They concluded that high debt could make euro area countries highly fragile in terms of exogenous adverse shocks. Taking the risk of unpreparedness may even lead to another debt crisis. The study requested by the European Parliament's Committee (Wieland, 2022) is discussing how major economies have responded to the Covid-19 pandemic and the impact of the pandemic and fiscal measures on debt sustainability. Figure 2 shows general government debt as a percentage of GDP in selected European countries from 1999. Since the start of the pandemic, the 100% government debt ratio of annual GDP threshold has been exceeded in many euro area countries such as Belgium, Cyprus, France, and Spain. There are also countries that already had a high debt-to-GDP ratio above 100% before 2020, such as Italy and Portugal. Greece, which has been hit hardest by the eurozone debt crisis (Featherstone, 2011), reached a debt ratio of up to 211% in 2020. Governments borrowed the liquidity from financial markets and the increase in debt-to-GDP ratios is the consequence of these actions. In this context, Wieland pointed to the cases of Italy and France (Figure 2), whose debt-to-GDP ratios had not declined even in the years following the debt crisis until 2019, with extremely low financing conditions. High debt ratios can be tolerated relatively easily, but only if they are lower than GDP growth. However, according to Wieland, countries must prepare for higher government funding costs in the future compared to GDP growth.



Figure 2 General Government Debt in selected countries

Source: Data from IMF, own processing

After the outbreak of the Covid-19 pandemic in March 2020, ECB initiated largescale unconventional monetary policy measures to stimulate the economy and prevent a fall in inflation in the euro area. To survive the crisis, ECB started to buy assets in the temporary programme Pandemic Emergency Purchase Program (PEPP). The program was aimed at households, private companies, and also governments to finance their expenses related to the crisis and lower borrowing costs. These measures also had an important fiscal aspect given the ECB's statement of its willingness to buy government and private debt from the financial markets and to provide monetary liquidity in return. An initial envelope of PEPP was €750 billion, which was later expanded to €1850 billion (European Central Bank, 2022a). According to the World Bank data, this number represented 15,4% of the euro area GDP in 2019. Although, this was not the only support program initiated by ECB. The Public Sector Purchase Programme (PSPP), under which the ECB purchases mainly government bonds and bonds of recognised agencies, has been active since 2015. At the end of March 2022, PSPP holdings were according to ECB €2530 billion. (European Central Bank, 2022b). Through not only the above-mentioned purchasing programmes, the ECB seeks to support the monetary policy transmission mechanism in order to maintain price stability and ensure the supply of funds to various sectors, including the government.

LITERATURE REVIEW

Many authors in the last decades have researched determinants of government debt. Several studies focused on one country (e.g. Neck and Getzner, 2001; Bandiera, 2008; Delgado-Téllez and Pérez, 2020) but most authors conducted research in the regions (e.g. Sinha, Arora and Bansal, 2011; Gargouri and Ksantini, 2016; Pečarić, Slišković and Kusanović, 2018; Filip, 2019; Briceño and Perote, 2020).

The issue of government debt can be viewed from several angles. There are studies focused on macroeconomic variables, institutional variables, structural variables, the political side of debt, or a combination of all the above options. The most described relationship by authors focused on government debt would be probably between GDP growth and the rising debt-to-GDP ratio (e.g. Woo and Kumar, 2015). Much of the recent studies seek to determine which aspect of the economy has the greatest impact on government debt. On the other hand, traditional economists have often focused more on the consequences of public debt, with explanations of the origin of debt being easily substantiated at the time (e.g. Barro, 1979; Krugman 1988).

The first macroeconomic variable that authors usually took into account when assessing the ratio of accumulated government debt is the amount of government debt in the previous period (e.g. Woo, 2001; Pečarić, Slišković, and Kusanović, 2018; Chirwa and Odhiambo, 2018; Wolswijk, 2020). The positive and significant relationship between these variables was confirmed by Gargouri and Ksantini (2016), suggesting that the debt-to-GDP ratio is a persistent variable. The same evidence was presented in the study of Determinants of the Public Debt in the Eurozone by Briceño and Perote (2020). As claimed in the research by Bellot, Selva, and Menendez (2017), the lagged dependent variable, which is changes in government debt, has a positive and statistically significant effect on the current level of debt. They attribute the dynamics of current debt to the effect of inertia. On the contrary, Delgado-Téllez and Pérez (2020) advocate a highly significant negative impact of the previous level of government debt on the current level in Spain. According to their study, the increase in debt-to-GDP in the previous year may result in lower debt levels in the current period.

The main emphasis in terms of macroeconomic variables seems to be on the impact of economic growth. Reinhart and Rogoff (2010) presented a controversial document after the financial crisis, which claims that if the level of government debt exceeds 90% of GDP, the country's economic growth should slow significantly. The results were based on an empirical study of 44 countries in the period mostly from the 1990s to 2009. These findings were refuted by Herndon, Ash, and Pollin (2013) arguing for errors in the dataset. Eventually, Reinhart and Rogoff acknowledged their inaccurate results. Although the fact that there is a concrete threshold of debt when economic growth stagnates was confirmed by Cecchetti, Mohanty, and Zampolli (2011). It has been demonstrated that GDP growth and public debt have a negative relationship (Gargouri and Ksantini, 2016; Semik and Zimmermann, 2022). With constructed logistic probability model, Semin and Zimmermann examined determinants of substantial public debt reduction in Central and Eastern European EU member states for the period 1996–2020. To increase the public debt, it is in their opinion necessary to implement structural reforms in order to improve the growth trend. The study by Sadik-Zada and Gatto (2019) conducted in 184 countries with a linear regression model suggests that a 1% increase in economic growth leads to a 3,32% decrease in the share of the central government debt in GDP. This corresponds to their hypothesis, which assumes a negative impact of economic growth on public debt. Using a GMM and fixed-effects models, Delgado-Téllez and Pérez (2020) decided to include lagged real GDP growth as an indicator of the economic cycle. In an analysis of the determinants of Spanish regional public debt, they argue that there are two channels through which GDP growth can affect public debt. The first one is the denominator of the debt-to-GDP ratio, and it is based on assumption that also high government debt ratios may be sustainable, at the same time, low government debt ratios may be unsustainable. The second channel affecting government debt is its impact on debt accumulation. In a study of economic, political, and institutional determinants of public deficits (Woo, 2001), the author considers GDP growth to be a proxy for countries facing economic recession in the period under review. There is an argument that GDP growth can have a positive and also a negative relationship with government surplus. According to Woo (2001), the expected relationship should be positive, but in case of a negative sign in regression, GDP growth could be associated with an expansionary fiscal policy with higher levels of tax revenue due to rising economic growth. The results answering this empirical question suggest a positive relationship, with the growth of economic growth, the government surplus will grow. Pečarić, Slišković, and Kusanović (2018) claim that the most important element of reducing the government debt in new members of the EU is influencing the GDP growth rate.

The interest rate movements may also affect the level of debt. The research by De Broeck and Guscina (2011) concluded that higher debt is associated with higher emission of debt instruments with a fixed coupon, long maturity, and local currency denomination. According to Braga and Vinclette (2011), fixed-rate bonds provide less risk to the government. Based on this assumption, low interest rates of government bonds may result in debt reduction. Similarly, Pečarić, Slišković, and Kusanović (2018) showed a positive impact of 10-year government bond yields on government debt as a percentage of GDP. They explained that this may be due to the high pressure of creditors on higher interest rates, which ultimately leads to a higher level of public debt. In the same vein, Chirwa and Odhiambo (2018) referred that real interest rates are debt creating both in the short-run and long-run. Debt accumulation is positively correlated to interest rate, they stated.

