Public debt in the East of Eden - how does the euro serve the sustainability of public finances?

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ABSTRACT Overall, European countries' public debt has benefited from the inflationary developments of recent quarters, mitigating the negative impact of previous overspending on fiscal balances. In this paper, we investigate the basic economic-statistical relationships underlying the debt accumulation since 2008 using linear panel regression estimates. Drawing on the findings of the literature exploring regional processes, the analysis focuses on the Central and Eastern European and Baltic countries, but extends the assessment of the determinants of public debt dynamics to the European Union as a whole. While the study points to the contradictory role of the common monetary policy in relation to a sustainable debt path, it also demonstrates that debt management is primarily the responsibility of domestic economic policy and cannot be shifted to the European level authorities.
KEYWORDS: government debt, interest burden, monetary policy, inflation, euro area
JEL-CODES: E63, H62, H63
DOI: https://doi.org/10.35551/PFQ_2024_3_2

Introduction

After the big bank bailouts and the coronavirus overspending, a calmer period of debt management in European countries has followed, thanks to wartime inflation. Over the past two years or so, the real interest rate paid on sovereign debt has typically been negative. But it is too early to sit back and relax watching the debt burden ease. Even as the inflationary period winds down, the huge average debt stock remains at around 90% of GDP on average in the euro area countries, and slowly approaching half of GDP in the former socialist bloc. A significant proportion of countries will eventually be able to finance this burden only at positive real interest rates, and economic growth will not necessarily offset the increase in public liabilities. Apart from a few outlier examples, such as Ireland, which has reduced its debt from above 100% of GDP to below 60%, most Member States are in breach of the Maastricht limit. This has particularly unpleasant consequences for those Member States that have to pay only interest on their debt at a level higher than the 3% deficit/GDP

allowed. This is the case for Italy and Hungary, the former being inside the latter remaining outside the euro area and, which as members of the EU, are forced to pay the largest share of their national income in interest payments to their sovereign creditors. While for the time being, the emerging Central and Eastern European and Baltic states are in a much better position overall compared to developed member states, the question arises whether the introduction of the euro will help to ease the debt burden and in sustaining public debt as indicated in the title of the study.

In our study, we examine the economic and statistical context behind the accumulation of public debt between Q1 2008 and Q1 2023. The analysis is carried out in a panel regression framework, focusing on the 11 emerging EU and now mostly euro area economies among the former socialist countries. The main research question, given its domestic implications, is whether euro area membership helps to moderate public debt dynamics, in the achievement of sustainable public debt defined in the Maastricht criteria, through common, moderate interest rates. The results of the estimation on a sample of 11 emerging market countries are compared with the results of the estimation for all countries of the European Union and a sample of 15 member states. In particular, we address the question of whether, despite common fiscal rules, the rise in public debt above 90% over the last decade in several euro area countries has had a negative impact on real growth.

The paper starts with a review of the literature on the harmful extent of public debt and the advantages and disadvantages of high public debt in general, and then briefly summarises the main findings of previous empirical analyses of the surrounding countries. Following the review of the empirical literature, the data and methodology are discussed in detail. The economic-statistical contextual framework of the analysis is based first and foremost on the study by Czeti-Hoffmann (2006) and Sávai-Kiss (2017). In light of the results, the paper draws lessons for economic policy.

1. Some ideas from the theoretical literature on the evolution of public debt

In response to a series of crises over the last decade, the EU has put in place a series of fiscal rules to curb debt. One set of rules takes into account the 60% level set by Maatricht, whereby the 60% debt limit encourages Member States to keep their debt-to-GDP ratio low. In contrast, Reinhart-Rogoff (2010) set the harmful level of debt above 90% of GDP, as they found that this is the level above which rising GDP can no longer curb debt. Two well-known critical studies, Égert (2013) and Herndon et. al. (2013), have challenged Reinhart-Rogoff's assumption on the grounds of the methodology used and the lack of a country-specific analysis.

It is questionable, however, whether fiscal or monetary rules can manage the public debt phenomenon more effectively. According to a 1981 study by Sargent and Wallace, even if the financing of public debt happens along price and interest rate moderating antiinflationary rules, it does not necessarily guarantee economic stability. Even if monetary rules are met, it might occur that fiscal policy becomes

dominant over monetary policy and then monetary policy will be compelled to deviate from the rules. Furthermore, if domestic bond purchases face an upper limit and it is exceeded, public debt can only be financed by the issuance of money or inflating debt. (Sargent – Wallace, 1981, cited in: Novák, 2013).

