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FISCAL SOLVENCY AND FISCAL LIMITATIONS UNDER ECONOMIC CRISIS AND RECOVERY: AN EMPIRICAL APPROACH OF UKRAINE

Abstract

The challenges of crisis phenomena can lead to a radical transformation in the stance of public finance and affect the opportunities for economic development. Since the instruments of fiscal adjustment directly determine the solvency and stability of public finances, in these conditions they require special attention. The purpose of the paper is to investigate and assess the correspondence between fiscal solvency, fiscal limitations, and socioeconomic development of Ukraine in a crisis and recovery policy based on compliance with fiscal rules. Empirical studies have not revealed a strong direct correspondence between fiscal solvency, debt security, and socioeconomic development. But at the same time, the implementation or approaching the implementation of fiscal rules has a positive effect on the level of socio-economic development only in conditions of macroeconomic stability, therefore, in a crisis, it is very important not to tighten fiscal rules too early. However, data from the post-crisis policy of Ukraine (2011, 2015, 2021) indicate that incentive measures were prematurely curtailed.

Keywords

fiscal solvency, debt security, economic growth, human development, fiscal rules

JEL Classification

E63, F63, H62, H63

INTRODUCTION

In response to the spread of crisis phenomena over the last decades (consequences of crisis 2008–2010, COVID-2019, fight against climate changes and war in Ukraine), the governments of many countries began to use available financial resources and reserves to support aggregate demand and strengthen business activity. They were forced to balance between, on the one hand, the need for fiscal incentives to revive economic activity and the challenges of fiscal consolidation to reduce the public debt burden and keep refinancing risks at a moderate level, on the other. Such consolidation in crisis conditions is excessively hostile to investment and procyclical, and ultimately too rigid. As a result, from 2020, the existing fiscal rules in European countries are temporarily suspended, but many experts warn against putting the European fiscal rules back into force in unchanged form beginning in 2024, and current fiscal rules must be the subject to revision (Priewe, 2022). According to experts, European governments should be granted as much fiscal freedom as possible, taking into account the macroeconomic framework for solvency and stability. And maintaining the stability of public finances should be achieved in the post-crisis period primarily through the positive effects of economic growth.

Recent research also confirms that tight, well-defined numerical rules, even if they are not always followed, act as an anchor for fiscal policymakers and contribute to more stable fiscal policy (Reuter et al., 2022). Also, fiscal rules improve fiscal discipline in emerging markets, and the extent of the effect of course depends on the characteristics of the countries' economies and the design of the rules (Tapsoba, 2012). Above all, the effectiveness of the rules depends on fiscal conservatism and the ability of the government to set a debt ceiling or target and ensure access to financing in times of crisis (Afonso & Jalles, 2019). The improper and non-transparent imposition of ceilings on public debt and budget deficits can harm the economy rather than support it (Pappa, 2020). As vital as it is for fiscal rules to provide for contingencies to ensure a large-scale and effective fiscal response to serious and unprecedented crises, it is equally important that fiscal rules provide clear guidance on how to generate savings during positive shocks (Díaz-Roldán et al., 2021). Against this background, recent studies show that the deterrent effect of fiscal rules is not clearly defined. Therefore, there is a need to explore the relationship between fiscal limits and economic development in selected Eastern European countries, especially given the European trends of revising fiscal rules in the post-crisis period and the need for economic recovery in Ukraine. Therefore, in this paper, it is important to estimate the fiscal solvency and limitations in a crisis and recovery policy regarding compliance with fiscal rules and macroeconomic stabilization.

1. LITERATURE REVIEW

Considering the results of recent research on fiscal consolidation and public finance sustainability, it is important to focus on the need to comply with fiscal rules at different stages of economic development in selected European countries in the short and long term. In other words, to determine whether fiscal ceilings are a prerequisite for the choice of fiscal regulation instruments to ensure the sustainability of public finances and a country's solvency. Based on the background, in practice, there are different views on the content of fiscal rules and their impact on the state of solvency and economic development of a country. Heinemann et al. (2018) confirm the relationship between the effect of fiscal rules and the levels of deficit and debt to GDP. In addition, the introduction of fiscal rules affects fiscal measures and fiscal solvency, and a set of fiscal rules reduces the cost of public debt service and lowers the cost of debt (Thornton & Vasilakis, 2020). Reiter et al. (2017) emphasize the positive impact of debt constraints on budget balance and reduction of government spending in the EU countries and find out that countries with tighter fiscal rules have better balance sheets and lower government bond yields. Gonzales et al. (2022) continued and added that benefit of implementing fiscal rules is reducing the cost of financing of governments, and it becomes more important for emerging market economies in which capital flow surges and reversions lead to overall macroeconomic instability. They al-

so concluded that fiscal rule relaxations due to the COVID-19 pandemic should be only temporary, and countries should return to their implementation soon. However, previous studies confirm the dependence of the effect of rules on the characteristics of the economy and the level of public debt. More recent studies by Gründler and Potrafke (2020) and Diaz-Roldan et al. (2021) also show that restrictive fiscal rules contributed to economic growth after the crisis, and that lower public debt levels contributed to economic recovery. Bergman and Hutchison (2020) argue that fiscal balance rules moderate the adverse fiscal effects of high debt shocks, and Hutchison (2020) adds that tight medium-term fiscal rules are an important tool for deficit reduction and recovery long-term solvency of countries. Boórl (2020) also noted that only proper implementation and enforcement of fiscal rules has a positive effect on a country's macroeconomic development. Improperly setting limits on the level of public debt and the budget deficit can harm the economy more than support it. Vinturis (2022) added that the simple presence of fiscal rules is not enough, and showed that an improvement of the strength of fiscal rules significantly affects fiscal performance in EU former-communist-countries, with a magnitude higher than that estimated for the EU non-former-communist countries, and this becomes more important in the context of European Union enlargement.

The authors of this research concur with Blanchard et al. (2021) that fiscal rules are not very successful

and need to be reformed due to their inefficiency and counterproductivity, as they are complex and cannot take into account all economic and political factors that cannot be predicted. Mühlbach (2022) comes to the same conclusion that the rules are not adapted to the current macroeconomic environment and should be changed at least with investment exceptions and MTBF objectives based on numerical targets should be replaced by an expenditure rule. Regling (2022) also added that returning to a debt target of 60% of GDP would be hard to defend from an economic perspective and would therefore weaken commitment to the rules, while agreeing on new rules and phasing them in once the economic situation normalizes could help guide market expectations and contain potential volatility.

Public debt and economic growth interact positively, that is, debt can stimulate production in the short run, while higher debt will negatively affect economic growth in the long run, demonstrating the importance of keeping debt levels within acceptable limits (A.-K. Albu & L.-L. Albu, 2021). Despite the stimulative effect of public debt, Briseño and Perote (2020) argue that high levels of public debt make EU countries vulnerable to external shocks. Therefore, it is advisable to look not only at the level of restrictions, but also focus on the timing and timeliness of the application of these rules. Furthermore, the adoption of medium-term fiscal rules can moderate the institutional features of emerging markets. The empirical research of European Union countries (Qehaja et al., 2022) found that variables of fiscal rule, public debt influence the fiscal deficit. In the case of Ukraine, Bohdan and Lomakovych (2021) revealed that a significant amount of external debt increases the impact of adverse global factors on the Ukrainian economy.