A budget deficit or surplus may be also an important determinant of government debt. The logical assumption in this direction would be that in the event of a government budget surplus, debt will be reduced because there is no need to borrow and vice versa. This statement is supported by several studies, for example by Pečarić, Slišković, and Kusanović (2018). Using the random effect static panel model, they concluded the negative effect of primary budgetary balance on public debt. Accordingly, Briceño and Perote (2020) demonstrated a negative relationship by applying lagged primary balance variable. In addition, they pointed to the financial support provided by the EU to maintain the economic industry during the pandemic and to achieve a surplus in operating balance. Randomeffects and fixed-effects model results in the Bellot, Selva, and Menendez study (2017) confirm the significant influence of primary operating balance to operative revenue ratio on debt levels. As we stated in the previous chapter, the maximum general government deficit in euro area member states should not exceed 3% of GDP. In such a case, the country would have to undergo an excessive deficit procedure to ensure stability in the EU.

The country's macroeconomic stability can be monitored through inflation. This is the reason why authors often add inflation to public debt research. Woo (2001) assumed fiscal deficits may be influenced by inflation through various channels. In his view, a high level of inflation can cause a reduction in tax incomes. In case income taxes are not indexed to inflation, the impact of inflation on deficits could be compensated by the positive effect of bracket creep on income tax revenue. In the end, the results claimed the negative effect of inflation on public surplus only in developed countries. The negative relationship between mentioned variables is recognized by many authors (Gargouri and Ksantini, 2016; Filip, 2019; Sinha, Arora, and Bansal, 2011; Omrane Belguith and Omrane, 2017; Pečarić, Slišković, and Kusanović, 2018; Briceño and Perote, 2020; De Broeck and Guscina, 2011). Interestingly, a study of the determinants of public debt in the euro area by Chirwa and Odhiambo (2018) argues that the relationship between inflation and public debt growth in the short run may depend on the European countries observed. Their findings reveal the debt-reducing relationship in the United Kingdom, France, and Ireland, but in the other states, results indicate the opposite, debt-creating relationship.

As we saw at the beginning of the pandemic in 2020, the inflation rate fell sharply. This is due to the slowdown in economic activity. Demand was reduced and the elasticity of inflation was demonstrated by a decline in the price level (Wieland, 2022). Countries with the highest difference in inflation rate between 2019 and 2020 are Slovenia, Latvia, and Estonia. Meanwhile, countries with the lowest difference include Austria, Portugal, and France (Figure 3). In the case of countries with lower disparities, this may indicate that their economies have not been significantly affected by the pandemic.

Figure 3 Inflation Rate in euro area countries



Source: Data from World Bank, own processing

Macroeconomic indicators potentially affecting government debt include trade openness. Some authors use export or import separately for the same purpose. According to Woo (2001), trade openness can be considered as a proxy for external shocks in the economy and as trade increases, the public surplus should increase. In his opinion, there are two ways of the possible impact on the public sector balance. Firstly, through the export profits of public enterprises, and secondly, through import taxes and import tariffs. Finally, research showed that the trade variable was insignificant. On the other hand, Gargouri and Ksantini (2016) found a strong impact of imports of goods and services on the debt-to-GDP ratio. In this vein, the negative and significant effect of the trade balance on the monitored ratio was argued by Filip (2019) using linear regression models.

Although some authors claim that the level of government debt is affected only by macroeconomic indicators, the literature also offers other views on this issue. Socioeconomic determinants can also have a major impact on public debt. For example, the expectancy of life at birth illustrates the years that a new-born child can expect to live if subjected throughout his life to the current mortality conditions (European Commission, 2022f). It is assumed, that government should spend more money on the health system, pension system, and other social policies to improve the well-being of citizens. A study by Briceño and Perote (2020) showed a significantly positive relationship between life expectancy and studied fiscal ratio. An increase in life expectancy in one year increases the government debt ratio by approximately 0,48 percentage points. Research on the relationship between debt and health by Clayton, Linnares-Zegarra, and Wilson (2015) indicates a positive impact. They argue that if governments have better access to

unsecured debt, households would be able to respond more quickly to financial shocks and spend more money on health which can be also positively connected to public debt.

The literature also considers a determinant such as the population that could affect the examined fiscal ratio. The authors often chose to use the proportion of people over the age of 65 in the country's total population or use the country's total population. On one hand, Filip (2019) argues in the research of public debt determinants in EU countries that there is a significant positive correlation between population size and debt-to-GDP ratio. On the other hand, the study by Sinha, Arora, and Bansal (2011) did not show a significant impact of the population on the debt ratio in high-income and middle-income group countries. Meanwhile, authors Bellot, Selva, and Menendez (2017) indicate that the effect of population growth and populations over 64 years of age on the studied fiscal ratio depends on the country. In the case of Austria and Belgium, the results show an expected positive impact. This means that the ageing of the population results in higher levels of public spending and possibly higher government debt. Contrastingly, a negative relationship between populations over 64 years and debt has been defined in Italy, France, and Germany. The authors attribute this to the fact that in these countries, such as Spain, there is a high density of communities and better availability of services, which may reduce the debt-to-GDP ratio. Using a panel ARDL approach, Chirwa and Odhiambo (2018) revealed that the population growth has a debt-reducing impact on examined ratio.

According to Briceño and Perote (2020), unemployment is one of the important socioeconomic indicators of debt, as people without work receive unemployment benefits in euro area countries. Due to the cost of unemployment insurance, they assume that an increase in the unemployment rate will result in an increase in the debt-to-GDP ratio. The empirical model showed that an increase in unemployment will rise the studied fiscal ratio between 0,10% and 0,12%, which confirmed the previous assumption. Similarly, Neck and Getzner (2001) in a study on the politico-economic determinants of public debt growth in Austria argue that a 1% increase in unemployment would reduce the primary surplus-to-GDP ratio by more than 0,5 percentage points. Unemployment may lead to a reduction in the revenues of former workers, which means a lack of taxes for the government and, in addition, an increase in the cost of social support, which increases debt (Filip, 2019). This statement was confirmed by the fact that the unemployment rate has a significant positive effect on the debt-to-GDP ratio. In this vein, Barro (1979) pointed out that increased levels of unemployment need social safety measures of governments partially financed by appealing to government debt.

The literature also offers other perspectives on what affects government debt. Some authors argue that institutional indicators such as level of corruption, political stability, government effectiveness, fiscal health, democracy, or tax burden may have an impact on

the studied fiscal ratio. Woo (2001) offers strong evidence of the impact of institutional variables on government debt. In his research, instead of the institutional variables themselves, an aggregate variable consisting of several components related to the quality of the institutions was used. This broad measure of institutional quality reaches a significance of 1% and has a positive sign, which means that an increase in the aggregate institutional variable would lead to an increase in the consolidated public surplus. This suggests that higher-quality government institutions may result in a lower level of government debt. Briceño and Perote (2020) support the claim that there is a relationship between the quality of institutions and the studied fiscal ratio. Using the worldwide governance indicators, they argue that there is a significant impact on government debt. For example, the democracy indicator showed a positive impact on the debt-to-GDP ratio, which means the higher the level of democracy in the country, the higher the examined fiscal ratio. This can be explained by the assumption that more democratic countries are putting pressure on public spending, demanding more public financial support, which may increase the public debt ratio. Similar results about institutional determinants were obtained by Delgado-Téllez and Pérez (2020). Their study of institutional and economic determinants of regional public debt in Spain confirms the direct impact of vertical fiscal imbalances and health expenditure on the debt-to-GDP ratio.

To measure the effect of categorical effect or economic shock on the debt-to-GDP ratio that may be expected to shift the outcome, the authors often include dummy variables of previous economic crises. Historically, government debt increased after every large-scale crisis, such as the global recessions in 1975, 1982, 1991, 2009, and most recently 2020 Covid-19 crisis (Kose et al., 2021). Analysis of the impact of the financial crisis on government debt issuance in eurozone countries by De Broeck and Guscina (2011) indicated the effect of recession and related changes in the macroeconomic environment caused a significant proportion of the deviation in government debt issuance. They concluded that the post-crisis dummy variable is significant in countries with higher debt or deficit. Wolswijk's research (2020) showed that the crisis variable did not have meaningful results. Contrastingly, Briceño and Perote (2020) included the dummies of transitory and also structural changes in economics in their analysis and their findings are exactly the opposite. The first one was statistically insignificant, but the dummy of structural changes defined a significant and positive relationship with the public debt ratio.