When studying the harmful economic impact of public debt, it is also important to recognise that in most cases public debt will not directly affect individuals, but will impose a really heavy burden on society indirectly through income distribution. Pro-cyclicality implies that taxes and interest rates rise in times of austerity, gradually shrinking the share of net income per capita. And the increased taxes really fall on poorer, working taxpayers. The negative scenario is that after a certain period of time, the taxpayers become so poor that they are unable to pay their duties (Mosolygó, 2011). Furthermore, as public debt increases, the level of public support for real estate falls, forcing a wider section of society to take out housing loans, i.e. to become indebted (Gagyi et al, 2019). In addition, the impact of public debt financing is crowding out private investment due to increased interest rates, leading to a gradual decline in GDP (Dedák, 2017). Moreover, paying taxes also drains funding from priority areas such as health and education. Furthermore, Kovács (2022) pointed out in a study brief that the negative proceeds of debt is accumulation, i.e. the deficit in a given year will be a burden for future generations, as the repayment of loans taken out to finance deficits may be delayed for several decades.

Krugman (2015) has approached the issue of public debt from a positive angle, as he argues that the advantage of debt is that it teaches a country's economic policy to take the right risk-sensitive or so-called prudent actions. Public debt is indeed an opportunity to intervene in times of economic crisis. In contrast, from the viewpoint of Barro (1974) arguing on the grounds of Ricardian equivalence, when the government finances spending by borrowing, individuals cut back on their expenditures and increase their savings to prepare for future tax burden. As a consequence, the decrease in consumption will not spur but rather restrain economic growth. Buchanan (1958) (cited in: Boudreaux, 2022) partly contradicted this automatic adjustment and the assumption of private economy individuals optimising for an infinite time horizon, as debt financing, in his view, is essentially spending future tax payers' income which current tax payers are well aware of.

In practice, such treaties and fiscal austerity measures are put in place that gradually monitor the economic processes of the particular countries, thereby curbing reckless economic actions to some extent. In the United States, the government can typically borrow at very low interest rates, thereby avoiding unsustainable indebtedness. In Europe, following the crisis, as a consequence of debt financing becoming more expensive, EU leaders were urged to reform the Stability and Growth Pact (SGP) repeatedly to tighten fiscal rules, which coordinates and monitors fiscal policy in the European Union with the aim of controlling fiscal balances, deficits and debt (Schuknecht et al., 2011).

Blanchard (2023) argues that the „goodness" or "badness" of debt depends mainly on whether it is used in the right way and over the right period, given the different socio-economic structures of countries. Overall, therefore, it is necessary

to understand the phenomenon of public debt before making judgements about its quality (Blanchard, 2023, cited in Kovács, 2023).

2. Preceding empirical results

A great number of researchers have also empirically examined the indicators influencing the dynamics of public debt using a variety of methodologies, of which we would like to highlight those that have used data from the Central and Eastern European region in their analyses. Table 1 below summarises the methodologies used by the five studies, the regions covered and the results obtained.

Table 1: Results of previous research

Author	*Period*	*Countries*	*Method*	*Indicators*	*Results*
Redzepagic – Llorca (2007)	1999–2006	East-Central Europe	regression using ordinary least squares (OLS)	– Primary budget balance as a share of GDP – gross public debt – political variables	– debt sustainable in Slovakia and Slovenia – electoral effects are significant in Poland
Karpová (2011)	1999–2008	EU 27	descriptive statistics	evolution of government debt over the period under review	poorer countries are excluded from economic integration because of excessive indebtedness
Holzner (2022)	2000–2021	Central-East and South-East Europe	descriptive statistics	evolution of government debt over the period under review	– public debt reduces investment – unemployment worsens public debt in the Baltic States

Author	Period	Countries	Method	Indicators	Results
Semik – Carpenter (2022)	1996–2020	Central Eastern and South Eastern Europe	logistic probability model	– fiscal impulse control variable – primary expenditure – GDP growth – real output gap – interest burden – government expenditure	– fiscal stimulus, GDP growth, expenditure cuts reduce debt – an increase in the interest burden has a negative impact on the level of public debt
Sávai – Kiss (2017)	1996–2014	Visegrad and Mediter-ranean countries	one-step dynamic panel regression	– Government debt as a share of GDP – General government deficit as a share of GDP, or abbreviated: deficit – real interest rate – real effective exchange rate – economic growth – inflation – current account deficit – Employment rate	– all variables are significant except the real effective exchange rate – increase in deficit and current account increases public debt – real interest rates, GDP growth and rising employment reduce debt ratios – inflation increases debt