At the same time, there are studies that point to an inverse effect of the level of debt on socio-economic development, which casts doubt on the positive impact of fiscal compliance on the solvency and development of the country's economy in the short term. Thus, Noga et al. (2018) argued that a small amount of public debt affects socio-economic development negatively, and debt is a stimulating factor for development, while the Maastricht criterion of the EU is unattainable and should

take into account indicators of socio-economic development and vary depending on the value of the debt. Furthermore, Combes et al. (2017) add that the rules work more effectively when the level of public debt is higher than the rule threshold. Afonso et al. (2023) found that the lagged public debt-to-GDP ratio, the fiscal rules index, and the sovereign ratings all have a positive impact on fiscal sustainability, whereas, on the other hand, the effect was negative from 2010 onwards and also when legislative elections were held and that both the lagged public debt-to-GDP ratio and the ratings only have a positive impact in countries whose average public debt-to-GDP ratio is both above 60% of GDP and after 2010. Davudi et al. (2022) refute the thesis that fiscal rules have prevented huge increases in debt over time. A return to fiscal policy limits is likely to take time if there are significant debt deviations. For countries with deficits above the rule limit, it will take a country on average 3-4 years to approach its average value. Besides, IMF research data shows that fiscal rules have been flexible during crises, but did not prevent a large and constant accumulation of debt over time and a deviation from the debt limit was very difficult to lift. Experts also note that the evidence of the benefits of compliance with the rules definitely emphasizes the difficult political choice of necessary improvement of the fiscal framework. One of the most important lessons from past experience is that unduly rigid rules tend to be unworkable and are not effectively enforced (Schick, 2010).

Despite the government's growing need for financing, in domestic practice, fiscal rules always serve as a ceiling for the development of strategic decisions in managing public debt and the budget deficit. Statistics on the debt activity of the Ukrainian government show that reduced foreign borrowing by Ukrainian corporations and banks and debt restructuring agreement have made major contributions to improving Ukraine's foreign debt to level below 60% of GDP limit in last years. However, the risks of refinancing remain high. There are additional risks to Ukraine's macroeconomic stability stemming from a distorted structure of public debt and low level of international reserves. High risks of external vulnerability of the economy and the increase in government borrowing since the beginning of the 2008 economic

crisis have explained the continued high rates of debt securities and high level of budget deficit in Ukraine. In addition, sustainable public finances also require that national fiscal policy be supported by monetary policy, which can control inflation in the medium to long term that reinforces price stability (Danylyshyn & Bohdan, 2022). And it is very important for evaluating the performance of fiscal rules to keep the growth of public expenditure below the growth of inflation (Díaz-Roldán et al., 2021).

The lack of an unambiguous view of the relationship between fiscal rules and fiscal solvency and economic growth in crisis and recovery periods justifies a need for a study aimed at assessing the correlation between fiscal solvency, fiscal constraints, and Ukraine's socioeconomic development in a crisis and within the framework of a recovery policy based on budget rules. Therefore, the purpose of the paper is to explore how the level of fiscal solvency and debt security based on compliance with fiscal rules affects the socio-economic development of a country in times of crisis and under the recovery policy. Thus, for further research, the scientific hypotheses will be:

H1: Setting a debt ceiling (fiscal rules) leads to an improvement in the socio-economic state of selected countries.

H2: Tightening fiscal rules (by deficit and debt) increases fiscal solvency¹ and promotes economic recovery in a crisis.

2. METHODOLOGY

To analyze the impact of fiscal rules and debt security on a country's socio-economic development, the integral indicator of debt security of Ukraine was calculated according to the methodology of the Ministry of Economy. Also, the dynamics of key macroeconomic indicators and indicators for the years 2006–2021 of Ukraine was examined, with the focus on indicators of real GDP growth rates, the human development index, indicators of debt and deficit in relation to GDP, and the index of fiscal solvency. This paper compares the ev-

idence from selected Eastern European countries (Bulgaria, Serbia, Hungary, and Poland). These countries were chosen due to their cultural, institutional, structural, and economic similarities with Ukraine. The study investigates the relationship between the percentage of implementation of fiscal rules and the growth rate of real GDP, with the change in the standard of living indicator (Human Development Index of UNDP), and with the index of fiscal solvency, to test the hypotheses using correlation-regression analysis with the study of standard error intervals. The paper uses a regression model for analysis as a way of mathematical sorting that allows one to clearly identify which of these variables really have an effect, which factors are most important, which factors could be ignored, how these factors interact with each other, and, the most important thing is how certain and influential are these factors.

This paper applies Pearson's linear pairwise correlation coefficient between the studied variables to establish the strength of the statistical relationship between the components of the models.

$$r_{xy} = \frac{\sum_{i=1}^n (x_i - \bar{x}) \cdot (y_i - \bar{y})}{(n-1) \cdot S_x \cdot S_y}, \quad \text{where} \quad (1)$$

$$\bar{x} = \frac{1}{n} \sum_{i=1}^n x_i, \quad \text{and} \quad \bar{y} = \frac{1}{n} \sum_{i=1}^n y_i.$$

S_x^2, S_y^2 sample variances. They can be calculated by:

$$S_{\bar{x}}^2 = \frac{\sum (x_i - \bar{x}_i)^2}{N-1}, \quad S^2 = \frac{\sum (y_i - \bar{y}_i)^2}{N-1}. \quad (2)$$

To assess the correlation, the following gradation of the variables is checked: $0 < |r| < 0.2$ – very low, $0.2 \leq |r| < 0.4$ – low, $0.4 \leq |r| < 0.7$ – medium, $0.7 \leq |r| < 0.9$ – strong, $0.9 \leq |r| < 1$ – very strong.

After the first look at the correlation matrix, multiple linear regression is used:

$$Y = b_0 + b_1 x_1 + b_2 x_2 + \varepsilon, \quad (3)$$

where Y – response variable (Real GDP growth, HDI, Fiscal Solvency index), b_0 – the effect of external independent factors on the response varia-

¹ In this study, the fiscal solvency index will be calculated by the formula: $S = \text{PB}/\text{GDP} \cdot (\text{GSY} - \text{Real GDP Growth}) / (1 + \text{GSY})$, where GSY – government securities yield, average in year, in %.

ble, and x_{1j} and x_{2j} – predictor variables, as degree of compliance with deficit and debt rules. This degree is calculated as:

$$x_{1j} = \frac{Deficit_{current}}{Deficit_{rule}}, \quad x_{2j} = \frac{Debt_{current}}{Debt_{rule}}. \quad (4)$$

The results of the regression are examined using the multiple R-squared to identify the strength of the relationship between the linear model and the dependent variables, and statistical significance of the beta coefficients in the resulting models to identify the presence of relationships by using p-value for the predictor variables and its comparison with t-value. Confidence intervals are also used here to estimate the behavior of models in crisis and post-crisis periods and the degree of uncertainty and instability of the resulting variables. Confidence intervals:

$$Ci = \bar{x} \pm Z_{\alpha/2} \cdot \frac{\sigma}{\sqrt{(n)}}. \quad (5)$$

This study is based on official statistics and methodology from the OECD, Eurostat, International Monetary Fund (World Economic Outlook: real GDP growth, General government gross debt, primary balance-to-GDP ratio), World Bank (Global Economic Monitor for EMBI+ index of Ukraine), United Nations Development Programme (Human Development Index), State Treasury Service of Ukraine (primary balance of Ukraine's state budget), Ministry of Finance of Ukraine (debt indicators of Ukraine), National Bank of Ukraine (government securities yield and official international reserves), National banks of Poland, Serbia, Bulgaria, Hungary (government securities yield) from 2006 to 2021, and Ministry of Economy of Ukraine (Methodology for calculating the integral indicator of debt security of Ukraine).