DATA AND METHODOLOGY

This paper aims to examine the determinants of government debt in the euro area region. Since in the euro area there is no fiscal union and social policies are not harmonised yet, this topic becomes more and more relevant. As we mentioned in previous paragraphs, existing literature offers a wide overview of the key determinants of debt. Nevertheless, in our opinion is also important to see the connection between the recent pandemic, which caused a big financial shock to the world economy. The focus of this study is on the nineteen (19) eurozone countries for the period 2000-2020 using annual data. These countries were strongly influenced by the crises in the observed period and a pandemic can be expected to be no exception. For this reason, it is interesting to watch the dynamics of government debt in this region.

In our study, we monitored the influence of 14 determinants on the selected dependent variable, which is general government debt as a share of GDP. Applying unbalanced panel data analysis, for this research we used the explanatory variables gathered in Table 2. Data were collected from the World Bank, IMF, ECB, and OECD. To extend the previous analysis, we have included well-known indicators from several sectors in order to achieve a more comprehensive model. Variables for the dynamic panel estimation were selected based on our literature review (especially Briceño and Perote, 2020).

The first group includes macroeconomic variables: government debt in the previous period, GDP growth, the long-term interest rate, net operating balance, inflation rate, and trade openness. The considered socioeconomic variables were life expectancy at birth, population, and unemployment rate. The third group added to the research were institutional variables: government effectiveness and voice and accountability. Finally, we included the recession dummies for the financial crisis in 2008-2009, the debt crisis in 2011-2012, and the covid crisis in 2020.

In the results, in addition to interpretation, we also offer a graphical analysis of the dynamics of the explanatory variables. In our opinion, it is interesting to see the government debt time trend with a variable that may affect it and discuss the possible implications.

| Variable name | Description | Data source | | | |
|------------------|---|--|--|--|--|
| GDebt(-1) | General Government Debt in the previous period (% of GDP) | IMF: Global Debt Database | | | |
| Growth | GDP growth (%) | World Bank: World Development Indicators | | | |
| Interest_rate | Long-term interest rate for convergence purposes, debt security issued, 10-year maturity, denominated in Euro (%) | ECB | | | |
| NOBalance | Net operating balance; Revenues – Expenses (% of GDP) | IMF: Government Finance Statistics | | | |
| Inflation | Inflation, GDP deflator (%) | World Bank: World Development Indicators | | | |
| InTrade | Natural logarithm of Trade (% of GDP) | World Bank: World Developmen Indicators | | | |
| Life | Life expectancy at birth (years, annual) | Eurostat: Sustainable development indicators | | | |
| InPopulation | Natural logarithm of total Population | World Bank: World Development Indicators | | | |
| Unemployment | Unemployment rate (%) | OECD: Labour force statistics | | | |
| Government | Government Effectiveness (Percentile Rank; 100 = highest rank, 0 = lowest rank) | World Bank: Worldwide Governance Indicators | | | |
| Democracy | Voice and Accountability (Percentile Rank; 100 = highest rank, 0 = lowest rank) | World Bank: Worldwide Governance Indicators | | | |
| Financial_crisis | Dummy variable (1 = event of crisis, 0 = other) | Own processed | | | |
| Debt_crisis | Dummy variable (1 = event of crisis, 0 = other) | Own processed | | | |
| Covid_crisis | Dummy variable (1 = event of crisis, 0 = other) | Own processed | | | |

Table 2 Data description and sources

Source: own processing

For the analysis of determinants of government debt, we used the econometrics software Gretl. The relationship between the variables is demonstrated using common linear regression estimators: pooled ordinary least squares model (OLS), the fixed-effects model, and the random-effects model (e.g. Fillip, 2019). Before the start of the regression, two variables have been transformed into a natural logarithm for ease of interpretation: Trade and Population. The empirical analysis is therefore based on the following formula:

$$\begin{split} GDebt &= \beta_0 + \beta_1 \, GDebt(-1) + \beta_2 \, Growth + \beta_3 \, Interest_rate + \beta_4 \, NOBalance \\ &+ \beta_5 \, Inflation + \beta_6 \, ln(Trade) + \beta_7 \, Life + \beta_8 \, ln(Population) \\ &+ \beta_9 \, Unemployment + \beta_{10} \, Government + \beta_{11} \, Democracy \\ &+ \beta_{12} \, Financial_crisis + \beta_{13} \, Debt_crisis + \beta_{14} \, Covid_crisis + \varepsilon \end{split}$$

where β_0 represents constant, β_{1-14} stands for the intercept of the model (coefficient), and ε is an unobserved random error.

Regarding the expected impact of our possible independent variables on general government debt, we have compiled this information in Table 3. Some of them may have a positive relationship and some a negative relationship. The effect we expect is that previous government debt, interest rate, life expectancy, population, unemployment, democracy, and structural change variables may increase the debt-to-GDP ratio and some of them may help reduce it, such as growth, net operating balance, inflation, trade and government efficiency. The individual impacts will be discussed in the following section of the thesis.

| Expected sign |
|---------------|
| (+) |
| (-) |
| (+) |
| (-) |
| (-) |
| (-) |
| (+) |
| (+) |
| (+) |
| (-) |
| (+) |
| (+) |
| (+) |
| (+) |
| |

Table 3 Expected signs of explanatory variables

Source: own processing

To check the accuracy of the results for the full sample, we decided to additionally divide the sample into two groups (Sinha, Arora, and Bansal, 2011), thus running the robustness test. The selected distribution criterion is income. GDP per capita from 2019 has been taken, creating 2 groups of countries (Table 4). Both samples have identical specifications as the main regression. This will allow us to compare and discuss the relationships and the stability of coefficients estimated for the full sample. The reason for the choice of 2019 was to avoid skewed results due to the pandemic in 2020. Subsequently, the impact of the same right-sided variables on the government debt will be tested.

| Euro area country | Income group based on |
|-------------------|-----------------------|
| | 2019 GDP per capita |
| Austria | High income |
| Belgium | High income |
| Cyprus | High income |
| Estonia | Middle income |
| Finland | High income |
| France | High income |
| Germany | High income |
| Greece | Middle income |
| Ireland | High income |
| Italy | High income |
| Latvia | Middle income |
| Lithuania | Middle income |
| Luxembourg | High income |
| Malta | Middle income |
| Netherlands | High income |
| Portugal | Middle income |
| Slovak Republic | Middle income |
| Slovenia | Middle income |
| Spain | Middle income |

Source: Data from World Bank, own processing

The correlation coefficients for the full sample given in Table 5 show the relationships between the variables separately. The highest coefficient is naturally between the current debt-to-GDP ratio and the debt in the previous period (0,986). Secondly, institutional variables are correlated at 0,856, which can be explained by their similarity in fundamentals. We included them to see the effects of both. All other coefficients of correlation are in the acceptable amount that should not affect the results of the estimates.