Source: own editing

In their study, Redzepagic and Llorca (2007) examined the countries of Central and Eastern Europe (CEE) from the perspective of fiscal sustainability and its policy determinants. The empirical study used regression analysis and the quarterly data of the countries were selected from the Eurostat database from 1999 to 2006. The regression estimation included the primary budget balance as a share of GDP and gross public debt. In addition to macroeconomic variables, political factors were also integrated in the analysis in order to investigate how the electoral cycle affects the debt situation and whether there is any significant relationship between the ideological orientation of the governing party and the level of debt. When analysing Poland and Slovenia, the coefficients showed that debt is sustainable in Slovenia but

not in Poland. This may be because, according to the research team, election results in Poland have a significant effect on debt. In Slovakia, their study found that public debt was sustainable, but not in the Czech Republic. Electoral variables did not yield significant results at all in the latter two countries. Redzepagic-Llorca (2007) finds that the significant political ideology variable in Poland can be explained by the strong left-right opposition in the country's political structure.

Karpová (2011) produced descriptive statistics for the EU-27 countries from 1999 to 2008 on pre-crisis trends, as was later done in a similar way by Holzner (2022). They find that in many countries public expenditure is increasing due to the difficulties caused by the crisis. In turn, drastic austerity measures, tax increases and restrictions on public consumption slow down the growth of some factors of domestic demand, and hence overall economic performance, in the long run. In this sense, only structurally sound, well thought-out fiscal reforms will prove effective. Karpová (2011) also notes that it is not possible to effectively combine a single monetary policy and an independent fiscal policy within the European Economic Area or within the framework of the Monetary Union. Weaker EU countries, such as Greece, are not able to provide mutual economic assistance, and poorer countries are thus excluded from economic integration, which is a very serious obstacle in the EU in the long run (Karpová, 2011).

Holzner (2022) examined the Central-East and South-East European region using descriptive statistics and projections. His results show that Russia, Turkey and Poland have debt levels above €200 trillion, while the other regions have a combined debt of just under €5 trillion. The pandemic has had a severe impact on many countries, including tourist destinations such as Croatia and Montenegro, and automotive regions such as Hungary, Slovakia, Romania and Slovenia. The damage caused by the Covid 19 outbreak not only brought industry to a standstill, but also led to a corresponding increase in expenditure, which gradually put the countries into debt. According to the researcher, the European Central Bank (ECB) had previously tried to bail out countries on the periphery of the EU. The non-EU member Montenegro, on the other hand, has been less relieved, as the Chinese highway project pushed up the already indebted country's debt-to-GDP ratio to 92% by 2020 compared to previous years. Another critical point is Slovenia, where the debt-to-GDP ratio has risen to over 70%, due to a major bailout of the banking sector in recent years. For the countries under review, Holzner found that, although refinancing was low and did not appear to have been a major drain on resources, one of the consequences of the debt in these countries was a sharp fall in investment, which has led to a GDP improvement of not more than 5 percentage points in the regions under review. Investment is falling sharply because of public debt, which is where resources are being withdrawn most rapidly under the fiscal tightening measures introduced to slow debt. Nevertheless, the study predicts a strong upswing in investment, as the EU's Green Deal and other development needs are expected to require large investments in the future.

Moreover, Holzner (2022) underlined that demographic facts explain the high unemployment rate as the population has undergone a substantial change, causing a decline or stagnation in the number of inhabitants, but certainly not an increase.

The Visegrad Four countries do not have high levels of unemployment in the areas studied, but in the Baltic countries the public debt is due, among other things, to a fall in employment.