3. RESULTS

The first hypothesis of the study is aimed at establishing the relationship between the debt ceiling (fiscal rules) and the level of socio-economic development of the countries selected for the study. When assessing the state of development of the economies of these countries, three waves in the dynamics of GDP (Figure 1) can be identi-

fied such as a high growth in the pre-crisis period (2006–2008), a sharp decline in growth during the crisis year, moderate growth in the post-crisis period (2010–2013) and accelerating GDP growth to crisis of 2020 due to the COVID-19 pandemic with a recovery in 2021. However, if during the first period Ukraine showed even higher growth rates compared to other countries, then in the second period, the country has a clear crisis dynamics and lags behind its European analogues. Post-crisis recovery during 2016–2019 was slower than in European countries. Due to the COVID-19 crisis, the negative impact on GDP dynamics was commensurate, and the recovery in 2021 was much slower given the external and internal risks associated with the 2008–2009 and 2014–2015 crises, which caused a state of chronic recession in the Ukrainian economy. The Ukrainian economy reacted more sensitively to the stresses associated with external and internal crises due to the lack of access to European support programs and capital markets. The growth of the human development index is observed throughout the study period with slight declines during three crisis periods in the economies of the studied countries, a slowdown in growth in post-crisis periods. The growth of Ukraine's index was slower than in Eastern Europe throughout the entire study period.

The increase in the deficit was a response to the crisis phenomena and the decline in the rate of socio-economic development in the studied countries (Figure 2). The dynamics of the ratio of the primary balance to GDP in selected countries during the study period is characterized by significant volatility with a tendency to chronic deficits in some countries (Ukraine, Hungary). In the crisis of 2008–2009 and post-crisis of 2010–2014, there was a violation of the convergence criterion of 3% of GDP in the studied countries except Bulgaria and Hungary. Since 2015, there has been a recovery and isolated cases of surplus in Bulgaria and Serbia. The response to the crisis in 2020 and 2021 was a significant deficit of the budgets of the studied countries. Poland, Hungary and Serbia are characterized by deeper reactions to the crisis. The dynamics of Ukraine's indicators was smoother within the framework of the policy of restraining the growth of the budget deficit and the higher cost of covering it.

Source: Composed by the authors (Tables A1 and A2 in Appendix A).

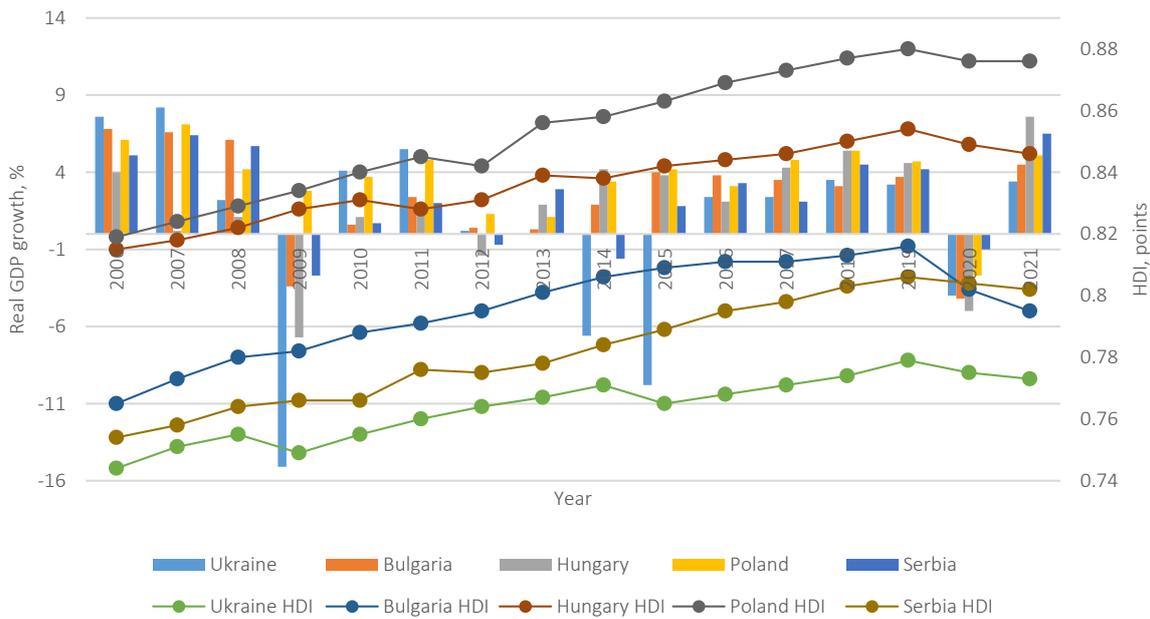


Figure 1. Real GDP growth in % for Ukraine, Bulgaria, Hungary, Poland, Serbia and Human Development Index (2006–2021)

The normal reaction to the increase in the deficit was the increase in public debt in the countries under study. During 2006–2021, there was a violation of the limit of 60% of GDP in Hungary, and in Serbia during 2014–2016 (Figure 3). The dynamics of Poland is characterized by relative stability. Bulgaria’s performance is lower than its counterparts. Ukraine’s dynamics reflect a greater sensitivity to internal and external shocks. In 2008–2009, Ukraine was affected by the global crisis, which significantly affected the national econ-

omy. This was due to the openness of the economy to international trade and capital flows, as well as the accumulation of high risks in various areas before the crisis. The crisis has led to a significant increase in the ratio of public debt to GDP, but the 60% of GDP limit was not violated until 2014. In 2014–2015, Ukraine became the epicenter of the crisis and experienced shocks caused by internal imbalances, which together gave impetus to a full-scale economic and financial crisis. The state faced a large-scale outflow of foreign capital. In Ukraine, there was a combi-

Source: Composed by the authors (Table A4 in Appendix A).