Table 5 Correlation matrix for the full sample

| Gdebt | Gdebt(-1) | Growth | Interest_rate | NOBalance | Inflation | Life | Unemployment | Government | Democracy | Financial_crisis | Debt_crisis | Covid_crisis | In Trade | In Population | |
|-------|-----------|--------|---------------|-----------|-----------|--------|--------------|------------|-----------|------------------|-------------|--------------|----------|---------------|------------------|
| 1 | 0,986 | -0,354 | 0,108 | -0,492 | -0,395 | 0,581 | 0,371 | -0,251 | -0,147 | -0,077 | 0,085 | 0,107 | -0,435 | 0,490 | Gdebt |
| | 1 | -0,246 | 0,080 | -0,419 | -0,367 | 0,580 | 0,364 | -0,253 | -0,141 | -0,131 | 0,054 | 0,042 | -0,428 | 0,494 | Gdebt(-1) |
| | | 1 | -0,156 | 0,459 | 0,386 | -0,285 | -0,159 | 0,026 | 0,001 | -0,383 | -0,120 | -0,353 | 0,258 | -0,239 | Growth |
| | | | 1 | -0,304 | -0,005 | -0,301 | 0,431 | -0,337 | -0,320 | 0,173 | 0,239 | -0,307 | -0,222 | -0,049 | Interest_rate |
| | | | | 1 | 0,329 | -0,118 | -0,509 | 0,298 | 0,290 | -0,110 | -0,176 | -0,223 | 0,293 | -0,261 | NOBalance |
| | | | | | 1 | -0,434 | -0,248 | -0,080 | -0,086 | -0,042 | -0,033 | -0,104 | 0,062 | -0,177 | Inflation |
| | | | | | | 1 | -0,095 | 0,306 | 0,442 | -0,024 | 0,066 | 0,081 | -0,102 | 0,319 | Life |
| | | | | | | | 1 | -0,501 | -0,548 | -0,061 | 0,154 | -0,089 | -0,339 | 0,195 | Unemployment |
| | | | | | | | | 1 | 0,856 | -0,008 | -0,016 | -0,001 | 0,210 | 0,031 | Government |
| | | | | | | | | | 1 | 0,014 | -0,036 | 0,005 | 0,205 | 0,088 | Democracy |
| | | | | | | | | | | 1 | -0,106 | -0,071 | -0,042 | 0,001 | Financial_crisis |
| | | | | | | | | | | | 1 | -0,071 | 0,042 | 0,002 | Debt_crisis |
| | | | | | | | | | | | | 1 | 0,048 | -0,009 | Covid_crisis |
| | | | | | | | | | | | | | 1 | -0,763 | InTrade |
| | | | | | | | | | | | | | | 1 | InPopulation |

RESULTS

After testing many other alternatives with different independent variables, Table 7 displays the best model specifications. We tested the same right-handed variables using different estimators. R-squared number of OLS and fixed-effects models suggest that the regression explains more than 96% of the variability of the dependent variable. This means that we have chosen the correct right-hand variables, which explain the dynamics of the debt-to-GDP ratio. Furthermore, F-statistics and their p-values determine the significance of the model. In both OLS and fixed-effects models, the value is lower than 0,05, which denotes those models are significant as a whole. According to the test for differing group intercepts, which tells us whether the estimation in OLS or fixed effects is more appropriate, the p-value is less than 0,05 meaning we should prefer to use fixed-effects. Hausman test with the p-value greater than 0,05 asserts to prefer the random-effects model to a fixed-effects (Brooks, 2008). Nevertheless, we decided to use all types of regressions and discuss differences in their results.

Summary statistics (Table 6) show the mean, median, standard deviation, minimum, and maximum of our variables. As can be seen, the lagged dependent variable is quite volatile, the average is 64,01% of GDP and the maximum is almost 190% of GDP. The interesting mean has variable NOBalance with the average value of -1,74% of GDP. This means that general government budgets in the euro area countries are more in deficit than in surplus, which is not a surprise after several downturns.

| Table o Summary Statistics for the full sample | | | | | | | | | | |
|--|-------|--------|-----------------------|---------|---------|--|--|--|--|--|
| Variable | Mean | Median | Standard deviation | Minimum | Maximum | | | | | |
| GDebt(-1) | 64,01 | 61,91 | 37,92 | 3,77 | 189,90 | | | | | |
| Growth | 2,10 | 2,29 | 4,12 | -14,80 | 25,20 | | | | | |
| Interest_rate | 3,59 | 3,89 | 2,56 | -0,51 | 22,50 | | | | | |
| NOBalance | -1,74 | -1,72 | 3,99 | -30,63 | 7,74 | | | | | |
| Inflation | 2,15 | 1,85 | 2,44 | -9,73 | 20,10 | | | | | |
| InTrade | 4,70 | 4,73 | 0,52 | 3,82 | 6,01 | | | | | |
| Life | 79,30 | 80,20 | 3,070 | 70,20 | 84,00 | | | | | |
| InPopulation | 15,65 | 15,51 | 1,54 | 12,87 | 18,24 | | | | | |
| Unemployment | 8,96 | 7,95 | 4,59 | 1,81 | 27,70 | | | | | |
| Government | 84,50 | 84,50 | 9,38 | 60,10 | 100,00 | | | | | |
| Democracy | 86,40 | 87,40 | 8,55 | 68,10 | 100,00 | | | | | |
| Financial_crisis | 0,10 | 0,00 | 0,29 | 0,00 | 1,00 | | | | | |
| Debt_crisis | 0,10 | 0,00 | 0,29 | 0,00 | 1,00 | | | | | |
| Covid_crisis | 0,05 | 0,00 | 0,21 | 0,00 | 1,00 | | | | | |

Table 6 Summary statistics for the full sample

Main results

| Dependent variable: General Government Debt (% GDP) | Pooled OLS | | | Fi | xed-effe | cts | Random-effects | | |
|---|-------------|----------|-----------|-------------|----------------------|-----------|----------------|-----|-----------|
| · _ · _ · | Coefficient | | p-value | Coefficient | | p-value | Coefficient | | p-value |
| Gdebt(-1) | 0,9429 | *** | (<0,0001) | 0,8745 | *** | (<0,0001) | 0,8891 | *** | (<0,0001) |
| Growth | -0,7946 | *** | (<0,0001) | -0,8185 | *** | (<0,0001) | -0,8354 | *** | (<0,0001) |
| Interest_rate | -0,0775 | | (0,5445) | -0,5215 | *** | (0,0023) | -0,4753 | *** | (0,0039) |
| NOBalance | -0,7726 | *** | (<0,0001) | -0,8208 | *** | (<0,0001) | -0,8010 | *** | (<0,0001) |
| Inflation | -0,0332 | | (0,7926) | -0,0338 | | (0,8009) | -0,0675 | | (0,6033) |
| InTrade | -1,9267 | ** | (0,0112) | 2,8419 | | (0,3888) | 1,7537 | | (0,5739) |
| Life | 0,3062 | ** | (0,0177) | -0,0842 | | (0,8145) | -0,1666 | | (0,6251) |
| InPopulation | -0,7873 | *** | (0,0029) | -11,3240 | ** | (0,0306) | -2,3876 | | (0,3953) |
| Unemployment | 0,0191 | | (0,7927) | 0,2031 | * | (0,0894) | 0,1464 | | (0,1977) |
| Government | -0,0835 | * | (0,0785) | -0,2070 | *** | (0,0044) | -0,1721 | ** | (0,0122) |
| Democracy | 0,0292 | | (0,6176) | -0,2105 | ** | (0,0290) | -0,1797 | * | (0,4115) |
| Financial_crisis | 0,5448 | | (0,5202) | 0,3102 | | (0,7104) | 0,2894 | | (0,7233) |
| Debt_crisis | 1,3268 | * | (0,0899) | 1,6843 | ** | (0,0362) | 1,7501 | ** | (0,0253) |
| Covid_crisis | 3,5368 | *** | (0,0080) | 3,0400 | ** | (0,0276) | 2,8099 | ** | (0,0357) |
| Constant | 6,8508 | *** | (0,5532) | 216,8850 | *** | (0,0081) | 81,4084 | * | (0,0933) |
| Observations | | 341 | | | 341 | | | 341 | |
| R-squared | | 0,9897 | | | 0,9628 | | | - | |
| F-statistics | | 2232,052 | 2 | | 1057,27 | 5 | | - | |
| P-value (F) | | 0 | | | 1,2 ^{e-294} | | | - | |

Table 7 Results for the full sample

*** denotes significance at 1% level; ** denotes significance at 5% level; * denotes significance at 10% level

Macroeconomic variables

The establishment of the Euro Area in 1999 with 11 founding members brought many regulations, which we discussed already in the theoretical part of the study. Maastricht criteria include the 3% of actual government deficit to GDP threshold and 60% of government debt-to-GDP threshold which should not be exceeded. In fact, these reference values were eventually exceeded by almost all member states mainly during the recessions. For example, in terms of the limit of government debt, Greece and Italy have never fallen below 100% of the debt-to-GDP ratio since 2000. On the contrary, a good example in terms of debt can be Luxembourg with a reference value of 60% never exceeded. Figure 4 shows the development of the debt-to-GDP ratio in Austria, Greece, Ireland, Italy, and Luxembourg. The average debt ratio in the euro area exceeded 60% during the financial crisis and has only been rising since then. The trend of this variable is therefore increasing rather than decreasing.