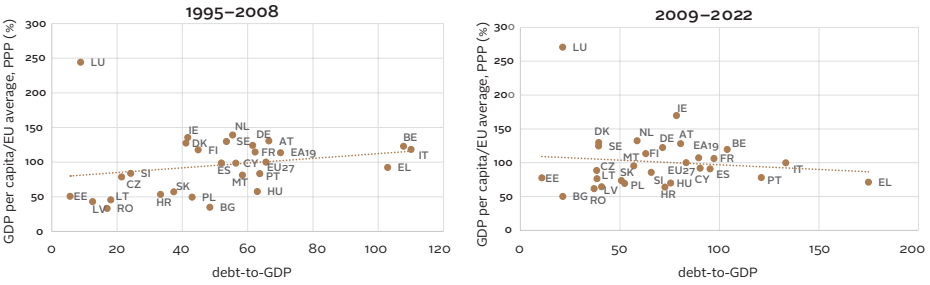
Overall, Holzner (2022) suggests decreasing the rate of the effective interest rate. He explains this by the fact that the effective interest rate in these regions improved after the ominous 2008 crisis, as the interest rate fell from 5% in 2009 to 3% in 2020, thus improving the risk of sovereign debt exposure. In addition, central banks have also sought to keep global interest rates close to zero, thereby helping to reduce debt-to-GDP ratios. The researcher suggests that countries should therefore take advantage of these opportunities provided by banks to increase investment and thus boost productivity, which can create debt resilience (Holzner, 2022).

Semik and Zimmermann (2022) used data from eleven Central and Eastern European countries between 1996 and 2020 to assess the determinants of debt reduction using a logistic probability model. Their study covers 131 debt reduction episodes, with 31 successful and 100 unsuccessful periods in their sample. The methodological basis and starting point was the research of Nickel et al. (2010), whose results suggest that persistent fiscal consolidation, based mainly on expenditure cuts, especially in social benefits and public wages, supports significant debt reduction. They also note that high government interest burdens reduce the likelihood of a meaningful reduction in the public debt ratio (Nickel et al., 2010 cited in Semik - Zimmermann, 2022). The variables used are: primary expenditure; GDP growth; real output gap; interest burden; government expenditure. The results of Simek-Zimmermann (2022) show that the control variable for the fiscal impulse has the expected positive sign, suggesting that a high primary surplus helps to reduce government debt significantly. GDP growth also has a downward effect on debt, so it may be necessary to implement structural reforms that support GDP growth trends in order to successfully reduce debt, especially during economic downturns. The real output gap is not found to be significant, but the regression suggests that a 1% increase in the interest burden increases debt by 9%. Reductions in government expenditure can have a significant impact on debt developments, with researchers suggesting that reductions in the following areas of government expenditure could affect debt levels: compensation of employees, social benefits, government consumption (goods and services), gross foreign exchange accumulation and EU subsidies. On the expenditure side, the increase in employment and the reduction in social spending have proved impressive results.

In contrast, taking all variables together, Semik-Zimmermann (2022) conclude from their regression that, in principle, fiscal austerity is the most effective in determining debt levels. That is, the key to effective debt management may be to reduce social and employment-related spending.

In their study, Sávai-Kiss (2017) looked at the GIPS countries, complementing the Visegrad Four and Cyprus data series of 1996-2014. Their sample is explained by the significant increase in public debt in several European countries following the 2008 crisis, as illustrated in Figure 1.

Figure 1: Public debt and GDP per capita in the EU countries



Source: Eurostat

Note: annual percentages are obtained by simple arithmetic averaging over 14 years, GDP/capita figures should be interpreted in relation to the EU27 PPP average (=100%)

From 2000 to 2005, the public debt of the V4 countries was below the EU average. Between 2006 and 2011, only Hungary exceeded the EU average. Among the GIPS countries (Greece, Italy, Portugal, Spain), Greece and Italy were already some 40 percentage points above the EU average before the crisis. Portugal and Spain's debt levels remained almost constantly at the same level from 1995 to 2001, then started to rise slowly from 2002 to 2008, before rising sharply after the crisis. Spain's debt-to-GDP ratio remained below the EU average until 2012 (Sávai-Kiss, 2017).

Of the indicators used by the authors, deficit, inflation, current account deterioration and rising real interest rates lead to an increase in public debt, while, GPD growth and employment growth lead to an improvement in public debt in the groups of countries studied. Overall, the magnitude of the coefficients was smaller in the panel estimation for the V4, and the effect of the real effective exchange rate was not found to be significant in any of the studies (Sávai-Kiss, 2017).