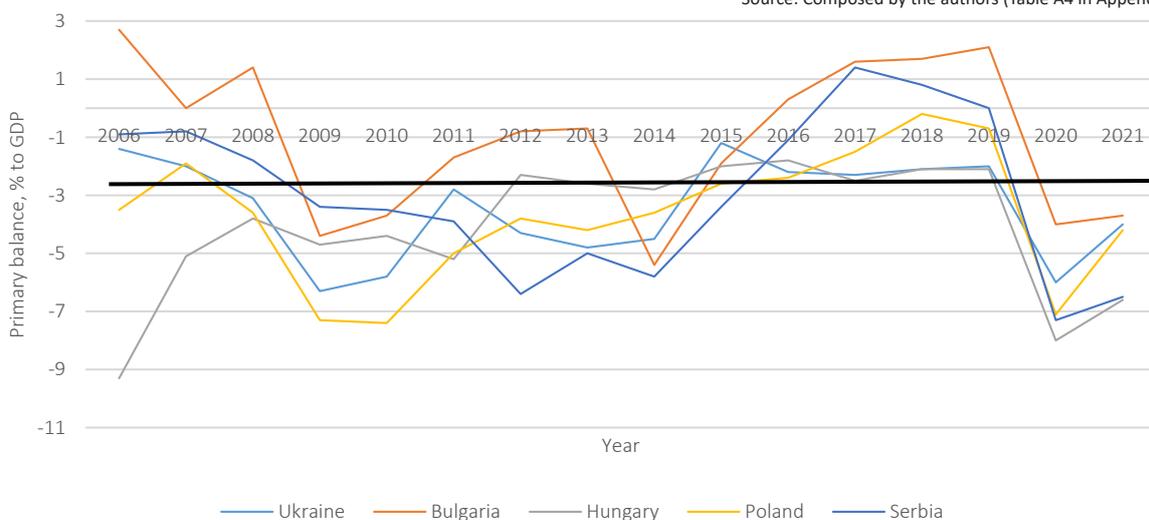


Figure 2. Primary balance in % to GDP for Ukraine, Bulgaria, Hungary, Poland, and Serbia (2006–2021)

Source: Composed by the authors (Table A3 in Appendix A).

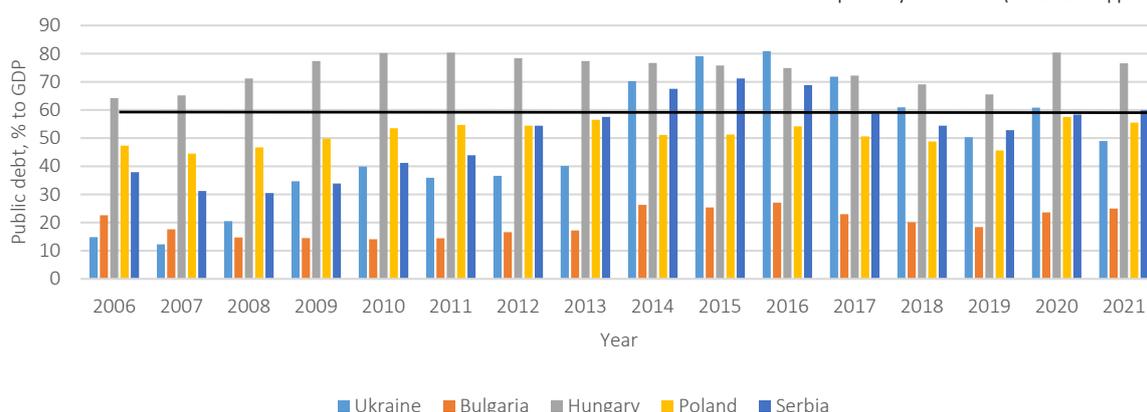


Figure 3. Public debt in % to GDP for Ukraine, Bulgaria, Hungary, Poland, and Serbia (2006–2021)

nation of currency, banking and debt crises, which were partly related to the risk of debt refinancing and a significant increase in the debt service burden after a deep devaluation of the exchange rate. The gradual leveling off of the hryvnia exchange rate, the reduction in foreign borrowing by Ukrainian corporations and banks, and the revival of Ukrainian exports have made major contributions to improving Ukraine's foreign debt capacity to level below 60% of GDP limit from 2018 to 2021.

At the same time, according to the calculations of the indicator of fiscal solvency, the studied countries needed additional fiscal measures to overcome the crisis in 2009 and 2020, during the rest

of the studied period, the indicators are close to zero. The specificity of the COVID-19 crisis led to the need to find new solutions and additional fiscal measures in order to overcome problems in the economy. This was reflected in the solvency index.

Despite lower levels of public debt, policy of controlling of the budget deficit, the situation with debt security in Ukraine was more difficult than in European countries (Table A10 of Appendix). This is evidenced by the debt security indicator. The dynamics of Ukraine's integrated debt security indicator is characterized by a secure level of security in the pre-crisis years and, along with this high level of risk of the debt crisis since the 2009 cri-

Table 1. Fiscal solvency index in Ukraine, Bulgaria, Hungary, Poland, and Serbia, 2006–2021

Source: Composed and calculated by the authors based on Tables A1, A4, A5 of Appendix A.

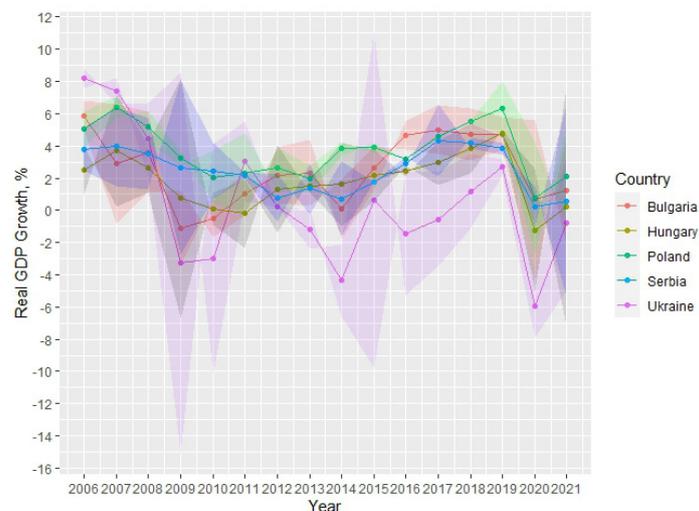
Year	Country				
	Ukraine	Bulgaria	Hungary	Poland	Serbia
2006	-0.23	-1.35	-3.56	0.51	-0.61
2007	0.39	0.00	-4.31	0.47	-0.28
2008	-2.33	-0.15	-2.93	-0.96	-1.03
2009	-13.03	-5.69	-7.35	-3.39	-3.82
2010	-3.20	-2.85	-3.29	-2.29	-2.90
2011	-1.01	-0.80	-3.45	-0.86	-2.96
2012	-3.93	-0.60	-2.40	-2.34	-6.22
2013	-4.46	-0.50	-1.51	-2.44	-3.04
2014	-6.18	-1.76	-0.29	-0.08	-6.24
2015	-1.95	0.81	0.18	1.05	-1.27
2016	-1.46	-0.14	-0.44	0.06	0.14
2017	-1.62	-1.17	0.81	0.48	0.27
2018	-1.60	-1.97	1.18	0.10	-0.49
2019	-1.53	-4.95	1.26	0.51	0.00
2020	-7.61	-13.85	-18.00	-11.93	-7.30
2021	-2.57	13.26	7.59	4.63	31.29

sis year. The growth of the absolute and relative size of the public debt of Ukraine naturally increased the vulnerability of public finances to the impact of shock factors. In 2014–2015, in line with the deep economic and financial crisis inside the country, the indicator was at an extremely dangerous level due to significant volatility spreads, high interest rates on bonds, significant growth of public debt with decrease of economic growth, along with a significant reduction in international reserves, which was reflected in the procedure of public debt restructuring of Ukraine in the end of 2015. After 2016, the level of risk remains high with a slow dynamics of recovery, and the 2020 crisis was reflected in the negative dynamics. The changes in 2016–2019 were caused by a significant strengthening of the real exchange rate of the hryvnia and a slight increase in real GDP with a slow increase in the absolute amount of debt. In the conditions of the pandemic, the risks have increased significantly. The most significant risks that are relevant for Ukraine: economic recession and a real decrease in budget revenues, which narrows the financial and economic base for debt repayment and servicing; the volatility of the global financial market with an increase in the burden of public debts; unpredictable changes in the prices of raw materials, which will affect the revenues of budgets and the creditworthiness of governments.