Source: Data from IMF, own processing

Thus, the first explanatory variable we have chosen, *general government debt in the previous period*, is in all three models considerably significant. With the debt rising by 1% last year, we expect this year's government debt to grow by around 0,90%. The positive relationship confirmed our assumptions, which are in line with most authors (Gargouri and Ksantini, 2016; Woo, 2001; Pečarić, Slišković, and Kusanović, 2018; Chirwa and Odhiambo, 2018; Wolswijk, 2020). Hence, lagged government debt shows its persistence during the observed period.

GDP is the most widely used indicator of the size and health of an economy over a period of time. Therefore, we assumed a strong impact of this variable on the debt-to-GDP ratio. Figure 5 presents selected countries and their *GDP growth*. As we would expect, the economic growth slowed during the recession in the economic cycle. According to our data, Lithuania was hit the hardest during the financial crisis. On the other hand, Greece's GDP growth was the lowest in 2011, in time of the debt crisis. An interesting case is Ireland, whose GDP growth reached 25% in 2015. Due to low corporate tax rates, many multinational large companies have moved their business to this country, which explains this rapid growth (OECD, 2016).



Figure 5 Growth in selected countries

Source: Data from World Bank, own processing

The results of regressions confirm a strong negative relationship between GDP growth and the studied fiscal ratio. With GDP growth increasing by 1%, the debt-to-GDP ratio should fall by around 0,80%. Figure 6 displays the average debt ratio and the average GDP growth in the euro area, which indicate the inverse relationship between these two variables. Therefore, our findings are in line with Gargouri and Ksantini (2016) and Semik and Zimmermann (2022). The GDP growth variable is significant at a 1% level, so our regression confirms that it determines the level of debt in GDP.



Figure 6 Average Debt-to-GDP ratio and average Growth in euro area countries

Source: Data from IMF and World Bank, own processing

The next variable of interest is the long-term *interest rate* in eurozone countries. According to European Central Bank (2022c), these statistics apply to the monthly average interest rates for long-term government bonds issued by each country. Figure 7 shows the interest rate in Belgium, Cyprus, Germany, Greece, Latvia, Portugal, Spain, and the average rate in the euro area. Until the financial crisis in 2008, the values ranged from 3% to 6%. Since then, they have become more volatile, for example in Greece, Portugal, and Latvia.



Figure 7 Long-term Interest rates in selected countries

Source: Data from ECB, own processing

Based on our assumption, this variable should have a positive effect on debt, which was not confirmed by our estimations. The expected relationship was that as long-term government bond interest rates rise, bond prices fall, which may lead to an increase in the debt-to-GDP ratio. As we can see in our results, the variable is significant in the fixed-effects model and random-effects model at 1%. An increase in the long-term interest rate by 1% will result in a reduction of around 0,5% in the examined fiscal ratio. The reason for this negative impact is the inclusion of Greece in our regressions. In this euro area member state, as can be seen in Figure 7, interest rates were rising sharply as a result of the 2011 debt crisis (22,5% in 2012). With the omission of Greece, the results indicate a positive relationship between interest rates and the studied fiscal ratio in all estimators. The average interest rates, including Greece, and their relationship to the debt-to-GDP ratio can be seen in Figure 8.



Figure 8 Average debt-to-GDP ratio and average Interest rate in euro area countries

Source: Data from IMF and ECB, own processing

Macroeconomic variables affecting debt include the *net operating balance*. This variable is calculated as revenue minus expenses in each general government balance sheet. A positive number for this variable indicates that the government has more revenue than expenses per year and vice versa. Figure 9 displays the net operating balance of selected euro area countries. The huge drop in Ireland's operating balance in 2010 could not be overlooked. After the failure of Anglo Irish Bank, which was too big to fail, the government had to rewrite its budget to cut borrowing in the following years. This bail-out cost the Irish government €45 billion (BBC, 2010). In addition, there are only two countries whose operating balance was above zero between 2000 and 2019: Luxembourg and Estonia.



Figure 9 Net Operating Balance in selected countries

Source: Data from IMF, own processing

The expected relationship between net operating balance and debt-to-GDP ratio was negative. This assumption was confirmed by all three estimators. The estimate indicates that an increase in the share of the operating balance in GDP by 1% will result in a reduction of around 0,8% in the examined fiscal ratio (in line with Bellot, Selva, and Menendez, 2017; Pečarić, Slišković, and Kusanović, 2018; Briceño and Perote, 2020). The variable is strongly (1%) significant in all models, suggesting that the net operating balance is a determinant of government debt. The inverse relationship of these variables can be seen in Figure 10.



Figure 10 Average Debt-to-GDP ratio and average NOBalance in euro area countries

Source: Data from IMF, own processing

Inflation is another macroeconomic variable added to the regression. Figure 11 shows the possible inverse relationship between the average inflation and the average debt ratio. Despite the high significance presented in studies by other authors (e.g. Gargouri and Ksantini, 2016; Filip, 2019; Sinha, Arora, and Bansal, 2011; Omrane Belguith and Omrane, 2017), our results do not show any significant relationship with the dependent variable.



Figure 11 Average Debt-to-GDP ratio and average Inflation in euro area countries

Source: Data from IMF and World Bank, own processing

The last macroeconomic variable chosen with a possible impact on the debt-to-GDP ratio is *Trade*. It is expressed as a sum of exports and imports of goods and services in the country measured as a share of GDP. As displayed in Figure 12, there are big differences between euro area countries. The share of trade in Luxembourg's GDP in 2015 exceeded 400%, which is the highest in the euro area. This is because Luxembourg is one of the most open countries in terms of exports, and in 2020 it became the first country in the world to rank first in the trade openness rankings (World Bank, 2022a). In this vein, Malta and Ireland are among the countries with a high trade indicator in the euro area. The average euro area trade openness indicator oscillates around 125% of GDP.





Source: Data from World Bank, own processing

The regression results show significant variable InTrade only in pooled OLS model at level 10%. The impact can be interpreted as meaning that with a 1% increase in InTrade, the debt-to-GDP ratio will decrease by almost 0,02%. The relationship between trade openness and the examined fiscal ratio is therefore negative, which is in line with Filip (2019). Figure 13 shows the average dependent variable and average trade. For the purposes of regression, this variable was transformed into the natural logarithm.



Figure 13 Average Debt-to-GDP ratio and average Trade in euro area countries

Source: Data from IMF and World Bank, own processing

Socioeconomic variables

The three regressions of government debt determinants also include socioeconomic variables. The expected effect on the debt-to-GDP ratio is positive. The first variable which we have tested is *life expectancy at birth* expressed in years. Rising this variable should increase the debt ratio. But before confirming that, we should see the trend of life expectancy in Figure 14. The dynamics were rising at least until the pandemic when growth slowed. According to OECD (2020), an indicator of life expectancy was rising every year above 2,5 years on average in the EU. In Spain and Italy, this indicator is above average in the euro area. Countries with low life expectancy include Latvia, Lithuania, and the Slovak Republic. The explanation could concern not only the quality of food or lifestyle, but also how much the government spends on health care. On a per-capita basis, the governments of Western and Northern Europe spend three times more on the health sector than some low spending countries in Central and Eastern Europe (OECD, 2020).