3. Methodology

The accumulation of public debt can be described by a simple statistical relationship. Year by year, the budget deficit adds to the existing public debt and economic growth reduces the debt-to-GDP ratio (d) (1). Since the total deficit includes the interest burden on the debt, if the primary deficit (b^p) is decoupled from the net interest payment, the long-term increase in government debt is essentially driven by the real interest rate (r) and real growth (g) differential. Inflation is eliminated because both the nominal interest rate and nominal growth include the change in the price level (π) (again, it is a different matter that in the case of nominal growth this is more likely to correspond to the GDP deflator, in the case of the nominal interest rate to the expected consumer price index in economic terms).

$$d_t = b_t^p + d_{t-1}(1 + r_t)(1 + \pi_t)/[(1 + g_t)(1 + \pi_t)] \quad (1) \qquad (1)$$

However, there may be a foreign currency denominated component of government debt, which is affected not only by the exchange rate change but also by the inflation rate of the foreign currency issuing country other than the home country, i.e. the change in the real exchange rate of the domestic currency against the foreign currency used as a source of financing the government debt. Thus, the change in government debt as a share of GDP between two periods, taking into account the financing structure, can be written as follows (see Czeti-Hoffmann, 2006) (2):

$$\Delta d \approx b_t^p + d_{t-1}(\text{domestic})\, r_{t_{domestic}}/(1+g_t) + d_{t-1}(\text{foreign})\,(r_{t_{foreign}} + e_t)/(1+g_t) - d_{t-1} * g_t/(1+g_t) + o_t \quad (2)$$

Where the domestic and foreign designations are used to distinguish between the different components of government debt denominated in different currencies, the (*e*) denotes the real exchange rate and (o) is used to denote any other one-off factor that increases the level of government debt irrespective of the revenue and expenditure side of the budget for the year and irrespective of the existing government debt. These may include privatisation receipts, debt assumptions (e.g. bank bailouts necessitated by the 2007-2009 crisis) and other adjustments that increase the stock of government debt.

Given the above context, the panel regression equation of our study includes, first of all, the variables that statistically determine the Maastricht debt indicator: the previous period's value of government debt, the primary budget balance net of interest revenue and expenditure, net interest payment as a share of GDP, the real exchange rate and real GDP growth. The real (effective) exchange rate was defined as the logarithm of the change between two quarters in the 20-country indices. The real exchange rate captures the change in the domestic and foreign inflation rate and the nominal exchange rate between two periods at a time. In addition, we also included the harmonised consumer price index (HICP) by itself among the explanatory variables instead of the real exchange rate for robustness check. For defining the quarterly consumer price index we calculated the average 12-month price level change. All indicators are presented in percentage form for ease of interpretation. For the foreign currency component of the debt we did not draw in any variable as a result of no adequate time series available. The impact of the common euro area monetary policy on government debt is illustrated using the ECB base rate and two dummies representing euro area membership and confining the ECB's asset purchase periods. The functioning of the fiscal councils from their starting date has also been dummy-coded. In addition to the baseline, we also explain the evolution of government debt with an equation that captures the impact of other macroeconomic indicators, such as the labour market (employment and unemployment rates) and the current account balance. These indicators also play an important role in the research of Sávai-Kiss (2017).

The main focus of the analysis is on the Central and Eastern European and Baltic states, i.e. what factors have led to the accumulation of debt in the 11 post-

socialist countries that joined the EU after 2003 (the CEECs) since 2008. However, the regression estimation is also carried out with control groups, first using data for only 4 additional EU Member States (Austria, Germany, Denmark, Sweden) and then for the EU27 as a whole.

The quarterly data for 2008Q1 to 2023Q1 were downloaded from the Eurostat database, except for the ECB base rate time series, which was obtained from the ECB website, weighted by the number of calendar days of the currently announced rate to calculate the quarterly value.