To determine the expediency of compliance with fiscal rules within the framework of economic recovery, the relationship between compliance with fiscal rules, fiscal solvency, and socio-economic development will be investigated.

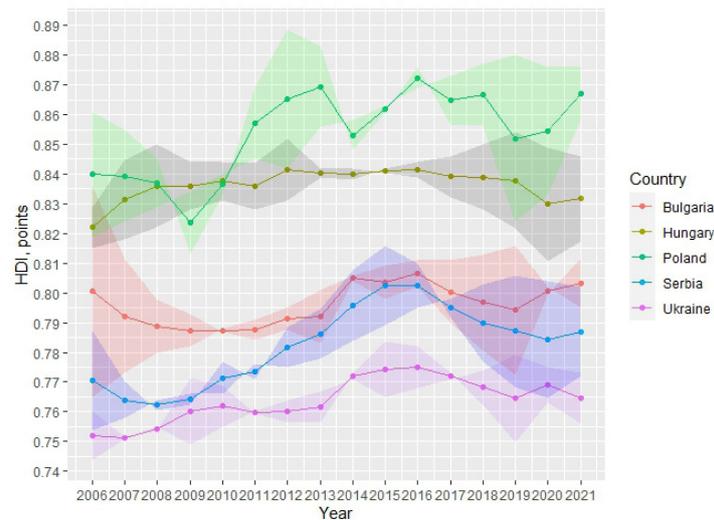
The results of the conducted correlation analysis (Table A6 of Appendix A) indicate the relationship between the implementation of fiscal rules in certain elements of the studied hypotheses, in particular, for Ukraine and Serbia, compliance with the debt rule is associated more with an increase in the standard of living, only for Ukraine, compliance with the deficit rule is largely associated with fiscal solvency. For Bulgaria, compliance with the deficit rule is related largely to economic growth, for Poland – to the debt ceiling. The case of Ukraine shows the following features: compliance with the debt rule has no positive effect on improving the standard of living, since public debt is largely used to cover current debt obligations and finance current budget expenditures such as social protection, education, and health care, to a lesser extent on investments, and compliance budget deficit rules have a more positive effect on fiscal solvency, improved fiscal discipline eliminates the need for additional fiscal measures. The study of the relationship between compliance with the rules of deficit and debt and indicators of socio-economic development (Table A7) indicates the absence of a reliable relationship between the indicators for all studied countries, the R^2 indicator in the models is less than 0.6.

In addition, the variation in standard errors for models (Figure 4) is extremely significant for all the countries under study in the reviewed period, especially in conditions of macroeconomic instability and crisis periods (for Ukraine: 2009–2010, 2014–2021, for other countries: 2009–2010, 2020–



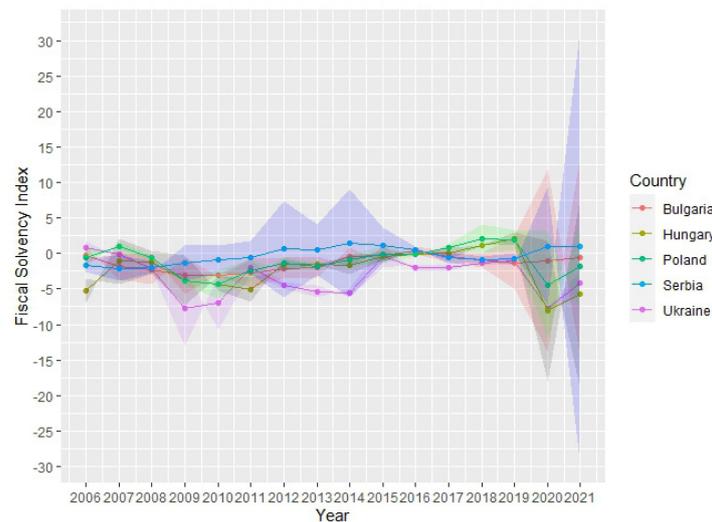
Source: Authors' calculation.

Figure 4. Fitted values of models, Hypothesis 1 (correlation between budget deficit, public debt and real GDP growth), with standard error intervals



Source: Authors' calculation.

Figure 5. Fitted values of models, Hypothesis 1 (correlation between budget deficit, public debt and HDI), with standard error intervals



Source: Authors' calculation.

Figure 6. Fitted values of models, Hypothesis 2, with standard error intervals

2021). The abnormal variation indicates a chronic recession in the Ukrainian economy.

In turn, the variation of errors in the models of the relationship between compliance with fiscal rules and the human development index indicator (Figure 5, Table A8) is uneven throughout the study period without clearly defined features in the context of crisis phenomena and macroeconomic stabilization. For Ukraine, there is a certain uniformity (variation increases in 2009–2010, 2015 and post-crisis 2016, as well as a normal response due to the COVID-19 pandemic).

Exploring the second hypothesis about the relationship between compliance with fiscal rules and

fiscal solvency in promotion of economic recovery under crisis conditions (Tables A9, Figure 6), it can be noted: there is no clearly defined relationship for all countries, except Ukraine; a significant variation in errors in 2020–2021, which confirms the specifics and uniqueness of the crisis of the COVID-19 pandemic, which led to the undermining of fiscal solvency in the countries under study and the need to apply specific measures in monetary and fiscal policy.

Also, the results can indicate that the time horizon for the restoration of the pace of social and economic development varies significantly for the selected countries, depending on the internal institutional features of the economies.

CONCLUSION

The conclusions drawn in this paper are relevant to two dimensions of the sustainability and resilience study of public finance. First, the analysis of fiscal solvency and fiscal constraints in Ukraine and similar countries in terms of socio-economic development, regional location and debt policy has largely focused on individual aspects, focusing on debt security, fiscal rules and the specifics of debt policy at different stages of economic development. Second, the few existing studies on the relationship between fiscal policy and economic growth have mostly focused on the experience of a few countries and do not include a comprehensive approach to assessing fiscal solvency, compliance of fiscal rules and social-economic development in different stages of the economic cycle. Looking at the time period from 2009 to 2021, the paper explores whether fiscal solvency is biased by the impact of fiscal compliance on socio-economic development at different stages of the economic cycle. Finally, despite the ambiguous current views of the global and domestic academic and professional communities on fiscal constraints, solvency and sustainability of public finances, the obvious fact is that fiscal policy based on fiscal discipline and compliance with fiscal rules is aimed at fiscal sustainability and has an impact on socio-economic development in times of macroeconomic stability.