Figure 14 Life expectancy at birth in selected countries

Source: Data from Eurostat, own processing

Life expectancy showed to be significant only in pooled OLS model, statistically at 5% level. The relationship is positive as we expected (Figure 15), which is in accordance with Briceño and Perote (2020). The interpretation would be that government debt-to-GDP will increase by approximately 0,31% if the life expectancy rate increases by 1 year. This result suggests that if governments spend more on health care, debt will increase on the one hand, but citizens' lives will be extended on the other.



Figure 15 Average Debt-to-GDP ratio and average Life in euro area countries

Source: Data from IMF and Eurostat, own processing

Literature also often considers *Population* to be one of the determinants of debt. With the higher population, there is expected to be higher debt because the government must support more people in terms of social systems. The differences in population within the euro area are dramatically big (Figure 16). For example, the biggest country, Germany with 83,24 million citizens in 2020 may be more likely to have higher debt. On the contrary, Luxembourg, with only a population of 620 thousand in 2020, may not have a problem managing the health and pension system.



Figure 16 Population in selected countries

Source: Data from World Bank, own processing

Variable InPopulation does not show to be statistically significant in all estimators. The transformed variable confirmed its significance in pooled OLS (1% level) and fixedeffects model (5%). Furthermore, we expected a positive relationship, but the effect in our regression suggests a negative one. In that case, with a 1% increase in the population, the debt-to-GDP ratio will decrease by around 0,008% (OLS) or 0,11% (Fixed effects). These results can be explained by the fact that the impact does not only depend on the number of population, but also on the age structure of the citizens. For example, when a country has more people in active years who contribute to the state budget through taxes and levies, this can have a negative impact on the government debt. Figure 17 presents the average debt-to-GDP ratio and average population in the euro area. Our findings confirmed that the population is one of the determinants of debt and are consistent with Chirwa and Odhiambo (2018).



Figure 17 Average Debt-to-GDP ratio and average Population in euro area countries

Source: Data from IMF and World Bank, own processing

The last socioeconomic variable we included in the regression is *Unemployment*. The unemployment rate is considered an indicator of the health of the economy. We expect the debt-to-GDP ratio to increase as the unemployment rate rises. The countries with the lowest unemployment rate in 2020 include Germany with 3,9% and the Netherlands with 3,87%. Quite the opposite cases are Greece with 16,48% and Spain with 15,65% in 2020 (Figure 18). This may be due to the fact that these countries are highly dependent on tourism, which is a relatively unstable sector. For comparison, the average unemployment rate in the euro area was 7,55% in 2020.



Figure 18 Unemployment rate in selected countries

Source: Data from OECD, own processing

Significance at the 10% level and a positive effect was shown by the variable unemployment only in the model with fixed effects. This means that if the unemployment rate increases by 1%, the debt-to-GDP ratio will increase by 0,2%. The reason could be related to the support of unemployment by governments in the euro area region. As the unemployed population grows, spending on unemployment benefits will increase, and so will the debt ratio. The positive relationship between the averages of these two variables is displayed also in Figure 19. Our findings are in line with Filip (2019) and Briceño and Perote (2020).



Figure 19 Average Debt-to-GDP ratio and average Unemployment in euro area countries

Source: Data from IMF and OECD, own processing

Institutional variables

As we mentioned in the literature review, there is strong evidence that government debt is affected by institutional variables. We included *Government effectiveness* and voice and accountability which represents *Democracy* in our regressions.

The expected relationship between government effectiveness and the debt-to-GDP ratio is negative. According to the World Bank, this variable captures the perception of the quality of several components of the general government sector: including the civil service and the degree of its independence from political pressures, policy formulation, and implementation, and the credibility of the government's commitment to such policies (World Bank, 2022b). The higher the rank, the higher government effectiveness. As we may see in Figure 20, the average percentile rank regarding this variable is around 85. The countries with the highest rank include Finland and Netherlands. These two ranked in the top 5 in the ranking of happiest countries worldwide (Statista, 2021). On the contrary,

countries which have something to improve in the efficiency of government are Greece and Italy.



Figure 20 Government effectiveness in selected countries

Source: Data from World Bank, own processing

The results confirmed the expected sign in the regression (Figure 21). Also, the significance of this variable is advocated in all three estimators: at 10% level in the OLS model, at 5% level in the random-effects model and at 1% level in the fixed-effects model. Therefore, increasing the government efficiency variable by 1 point will reduce the debt-to-GDP ratio by 0,08% (OLS); 0,21% (Fixed-effects); 0,17% (Random-effects). Hence, the findings of regressions are in accordance with Woo (2001) and Briceño and Perote (2020).



Figure 21 Average Debt-to-GDP ratio and average Government in euro area countries

Source: Data from IMF and World Bank, own processing

The second institutional variable included in our three estimators is the level of democracy measured by voice and accountability. The indicator captures the perception of the extent to which the country's citizens can participate in the choice of government, as well as freedom of expression, freedom of association, and free media (World Bank, 2022b). We assume the positive relationship between democracy and the debt-to-GDP ratio. The higher the rank, the higher the democracy in the country. Once again, countries with the highest ranks in the euro area are Finland and Netherlands (Figure 22). Latvia and Slovakia, on the other hand, are the lowest-ranked countries. The reason may be that both countries have been in the communist regime in the past, which may still have implications for the quality of their institutions.

Figure 22 Democracy in selected countries



Source: Data from World Bank, own processing

The democracy variable had significance in two models: at 5% level in the fixedeffects model and at 10% level in the random-effects model. However, the relationship is the opposite of our expectations. The results denote that with an increase in democracy in 1 point, the dependent variable will reduce by 0,21% (fixed-effects) or 0,18% (randomeffects). Figure 23 shows the inverse relationship between the averages of the variable democracy and the debt-to-GDP ratio, indicating their negative impact.



Figure 23 Average Debt-to-GDP ratio and average Democracy in euro area countries

Source: Data from IMF and World Bank, own processing

Structural change variables

Considering the recent pandemic, it was necessary to include dummies for structural changes in our regressions. We can thus monitor their impact on the debt-to-GDP ratio. The assumed relationship between crisis dummies and the debt-to-GDP ratio is positive. Unfortunately, the financial crisis that occurred in 2008-2009 did not show to be a determinant of debt according to our results.

On the other hand, the debt crisis which affected several countries during 2011-2012 in the euro area, especially Greece, is in our regressions statistically significant. The results show that in an event of a debt crisis, the debt-to-GDP ratio will rise by 1,33% (OLS), by 1,68% (fixed-effects), and by 1,75% (random-effects). The relationship is therefore positive which is in line with Briceño and Perote (2020).

The covid crisis dummy has according to regression results greater impact compared to the debt crisis. Significance levels are 1% in pooled OLS model and 5% in fixed-effects and random-effects models. The impact indicated by our estimators is positive, as expected. During the pandemic, the studied fiscal ratio increased by 3,5% (OLS), by 3,04% (fixed-effects), and by 2,81% (random-effects). Let us remember the increase in the government borrowing on financial markets to raise funds to support healthcare during a pandemic which we discussed in the theoretical part of this thesis. Finally, we can state that our findings are consistent with Briceño and Perote (2020).