The panel estimation was first carried out using simple OLS panel regression on the level data, and then, after the Welch and Hausman tests, it became justified to use the fixed effect (FE) estimation, which is thus considered as the starting point for the investigation of the relationship between the variables. Indeed, the fixed effect estimation assumes that there are entity-specific variables in the observed cross-sectional data that have an impact on the outcome variable in addition to the observed ones (e.g. economic policy perception of public debt, political lobbying effect, etc.) that cannot be captured by the explanatory variables, therefore it is worth including this variable in the model as a different intercept of observation units depending on the result of the Welch test. If this additional effect, which is different per observation unit and not well represented by the explanatory variables, is not correlated with the other regressors, which is the null hypothesis of the Hausman test, it can be included in the model as a random effect. However, in the models we have examined, the test statistic of the Hausman test has led us to reject the null hypothesis in all cases. Furthermore, for panel regression estimation, it is important that the variance of the error terms is heteroskedasticity-consistent, which is ensured by the robust error terms condition proposed by Arellano. After the selection of variables, we examine the correlation between variables and also check VIF multicollinearity test values. Finally, to examine the stationarity of the variables, the Levin-Lin-Chu unit root test was performed by taking into account four quarterly lags according to the quarterly frequency of the data, and led to the acceptance of the stationarity of the panel data series for the majority of the variables. Exceptions to this were the primary and interest payment balances of the budget-to-GDP ratio, the employment and unemployment rates and the current account balance to GDP ratio. However, even for the dependent variable, i.e. the debt-to-GDP ratio itself, the test statistic was not completely clear-cut. Moreover, the estimation of the factors explaining the change in the outcome variable, i.e. the dynamics of public debt, implies a different economic context. This justified the inclusion of a first-order differential of the dependent variable and some explanatory variables in the panel regression equations consisting of the variables already listed above.

4. Results of the panel regression estimates

The first estimations were made for the government debt as dependent variable, i.e. the evolution of the factors determining the level of government debt. Two models

were used in the estimation: one to observe the statistical relationships determining the accumulation of public debt and the second to observe the impact of other economic variables. In the majority of cases, fixed effects (FE) panel estimation was used instead of OLS when the Welch test made it reasonable to reject the null hypothesis of equal group means. The model selection is indicated in the second row of Table 2 and 3 containing regression results. The random effects model was not supported by test statistics in any of the cases.

The results of the estimates of government debt-to-GDP ratios for the CEE countries, the EU27 and the enlarged group of 15 with control countries are shown in the table below:

Table 2: Examination of the factors explaining the level of government debt-to-GDP

	CEEC 11		EU 27		15 countries	
Variable/ model	1. model OLS	2. model FE	1. model OLS	2. model FE	1. model FE	2. model FE
Constant	0.5964*** (0.2245)	1.8597** (0.7053)	0.6491*** (0.1308)	1.7160* (0.8558)	1.4265*** (0.4588)	1.9809*** (0.6274)
Debt_1	0.9733*** (0.0048)	0.9195*** (0.0190)	0.9868*** (0.0031)	0.9391*** (0.0096)	0.9505*** (0.0100)	0.9312*** (0.0140)
Primary balance	-0.1228*** (0.0289)		-0.1587*** (0.0243)		-0.1284*** (0.0285)	
Net interest	0.6321*** (0.1213)		0.2962*** (0.1001)		0.7359*** (0.1312)	
GDP growth	-0.1799*** (2.4734)		-0.2525*** (0.0256)		-0.1797*** (0.0202)	
lnReal exchange rate	-0.1364 * (6.6483)		-0.0612 (0.0601)		-0.1102* (0.0624)	
Current account balance_1		0.0242 (0.0135)		-0.0184 (0.0200)		0.0249 (0.0149)
Un-employment		0.1973*** (0.0347)		0.2364*** (0.0500)		0.1733*** (0.0337)
Eurozone	0.3888** (0.1338)	0.1389 (0.3254)	0.4374*** (0.0814)	1.1510*** (0.4098)	0.6025* (0.3143)	0.6117** (0.2820)
Asset purchases	0.2379* (0.1297)	-0.0302 (0.1694)	0.3259*** (0.0970)	0.0666 (0.1120)	0.3531*** (0.1043)	-0.0416 (0.1203)
Budget Council	_	0.8047** (0.3179)	-0.2194** (0.0793)	-0.1696 (0.2240)	0.1069 (0.1499)	0.0643 (0.3179)
Adjusted R^2	99.36%	95.70%	99.66%	96.06%	96.36%	94.97%

Significant values of the coefficients at 1% (***), 5% (**) and 10% (*) are indicated by asterisks.

Based on the panel diagnostics for a panel of only CEE countries exploring statistical relationships, the hypothesis of different cross-sectional intercepts was rejected, i.e. the OLS model showed a better fit. In all cases, the variables revealed the expected statistical correlation, but excessively high (above 95%) R^2 values indicate model specification errors. While the positive sign of the asset purchase dummy in the baseline model (1. model) for all country groups examined partially contradicts the expected effect, this is presumably explained by the fact that it captures crisis periods rather than the positive impact of ECB purchases on sovereign yields.