Thus, the results of the empirical study indicate the absence of a reliable relationship between the compliance with the fiscal rules and indicators of socio-economic development for all studied countries, especially in conditions of macroeconomic instability and crisis periods (for Ukraine: 2009–2010, 2014–2021, for other countries 2009–2010, 2020–2021) due to existing limitations of this investigation (time interval, economic cycles, evidence of selected countries). In case of Ukraine, it is also shown that compliance with the debt rule has no positive effect on improving the standard of living, since public debt is largely used to cover current debt obligations and finance current budget expenditures, to a lesser extent on investments, and compliance budget deficit rules have a more positive effect on fiscal solvency, improved fiscal discipline eliminates the need for additional fiscal measures. The evidence of Ukraine's post-crisis policies (2011, 2015, 2021) shows that stimulus measures were curtailed prematurely, which is confirmed by the conclusions of the second hypothesis, namely, the absence of a clearly defined relationship between indicators of compliance with fiscal rules and fiscal solvency in promotion of economic recovery for all countries, except Ukraine.

Therefore, for further research, it seems important to take into account the correspondence between fiscal solvency, fiscal limitation in making timely balanced macro-financial decisions and to determine the mutual impact on economic stability at different stages of the economic cycle.

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REFERENCES

1. Afonso, A., & Coelho, J. C. (2023). Public finances solvency in the euro area. *Economic Analysis and Policy*, 77, 642-657. <https://doi.org/10.1016/j.eap.2022.12.027>
2. Afonso, A., & Jalles, J.T. (2019). Fiscal Rules and Government Financing Costs. *Fiscal Studies*, 40, 71-90. <https://doi.org/10.1111/1475-5890.12182>
3. Albu, A.-C., & Albu, L.-L. (2021). Public debt and economic growth in Euro area countries. A wavelet approach. *Technological and Economic Development of Economy*, 27(3), 602-625. <https://doi.org/10.3846/tede.2021.14241>
4. Badinger, H., & Reuter, W. H., (2017). The case for fiscal rules. *Economic Modelling*, 60(C), 334-343. <https://doi.org/10.1016/j.econmod.2016.09.028>
5. Bergman, U. M., & Hutchison, M. (2020). Fiscal procyclicality in emerging markets: The role of institutions and economic conditions. *International Finance*, 23(2), 196-214. <https://doi.org/10.1111/inf.12375>
6. Bergman, U. M., Hutchison, M. M., & Jensen, S. E. H. (2016). Promoting sustainable public finances in the European Union: The role of fiscal rules and government efficiency. *European Journal of Political Economy*, 44, 1-19. <https://doi.org/10.1016/j.ejpoleco.2016.04.005>
7. Blanchard, O., Leandro, A., & Zetelmeyer, J. (2021). Redesigning EU fiscal rules: From rules to standards. *Economic Policy*, 36(106), 195-236. <https://doi.org/10.1093/epolic/eiab003>
8. Bogdan T., & Lomakovych V. (2021). Financialization of the global economy: Macroeconomic implications and policy challenges for Ukraine. *Investment Management and Financial Innovations*, 18(1), 151-164. [https://doi.org/10.21511/imfi.18\(1\).2021.13](https://doi.org/10.21511/imfi.18(1).2021.13)
9. Boórl, M. (2020). Impact of fiscal rules on level of economic growth in monetary unions. [Vplyv fiškálnych pravidiel na úroveň ekonomického rastu v monetárnych úniách] *Politická Ekonomie*, 68(6), 695-724. <https://doi.org/10.18267/J.POLEK.1300>
10. Briceño, H. R., & Perote, J. (2020). Determinants of the public debt in the eurozone and its sustainability amid the Covid-19 pandemic. *Sustainability (Switzerland)*, 12(16) <https://doi.org/10.3390/su12166456>
11. Caselli, F., Davoodi, H., Gonçalves, C., Hong, G. H., Lagerborg, A., Medas, P., Nguyen, A., & Yoo, J. (2022). The Return to Fiscal Rules. *IMF Staff Discussion Note 2022/002*. Washington, DC: International Monetary Fund.
12. Combes, J.-L., & Minea, A. & Sow, M. (2017). Is fiscal policy always counter- (pro-) cyclical? The role of public debt and fiscal rules. *Economic Modelling*, Elsevier, 65(C), 138-146. <https://doi.org/10.1016/j.econmod.2017.05.017>
13. Danylyshyn, B., & Bohdan, I. (2022). Monetary policy during the wartime: How to ensure macroeconomic stability. *Investment Management and Financial Innovations*, 19(2), 344-359. [https://doi.org/10.21511/imfi.19\(2\).2022.30](https://doi.org/10.21511/imfi.19(2).2022.30)
14. Davoodi, H. R., Elger, P., Fotiou, A., Garcia-Macia, D., Han, X., Lagerborg, A., Lam, W. R., Medas, P. A. (2022). *Fiscal Rules and Fiscal Councils: Recent Trends and Performance During the COVID-19 Pandemic* (IMF Working Paper No. 2022/011). Retrieved from <https://ssrn.com/abstract=4065432>
15. Díaz-Roldán, C., Filho, F., & da Silva Bichara, J. (2021). Fiscal Rules in Economic Crisis: The Trade-off Between Consolidation and Recovery, from a European Perspective. *Economics*, 15(1), 199-216. <https://doi.org/10.1515/econ-2021-0013>
16. Eurostat. (n.d.) Retrieved from https://ec.europa.eu/eurostat/databrowser/view/GOV_10DD_EDPT1__custom_1917977/default/table?lang=en
17. Gomez-Gonzalez, J. E., Valencia, O. M., & Sánchez, G. A. (2022). How fiscal rules can reduce sovereign debt default risk. *Emerging Markets Review*, 50. <https://doi.org/10.1016/j.ememar.2021.100839>
18. Gründler, K., & Potrafke, N. (2020). Fiscal Rules: Historical, Modern, and Sub-National Growth Effects. *Political Economy – Development: Domestic Development Strategies eJournal*.
19. Heinemann, F., Moessinger, M.-C. & Yeter, M. (2018). Do fiscal rules Constrain Fiscal Policy? A Meta-Regression Analysis. *European Journal of Political Economy* 51, 69-92. <https://doi.org/10.1016/j.ejpoleco.2017.03.008>
20. Hutchison, M. M. (2020). The global pandemic, policy space and fiscal rules to achieve stronger stabilization policies. *Seoul Journal of Economics*, 33(3), 307-331. <https://doi.org/10.22904/sje.2020.33.3.003>
21. International Monetary Fund. (n.d.). *World Economic Outlook*. Retrieved from <https://www.imf.org/external/datamapper/datasets/WEO>
22. Kotina, H., Stepura, M., & Kondro, P. (2022). How does active digital transformation affect the efficiency of governance and the sustainability of public finance? The Ukrainian case. *Baltic Journal of Economic Studies*, 8(1), 75-82. <https://doi.org/10.30525/2256-0742/2022-8-1-75-82>
23. Ministry of Finance of Ukraine. (n.d.b.). *Official website*. Retrieved from <https://mof.gov.ua/en/derzhavnij-borg-ta-garantovani-jderzhavju-borg>
24. Mühlbach, C. (2022). The European fiscal rules need major reforms. [Ein Update für die europäischen Fiskalregeln]. *Wirtschaftsdienst*, 102(6), 456-460. <https://doi.org/10.1007/s10273-022-3218-0>
25. National Bank of Serbia. (n.d.). *Official website*. Retrieved from https://nbs.rs/en/drugi-nivo-navigacije/statistika/ks_stat/
26. National Bank of Ukraine. (n.d.). *Official website*. Retrieved from <https://bank.gov.ua>