Results of the divided samples

| Dependent variable: General Government Debt (% GDP) | Pooled OLS | | | Fixed-effects | | | Random-effects | | |
|---|-----------------------|--------|-----------|-----------------------|--------|----------------|----------------|-----|-----------|
| | Coefficient | | p-value | Coefficient | | <i>p-value</i> | Coefficient | | p-value |
| Gdebt(-1) | 0,9515 | *** | (<0,0001) | 0,8813 | *** | (<0,0001) | 0,8990 | *** | (<0,0001) |
| Growth | -0,8095 | *** | (<0,0001) | -0,9424 | *** | (<0,0001) | -0,9596 | *** | (<0,0001) |
| Interest_rate | -0,5596 | *** | (0,0076) | -0,9026 | *** | (0,0006) | -0,8640 | *** | (0,0005) |
| NOBalance | -0,8699 | *** | (<0,0001) | -0,8833 | *** | (<0,0001) | -0,8574 | *** | (<0,0001) |
| Inflation | 0,0637 | | (0,7228) | 0,0538 | | (0,7811) | 0,0719 | | (0,7022) |
| InTrade | -3,9511 | ** | (0,0240) | 4,8345 | | (0,4115) | 3,7471 | | (0,4996) |
| Life | 0,2604 | | (0,2152) | -0,6509 | | (0,2552) | -0,5428 | | (0,3131) |
| InPopulation | -0,9693 | | (0,1685) | -9,4155 | | (0,3839) | 0,2699 | | (0,9566) |
| Unemployment | -0,0585 | | (0,6582) | 0,1213 | | (0,4890) | 0,1186 | | (0,4849) |
| Government | -0,2168 | ** | (0,0316) | -0,2151 | * | (0,0821) | -0,1818 | | (0,1131) |
| Democracy | 0,0077 | | (0,9396) | -0,3291 | * | (0,0937) | -0,2195 | | (0,1915) |
| Financial_crisis | -0,7524 | | (0,6225) | -1,9373 | | (0,2221) | -1,7312 | | (0,2593) |
| Debt_crisis | 2,2569 | | (0,1148) | 1,7765 | | (0,2571) | 1,9079 | | (0,2087) |
| Covid_crisis | 1,9515 | | (0,3955) | 1,5010 | | (0,5520) | 1,2412 | | (0,6085) |
| Constant | 36,4571 | * | (0,0648) | 226,7483 | | (0,2141) | 62,4046 | | (0,4933) |
| Observations | | 152 | | | 152 | | | 152 | |
| R-squared | | 0,9898 | | | 0,9657 | | | - | |
| F-statistics | 1051,435 | | | 692,974 | | | - | | |
| P-value (F) | 7,08 ^{e-132} | | | 8,63 ^{e-123} | | | - | | |

Table 8 Results for the middle-income countries

*** denotes significance at 1% level; ** denotes significance at 5% level; * denotes significance at 10% level

| Dependent variable: General Government Debt (% GDP) | Pooled OLS | | | Fixed-effects | | | Random-effects | | |
|---|-----------------------|-----|-----------|-----------------------|-----|-----------|----------------|-----|-----------|
| | Coefficient | | p-value | Coefficient | | p-value | Coefficient | | p-value |
| Gdebt(-1) | 0,9151 | *** | (<0,0001) | 0,8775 | *** | (<0,0001) | 0,8881 | *** | (<0,0001) |
| Growth | -0,8754 | *** | (<0,0001) | -0,8930 | *** | (<0,0001) | -0,8948 | *** | (<0,0001) |
| Interest_rate | 0,6312 | ** | (0,0150) | 0,9871 | *** | (0,0007) | 1,0300 | *** | (0,0002) |
| NOBalance | -0,6681 | *** | (<0,0001) | -0,6383 | *** | (<0,0001) | -0,6494 | *** | (<0,0001) |
| Inflation | -0,5231 | *** | (0,0084) | -0,4586 | | (0,0217) | -0,4566 | ** | (0,0186) |
| InTrade | 0,1664 | | (0,8255) | 1,7001 | | (0,6394) | 0,1885 | | (0,9555) |
| Life | 0,4447 | | (0,1686) | 1,5514 | *** | (0,0013) | 1,3050 | *** | (0,0030) |
| InPopulation | -0,2680 | | (0,3254) | -15,7801 | * | (0,0545) | -5,3167 | | (0,2413) |
| Unemployment | 0,1121 | | (0,3636) | 0,1036 | | (0,5880) | 0,0111 | | (0,9500) |
| Government | -0,0941 | * | (0,0668) | -0,2362 | *** | (0,0050) | -0,2440 | *** | (0,0026) |
| Democracy | -0,0302 | | (0,6761) | -0,2203 | ** | (0,0448) | -0,2154 | ** | (0,0433) |
| Financial_crisis | 0,4223 | | (0,6306) | -0,4852 | | (0,5847) | -0,5031 | | (0,5627) |
| Debt_crisis | 1,2148 | | (0,1358) | 0,5841 | | (0,4777) | 0,6056 | | (0,4520) |
| Covid_crisis | 5,0666 | *** | (0,0003) | 5,6017 | *** | (<0,0001) | 5,2035 | *** | (0,0001) |
| Constant | -15,6208 | | (0,6059) | 169,1274 | | (0,2141) | 27,9280 | | (0,6919) |
| Observations | 189 | | | 189 | | | 189 | | |
| R-squared | 0,9914 | | | 0,9715 | | | - | | |
| F-statistics | 1546,492 | | | 1030,825 | | | - | | |
| P-value (F) | 2,00 ^{e-174} | | | 1,21 ^{e-165} | | | - | | |

Table 9 Results for the high-income countries

*** denotes significance at 1% level; ** denotes significance at 5% level; * denotes significance at 10% level

Middle-income countries

The results of the middle-income countries sample (Table 8) show high significance according to a p-value of the F-statistics (1% level). R-squared are in both pooled OLS and fixed-effects comparable with the main results, which is higher than 96%.

As we can see, in terms of macroeconomic variables, there are comparatively large coefficients of influence as in the main results. Government debt in the previous period, GDP growth, long-term interest rate, net operating balance and trade have confirmed an impact on the debt-to-GDP ratio. Inflation is insignificant in all estimated models same as well as in the main results. Socioeconomic variables do not seem to determine debt in middle-income countries due to their insignificance. Government effectiveness and Democracy illustrate the effect on the studied fiscal ratio, mostly in the fixed-effects model. Relationships are negative as in the main results. Finally, all structural change variables are insignificant, which is interesting because they showed a strong impact on the debt ratio in the full sample.

High-income countries

The estimations of determinants of government debt in high-income countries are also promising (Table 9). High R-squared in both pooled OLS (99%) and fixed-effects (97%) models suggests that the variability of the dependent variable is well explained. In addition, this claim is confirmed by the p-values of the F-statistics.

The size of the coefficients of macroeconomic variables is, with a few exceptions, the same as in the main results. The exception is especially the long-term interest rate variable with a positive sign across all models, as we assumed for all regressions. This variable indicates that a 1% increase in the long term interest rate will lead to an increase in the debt-to-GDP ratio of 0,67% (OLS), 0,99% (fixed-effects) or 1,03% (random-effects). These influences are relatively big in comparison with the main results. The reason for this surprisingly expected change from the main results could be that Greece is included in middle-income countries, so this regression was not affected by possible distortions. Another variable that does not correspond to the main results is inflation. In the case of high-income countries, it has shown to be significant in the pooled OLS and random-effects models. The impact is negative, with a 1% increase in inflation, the debt-to-GDP ratio will decrease by 0,52% (OLS) or 0,46% (random-effects). The variable of trade openness is not significant in the sample of high-income countries.

Some of the socioeconomic variables illustrate the strong impact on the debt ratio in the countries with high income. First, life expectancy shows that 1 year increase in this variable will increase the studied fiscal ratio by 1,55% (OLS) or 1,31 (random-effects). These results indicate a huge difference in impact compared to the main results. Secondly, the unemployment rate does not show to be a determinant of government debt in highincome countries due to its insignificancy. Lastly, the population is significant at a 10% level in fixed-effects with a comparable coefficient as in the main results.

In terms of institutional variables, they both showed the same relationship with the debt-to-GDP ratio as in the main results. Although, the coefficients in the random-effects model are a little higher.