The analysis of the EU-27 as a whole, and that of 15 countries covering the CEE countries extended by 2-2 euro area and non-euro area members, led to similar results to the model restricted to the countries of Central and Eastern Europe. The CEECs model including the control group (15 countries) amplified the coefficient of the net interest variable and the euro area dummy (the latter is even significant at 5% when the fiscal council variable is omitted). The impact of economic crises on the level of public debt is more pronounced in the dataset covering Germany and Austria, as well as the two Scandinavian non-euro area countries. It is also well observable that the real exchange rate is less significant in countries that typically use the euro (or a currency with a close peg to the euro, see Denmark).

The high significance of the lag of the dependent variable, and the result of the Wooldridge test for first-order autocorrelation in errors (at 95% significance level) justifies the specification of a model describing the change in debt instead of the level of debt. This approach is of course important for its economic content as well, since it expresses the increase in government debt between two periods. However, unit tests also require the first order differencing of variables for the primary balance, interest expenditure and current account as a share of GDP, employment and unemployment rates.

Table 3: Examination of the factors that capture quarterly changes in government debt

	CEEC 11		EU 27		15 countries	
Variable/ model	1. model OLS	2. model OLS	1. model FE	2. model OLS	1. model FE	2. model OLS
Constant	0.7759*** (0.1962)	0.5782** (0.2124)	0.4403 (0.3606)	0.7092*** (0.1645)	0.6392*** (0.1999)	0.5817*** (0.1720)
dPrimary balance	-0.0223*** (0.0069)		-0.0501*** (0.0192)		-0.0308*** (0.0098)	
dNet interest	0.5849** (0.2397)		0.2651 (0.1944)		0.5784** (0.2213)	
GDP growth	-0.2247*** (0.0299)		-0.3063*** (0.0276)		-0.2356*** (0.0233)	
lnReal exchange rate	-0.1539** (0.0666)		-0.0407 (0.0676)		-0.1109 (0.0679)	
dCurrent account balance		0.0009 (0.0092)		0.0159 (0.0129)		0.0002 (0.0087)
dUn-employment		0.9561*** (0.2459)		1.1748*** (0.2150)		1.0015*** (0.2340)
Eurozone	0.2090 (0.1410)	0.1861 (0.1570)	1.1032* (0.5530)	0.2987* (0.1455)	0.6960 (0.4524)	0.1819 (0.1359)
Asset purchases	0.2166 (0.1291)	-0.0681 (0.1371)	0.4130*** (0.1131)	0.0295 (0.0818)	0.2901*** (0.0908)	-0.0423 (0.1038)
Budget Council	-0.2657 (0.2090)	-0.3550* (0.1897)	-0.8308*** (0.1822)	-0.8374*** (0.1907)	-0.6114*** (0.1444)	-0.5163*** (0.1585)
Adjusted R^2	29.12%	10.28%	30.23%	10.32%	29.58%	10.79%

Significant values of the coefficients at 1% (***), 5% (**) and 10% (*) are indicated by asterisks.

In the differenced model, the OLS estimation using the baseline indicators for the Central and Eastern European countries explained much less of the variance (around 30%) in (the growth of) the public debt-to-GDP ratio but with statistically more robust test values. The baseline indicators are included in the estimation with the expected sign. The dummies are not statistically significant (due to their p-values a few percentage points above 10%), but improved the explanatory power of the model (the same was true for the extended panel of 15 countries). Looking at the EU27 as a whole, the fixed effects (FE) model is a better fit in this case and justifies the effect of euro area membership. Among the variables, the real exchange rate loses explanatory power, which is reasonable given the euro-based debt financing of most countries. It is less understandable that the change in the net interest payment variable has no effect on the change in government debt for the EU as a whole. However, the balance

of interest revenues and expenses shows very little change from quarter to quarter in most of the more advanced countries and the basic data are only accurate to one tenth of a percent, which may explain this phenomenon. Moreover, what is striking in the dynamic interpretation is that the euro area effect contributes significantly, albeit with low explanatory power, to the increase in debt levels in the EU as a whole. Similarly, asset purchases (i.e. the period of crises) also increase debt levels, especially in the EU as a whole which includes the Mediterranean countries as well.