27. Noga, M., Postula, M., & Klepacki, J. (2018). The Impact of the European Public Debt Criterion on the Real Socio-Economic Development. *Transformations in Business & Economics*, 17(45), 38-54.
28. OECD. (2021). *Economic Outlook No 110 - December 2021*. Retrieved from https://stats.oecd.org/viewhtml.aspx?datasetcode=EO110_INTERNET&lang=en#
29. Pappa, E. (2020) Fiscal Rules, Policy and Macroeconomic Stabilization in the Euro Area. *ECB Forum on Central Banking*. Frankfurt: European Central Bank.
30. Priewe, J. (2022) European Fiscal Rules and the German Debt Brake – Reform Options, *FES diskurs*. Retrieved from <https://library.fes.de/pdf-files/a-p-b/19678.pdf>
31. Qehaja, D., Zhushi, G., & Salihu, A. (2022). The impact of fiscal rules on the fiscal deficit for ten countries of the European Union – empirical analysis for the period 1995-2020. *International Journal of Sustainable Development and Planning*, 17(3), 1017-1023. <https://doi.org/10.18280/ijstdp.170333>
32. Regling, K. (2022). EU fiscal rules: A look back and the way forward. *Intereconomics*, 57(1), 8-10. <https://doi.org/10.1007/s10272-022-1020-2>
33. Reuter, W.H. (2015). National numerical fiscal rules: Not complied with, but still effective? *European Journal of Political Economy*, 39, 67-81. <https://doi.org/10.1016/j.ejpoleco.2015.04.002>
34. Reuter, W. H., Tkačevs, O., & Vilerts, K. (2022). Fiscal rules and volatility: the role of stabilising properties and compliance. *Empirica*, 49, 21-52. <https://doi.org/10.1007/s10663-021-09522-9>
35. Schick, A. (2010). Post-Crisis Fiscal Rules: Stabilising Public Finance while Responding to Economic Aftershocks. *OECD Journal on Budgeting*, 10/2. <https://doi.org/10.1787/budget-10-5km-7rqpkqts1>
36. Tapsoba, R. (2012). Do National Numerical Fiscal Rules really shape fiscal behaviours in developing countries? A treatment effect evaluation. *Economic Modelling*, 29, 1356-1369. <https://doi.org/10.1016/j.econmod.2012.03.003>
37. The State Treasury Service of Ukraine. (n.d.). *Official website*. Retrieved from <https://www.treasury.gov.ua/en>
38. Thornton, J., & Vasilakis, C. (2020). Do fiscal rules reduce government borrowing costs in developing countries? *International Journal of Finance and Economics*, 25(4), 499-510. <https://doi.org/10.1002/ijfe.1771>
39. United Nations. (n.d.). *Human Development Report*. Retrieved from <https://hdr.undp.org/data-center/human-development-index#/indicies/HDI>
40. Vinturis, C. (2022). A multi-speed fiscal Europe? fiscal rules and fiscal performance in the EU former communist countries. *Post-Communist Economics*, 34(2), 149-172. <https://doi.org/10.1080/14631377.2020.1867432>
41. World Bank Data. (n.d.). *Global Economic Monitor*. Retrieved from <https://databank.worldbank.org/source/global-economic-monitor-gem>

APPENDIX A

Table A1. Real GDP growth in Ukraine, Bulgaria, Hungary, Poland, and Serbia, 2006–2021, in %

Source: IMF WEO (2022).

Year	Country				
	Ukraine	Bulgaria	Hungary	Poland	Serbia
2006	7.6	6.8	4	6.1	5.1
2007	8.2	6.6	0.2	7.1	6.4
2008	2.2	6.1	1.1	4.2	5.7
2009	-15.1	-3.4	-6.7	2.8	-2.7
2010	4.1	0.6	1.1	3.7	0.7
2011	5.5	2.4	1.9	4.8	2
2012	0.2	0.4	-1.4	1.3	-0.7
2013	0	0.3	1.9	1.1	2.9
2014	-6.6	1.9	4.2	3.4	-1.6
2015	-9.8	4	3.8	4.2	1.8
2016	2.4	3.8	2.1	3.1	3.3
2017	2.4	3.5	4.3	4.8	2.1
2018	3.5	3.1	5.4	5.4	4.5
2019	3.2	3.7	4.6	4.7	4.2
2020	-4	-4.2	-5	-2.7	-1
2021	3.4	4.5	7.6	5.1	6.5

Table A2. Human Development Index, Ukraine, Bulgaria, Hungary, Poland, and Serbia, 2006–2021

Source: UNDP HDR (2022).

Year	Country				
	Ukraine	Bulgaria	Hungary	Poland	Serbia
2006	0.744	0.765	0.815	0.819	0.754
2007	0.751	0.773	0.818	0.824	0.758
2008	0.755	0.78	0.822	0.829	0.764
2009	0.749	0.782	0.828	0.834	0.766
2010	0.755	0.788	0.831	0.84	0.766
2011	0.76	0.791	0.828	0.845	0.776
2012	0.764	0.795	0.831	0.842	0.775
2013	0.767	0.801	0.839	0.856	0.778
2014	0.771	0.806	0.838	0.858	0.784
2015	0.765	0.809	0.842	0.863	0.789
2016	0.768	0.811	0.844	0.869	0.795
2017	0.771	0.811	0.846	0.873	0.798
2018	0.774	0.813	0.85	0.877	0.803
2019	0.779	0.816	0.854	0.88	0.806
2020	0.775	0.802	0.849	0.876	0.804
2021	0.773	0.795	0.846	0.876	0.802

Table A3. General government gross debt, Ukraine, Bulgaria, Hungary, Poland, and Serbia, 2006–2021, in % of GDP

Source: IMF WEO (2022).

Year	Country				
	Ukraine	Bulgaria	Hungary	Poland	Serbia
2006	14.8	22.6	64.2	47.3	37.9
2007	12.3	17.6	65.2	44.5	31.2
2008	20.5	14.7	71.2	46.7	30.5
2009	34.7	14.5	77.4	49.8	33.9
2010	39.9	14.1	80.2	53.5	41.2

Table A3 (cont.). General government gross debt, Ukraine, Bulgaria, Hungary, Poland, and Serbia, 2006–2021, in % of GDP

Year	Country				
	Ukraine	Bulgaria	Hungary	Poland	Serbia
2011	35.9	14.4	80.4	54.7	43.9
2012	36.6	16.6	78.4	54.4	54.4
2013	40.1	17.2	77.4	56.5	57.5
2014	70.2	26.3	76.7	51.1	67.5
2015	79.1	25.4	75.8	51.3	71.2
2016	80.9	27.1	74.9	54.2	68.8
2017	71.8	23	72.2	50.6	58.6
2018	60.9	20.1	69.1	48.8	54.4
2019	50.3	18.4	65.5	45.6	52.8
2020	60.8	23.6	80.4	57.5	58.4
2021	48.94	25	76.6	55.5	59.9

Table A4. Primary balance-to-GDP ratio, Ukraine, Bulgaria, Hungary, Poland, and Serbia, 2006–2021, in %

Source: IMF WEO (2022).