The last group of variables in the high-income sample includes the financial crisis, the debt crisis and the covid crisis. Unfortunately, only the latter indicated a significant impact on the examined fiscal ratio. The covid crisis structural change variable has higher coefficients in all three estimators. The results argue that in time of pandemic the debt-to-GDP ratio will increase by approximately 5,3%.

DISCUSSION

In this section, we will summarise and discuss the results of the models we had estimated. The overall outcomes of our estimates have shown that most of the variables involved determine the level of debt in the euro area countries.

Sound public finance and sovereign debt sustainability are key objectives of fiscal policy within the EU. Currently, the European Commission is discussing the new budgetary plans for 2022. The topic of interest is debt sustainability, which is desirable to achieve. Following the covid-19 crisis and the current war in Ukraine, it is necessary to support the budgets of countries with higher debt-to-GDP ratios, such as Greece, Italy, and Portugal (Figure 24), and to pursue prudent fiscal policies. The support provided by the EU is a Recovery and Resilience Facility that helps with implementing reforms and investments in order to achieve among other things climate neutrality and digital transitions. At the same time, the EC recommends the EU members adopt more differentiated fiscal policies in 2022 (Bardone et al., 2021).





Source: Data from IMF, own processing

The government debt can be affected by many exogenous and endogenous factors. In this research, we aimed to include the indicators from various sectors which may have the potential to impact the debt ratio. We tried to find the implications which could lead to a reduction or growth of the studied fiscal ratio.

The regressions demonstrated in the thesis have promising and mostly expected results. In total, all nine models are statistically significant (based on the p-value of F-statistics), so we can say that the specification we have chosen is appropriate. With respect to R-squared, the dynamics of the dependent variable, which was general government debt as a percentage of GDP, were explained in all estimates.

The macroeconomic variables which are shown to be determinants of debt-to-GDP include government debt in the previous period, GDP growth, long-term interest rate, net operation balance, and trade openness. It is understandable, that the lagged dependent variable will affect the studied fiscal ratio positively. The trend of this variable is upward, and we, therefore, consider it appropriate to discuss new fiscal rules to reduce debt in the EU. What is more, the participants of the survey by the European Commission (2020g) think that the debt and deficit criteria anchored in the Maastricht Treaty should be revised upwards to include the expected costs of the compulsory public investment. This view is shared also by trade unions, think-tanks, and us. Economic growth with an inverse relationship to the debt-to-GDP ratio was significant in all nine models. This demonstrates the importance of support for the countries most affected by the recession. Stopping economic growth would further exacerbate the already high levels of debt. For example, in case of a pandemic, the most affected countries included Italy, Spain, and Greece which were allowed to use the Recovery and Resilience Facility to support their recovery. Unsurprisingly, the net operating balance in these countries fell almost to double digits in 2020, which is also indicated to be a significant determinant of debt. We think that the interest rate, which had a positive sign only in the sample of high-income countries, concerns Greece, which is skewing estimates due to high growth during the debt crisis. Finally, the trade openness variable, which was significant in the pooled OLS for the full sample as well as the middle-income countries, can be considered a determining factor in government debt. According to our results, the more open a country is to imports and exports, the more debt can be reduced. Research has shown that inflation determines the debt-to-GDP ratio in a sample of high-income countries. The relationship is negative as we expected, with rising price levels, debt will decrease. In these uncertain times, rising inflation is a major problem not only for households but also for governments and their budgets. Although its growth reduces debt, high inflation may cause pressure to increase state welfare or work benefits, it may slow GDP growth and therefore lower the standard of living or increase the market interest rates, making government loans more expensive.

In terms of socioeconomic variables, we chose life expectancy, population, and unemployment. The first named variable showed its significance in the main results (OLS)

and in the high-income sample (fixed-effects and random-effects). As we mentioned in the results, our findings confirmed a positive effect on the debt-to-GDP ratio. Higher life expectancy could bring more expenses to the government in terms of health or pension support. But on the other hand, higher values of this independent variable indicate an advanced population in terms of quality of life. If we are talking about the population, the confirmed relationship with the debt ratio was negative. Even though our expected result was positive, the reason for the opposite sign is difficult to determine. It can be affected by the different structures of the population or the high influx of immigrants at a young age. In Germany, for example, immigrants represent about 1,5% of the total population (European Commission, 2022g). The unemployment rate showed positive sign and significance only in the results for the full sample. High unemployment may lead to a reduction in GDP and consequently to an increase in the level of debt, as we can see in Greece or Spain, with an unemployment rate above 15% in 2020.

The institutional variables of government effectiveness and democracy have confirmed the impact on the debt-to-GDP ratio at least in one estimator in each sample. The effect of both variables was negative in all cases. The more efficient the government is, the more the debt will be reduced. Meanwhile, if the democracy rank in the country is higher, the lower is studied debt ratio. The assumption was that more democratic countries put pressure on the government expenditure which is then projected to higher debt-to-GDP ratio. However, this is not always the case and Ireland is an example of a country with a high percentile rank of democracy (95) and a low debt ratio in 2020 (59%).

Last but not least we included the variables of structural changes in our regressions. The dummies of debt crisis and covid crisis demonstrated significant impact mainly in the results for the full sample. The effect was positive: if there is a recession, the debt will rise. Just recently during the pandemic, we witnessed the greatest debt growth since the founding of the euro area. Therefore, the importance of appropriate regulations and policies within the EU should be discussed. EU is expected to be prepared for such recessions in order to avoid severe consequences such as the sharp rise in government debt. Surprisingly, the financial crisis dummy did not show its significance in the context of the examined fiscal ratio.

The test of the stability of coefficients, as we named the split of the full sample, showed only small differences in the behaviour of explanatory variables. We think that the distribution based on the income group demonstrated the accuracy of the main results, because the signs that differed from the main results had a logical explanation for the specific countries in the sample. The sample of middle-income countries with 152 observations showed the significance of government debt in the previous period, GDP growth, long-term interest rate, net operating balance, trade openness, government

effectiveness, and democracy. In addition to the same variables as in the middle-income sample, the high-income countries sample with 189 observations also identified inflation, life expectancy, population, and covid crisis as the determinants of the debt-to-GDP ratio.

We are aware that using simple estimators such as pooled OLS, fixed-effects and random-effects may be a limitation of this paper. In addition, the data availability may be an issue in estimating the impact of pandemics in our regressions, as the year 2021 is not included. To capture the effect of the current recession in line with the ongoing crisis and war in Ukraine, we would recommend further research on the determinants of government debt, including the years 2021 and subsequently 2022.

CONCLUSION

Government debt and its sustainability can be affected by many internal and external factors and the high levels can have long-term consequences on the economies. As we mentioned before, rising government debt could help the countries' economies to grow, but also cause issues for the creditors and citizens of the borrowing state. Understandably, the EU is working to put rules in place to enforce prudent fiscal policies in the euro area. From our point of view, it is important to set precise rules to prevent economic downturns during the crises we experienced during the Covid-19 pandemic. In our research, we tried to estimate the effects of the main determinants of government debt using dynamic panel data from 19 countries in the euro area during the period from 2000 to 2020.

In order to assess the evolution of government debt in the euro area, we identified four sets of independent variables: macroeconomic, socioeconomic, institutional and structural change variables. Most of the macroeconomic variables had expected signs including general government debt in the previous period, GDP growth, net operating balance, and trade openness. The interest rate in the main results had a negative effect, which was the opposite of our assumptions, but the sample for the high-income countries had shown a positive sign. In terms of socioeconomic variables, the assumed relationship was demonstrated by life expectancy and unemployment rate. Oppositely, the population has shown a negative impact on the debt-to-GDP ratio. Institutional variables included government effectiveness which has been significant in almost all models and democracy, which showed a negative relationship that was contrary to our expectations. Finally, the covid crisis dummy from our structural change variables has demonstrated one of the strongest positive effects on government debt levels. One explanatory variable that was not significant in any regression is, surprisingly, the dummy of the financial crisis.

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