In addition to the basic statistical relationship, we also explained public debt accumulation using other indicators suggested by the literature (see Sávai-Kiss (2017)), namely the unemployment rate and the current account balance as a share of GDP (2. model). In this case, we also included the dummies in the regression equation. The resulting model showed a much weaker fit, explaining only 10% of the variability in the quarterly increase in debt. Not to mention that the current account balance does not gain any significant sign at all. Nevertheless, we can positively conclude that the explanatory variables here also mostly have the expected effect on the dependent variable. Unemployment is a strong contributor to the accumulation of public debt in all country groups, especially in the EU-27 as a whole, and the current account (for which the one-period lagged value is included in the first round) shows a nearly significant explanatory power only for level data in the panel regression analysis for the CEEC and the 15-country group. (We also fail to detect a strong correlation between the two variables when the current account is included as a dependent variable, which may be due to the quarterly frequency of the data.) While the level of government debt is also typically higher in euro area countries, its increase is only positively affected by the introduction of the Fiscal Council institution among the dummies included, irrespective of the composition of the panels, which strengthens the arguments in favour of the national control over fiscal compliance.

To check robustness, and to be able to evaluate the effectiveness of common monetary policy we replaced some variables from the original setting with alternative ones. For each group of countries, we also estimated the baseline model (1. model) by including the corresponding period value of the consumer price index instead of the real exchange rate. The inflation rate was found to be significant in all equations (with a stronger explanatory power than the real exchange rate) and its contribution to the reduction in government debt or the mitigation of government debt growth was clearly demonstrated for all model specifications. Moreover, it typically amplified the explanatory power of the dummy for euro area membership. The ECB base rate together with the dummies, generally showed no significant effect on government debt or its increase in the CEE countries (both in the base and extended cases). When the euro area (and occasionally the fiscal council) dummy is separately included in the regression, the base rate takes a negative sign, contrary to expectations, presumably again reflecting the effect of deflationary processes in the wake of crises (when the base rate typically took a zero value). Thus, ECB interest rate cuts have not helped to reduce public debt in the region when considered in the panel framework of the CEEC economies. This is particularly well illustrated by the fact that the estimation does not show any contribution to the maintenance of fiscal balance when omitting

the net interest payment variable. In contrast, the ECB's keeping interest rates low has significantly reduced both the level and growth of public debt in the EU-27 as a whole, in contrast to the real exchange rate and asset purchases variables. (It should be noted here that the contradictory effect of the ECB's interest rate policy can also be detected here, as the first-order differential for the change in interest rates is already resulting in estimates with negative coefficients.) When replacing the net interest payment variable for the average interest rate on public debt our previous results are confirmed. Finally, the findings of previous empirical research are also confirmed by including employment instead of unemployment in the second model.

Finally, a panel regression analysis was also conducted to test whether economic growth is negatively affected by a debt ratio above 90%. While the level of public debt strengthens, its increase significantly restrains the growth of the real economy in fixed-effects panel estimates based on different variable combinations in the EU-27, the negative contribution of countries to GDP growth above the 90% threshold is not always significant. Similar results are obtained in the GMM model framework.

Summary, economic policy lessons

International and even EU statistics show that the parallel between the level of public debt and economic development cannot be justified unequivocally, the conditionality of the common monetary policy requires European Union countries to maintain public debt within constraints. Nevertheless, the government deficit financed at high market interest rates significantly reduces the room for manoeuvre of the budget, which can be easily seen in the example of the Central and Eastern European countries, and especially Hungary or of the eurozone member Italy. While the crises that unfolded in the preceding low inflation environment posed a serious challenge to euro area economies, the war and energy crises that triggered high inflation seem to have relatively benefited these countries in terms of debt sustainability. Since the set of countries adopting the single currency is constantly changing, the control group for the examination of public debt dynamics is constantly changing as well, and the analysis is therefore subject to methodological limitations. The budgetary impact of euro area membership and of the common monetary policy in general is therefore controversial. Moreover, in the context of the controversy surrounding the introduction of the euro in Hungary, the fact that EMU membership may also worsen the already fragile balance of public finances should be an important consideration. Furthermore, the commonly applied fiscal rules based on integration cooperation, which have been introduced in the reforms of the SGP and a series of subsequent non-binding fiscal agreements, do not necessarily ensure that public debt is kept stable. As the importance of fiscal councils underlines, debt management remains a national responsibility, and in the CEE region this requires, above all, a further strengthening of the role of the cheapest and most domestically based financing alternatives. ■

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