Year	Country				
	Ukraine	Bulgaria	Hungary	Poland	Serbia
2006	-1.4	2.7	-9.3	-3.5	-0.9
2007	-2	0	-5.1	-1.9	-0.8
2008	-3.1	1.4	-3.8	-3.6	-1.8
2009	-6.3	-4.4	-4.7	-7.3	-3.4
2010	-5.8	-3.7	-4.4	-7.4	-3.5
2011	-2.8	-1.7	-5.2	-5.0	-3.9
2012	-4.3	-0.8	-2.3	-3.8	-6.4
2013	-4.8	-0.7	-2.6	-4.2	-5
2014	-4.5	-5.4	-2.8	-3.6	-5.8
2015	-1.2	-1.9	-2.0	-2.6	-3.4
2016	-2.2	0.3	-1.8	-2.4	-1.1
2017	-2.3	1.6	-2.5	-1.5	1.4
2018	-2.1	1.7	-2.1	-0.2	0.8
2019	-2	2.1	-2.1	-0.7	0
2020	-6	-4	-8.0	-7.1	-7.3
2021	-4	-3.7	-6.6	-4.2	-6.5

Table A5. Government securities yield, Ukraine, Bulgaria, Hungary, Poland, and Serbia, 2006–2021, in %

Source: Authors' compilation based on NBU, OECD, NBS.

Year	Country				
	Ukraine	Bulgaria	Hungary	Poland	Serbia
2006	9.26	4.2	7.1	5.2	18.02
2007	6.71	4.5	6.7	5.5	10.4
2008	11.86	5.4	8.2	6.1	14.67
2009	12.21	7.2	9.1	6.1	12.65
2010	10.39	6	7.3	5.8	8.97
2011	9.17	5.4	7.6	6	11.42
2012	12.94	4.5	7.9	5	9.66
2013	13.13	3.5	5.9	4	8.93
2014	13.98	3.3	4.8	3.5	6.98
2015	13.07	2.5	3.4	2.7	3.46
2016	9.16	2.3	3.1	3	2.82
2017	10.47	1.6	3	3.4	2.83
2018	17.79	0.9	3.1	3.2	2.42
2019	16.93	0.4	2.5	2.3	1.49
2020	10.20	0.3	2.2	1.5	0.63
2021	11.34	0.2	3	1.9	0.29

Table A6. Correlation matrix for Hypothesis 1 and Hypothesis 2

Source: Authors' calculation.

Country	Cor(PB/GDP)	Cor(Debt/GDP)	Cor(PB/Hdi)	Cor(Debt/Hdi)	Cor(PB/FS)	Cor(Debt/FS)
Ukraine	-0,46	-0,39	-0,02	0,72	-0,81	-0,08
Bulgaria	-0,63	0,19	0,01	0,44	-0,05	0,20
Hungary	-0,21	-0,38	-0,42	0,16	-0,45	-0,25
Poland	-0,55	-0,70	-0,32	0,36	-0,59	0,38
Serbia	-0,47	-0,22	0,01	0,74	0,09	0,12

Table A7. Results of modelling for Hypothesis 1 (correlation between budget deficit, public debt and real GDP growth)

Source: Authors' calculation.

Coefficients	Ukraine	Bulgaria	Hungary	Poland	Serbia
Intercept Pr(>t)	0.0139 *	0.98079	0.0975	0.00479 **	0.0908 .
Deficit Pr(>t)	0.0418 *	0.00775 **	0.3857	0.29094	0.0973 .
Debt Pr(>t)	0.0703 .	0.27734	0.1455	0.02735 *	0.6632
Residual standard error	5.436	2.528	3.592	1.714	2.725
Multiple R-squared	0.3904	0.453	0.1923	0.5276	0.2358
F-statistic	4.162	5.383	1.547	7.259	2.005
p-value	0.04008	0.01982	0.2496	0.00764	0.1742

Note: Point after value means 95% significance, * – 99%, ** – 99,9% with alpha = 0.05.

Table A8. Results of modelling for Hypothesis 1 (correlation between budget deficit, public debt and HDI)

Source: Authors' calculation.

Coefficients	Ukraine	Bulgaria	Hungary	Poland	Serbia
Intercept Pr(>t)	< 2e-16 ***	1.17e-15 ***	2.89e-11 ***	2.5e-08 ***	< 2e-16 ***
Deficit Pr(>t)	0.83322	0.9453	0.122	0.00926 **	0.35646
Debt Pr(>t)	0.00223 **	0.0974 .	0.568	0.00740 **	0.00108 **
Residual standard error	0.007694	0.01471	0.0115	0.01585	0.01238
Multiple R-squared	0.5256	0.1972	0.1961	0.4922	0.5734
F-statistic	7.203	1.585	2	6.3	8.735
p-value	0.007846	0.2399	0.2421	0.01222	0.003939

Note: Point after value means 95% significance, ** – 99,9%, *** – 99,99% with alpha = 0.05.

Table A9. Results of modelling for Hypothesis 2.

Source: Authors' calculation.

Coefficients	Ukraine	Bulgaria	Hungary	Poland	Serbia
Intercept Pr(>t)	0.064794 .	0.377	0.2324	0.5816	0.656
Deficit Pr(>t)	0.000146 ***	0.822	0.0751 .	0.0646 .	0.831
Debt Pr(>t)	0.359207	0.473	0.2706	0.7302	0.720
Residual standard error	2.06	5.53	4.884	2.991	9.335
Multiple R-squared	0.685	0.04269	0.2734	0.3493	0.01761
F-statistic	13.14	0.2899	2.446	3.489	0.1165
p-value	0.000548	0.7531	0.1254	0.06124	0.891

Table A10. Debt security indicators affecting fiscal solvency in Ukraine, 2006–2021

Source: Authors' compilation and calculation based on the methodology of the Ministry of Economy of Ukraine.

Indicator/Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Public debt to GDP ratio, %	14,25	11,81	19,12	33,46	40,05	36,40	36,70	39,91	69,37	79,06	80,90	71,84	60,91	50,24	60,44	48,94
Gross external debt-to-GDP ratio, %	50,6	56	56,1	88,3	86,2	77,3	76,6	79,1	96	130	120,6	103	87,8	78,8	80,9	64,6
Average government securities yield, %	9,26	6,71	11,86	12,21	10,39	9,17	12,94	13,13	13,98	13,07	9,16	10,47	17,79	16,93	10,2	11,34
EMBI+ Index, points	202,8	200,6	845,5	1617,2	589,7	591,5	810	736,8	1013,5	2374,6	762,5	564,2	532,8	491,5	650,7	1096
Official international reserves to gross external debt ratio, %	41,02	40,47	31,00	25,63	29,47	25,19	18,23	14,37	6,01	11,30	13,81	16,29	18,15	20,78	23,18	23,85
Integral indicator of debt security	0,74	0,75	0,50	0,30	0,37	0,40	0,31	0,30	0,12	0,13	0,22	0,27	0,24	0,30	0,26	0,28
Risk assessment	Low	Low	Medium	High	High	Medium	High	High	Debt crisis	Debt crisis	High	High	High	High	High	High