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ТРАНСФОРМАЦІЯ ПРИБУТКОВОСТІ ДЕРЖАВНИХ ОБЛІГАЦІЙ В УМОВАХ БОРГОВОЇ КРИЗИ

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Анотація. У статті аналізується дохідність державних облігацій, як довгострокових, так і короткострокових, країн, які найбільше постраждали від боргової кризи, а саме Греція, Італія, Португалія, а також країн, які отримали найбільшу вигоду від обставин, що склалися, а саме Німеччина і Франція. Було виявлено зростання дохідності двох видів державних облігацій (з терміном погашення 10 років і 1 рік) по всіх аналізованих країн (крім Німеччини і Франції) в період боргової кризи з кінця 2009 р. Пік дохідності за державними облігаціями країн Південної Європи припав на 2011 р. Під час боргової кризи німецькі державні облігації отримали вигоду і, як результат, дохідність державних облігацій Німеччини і Франції знижувалася. У наступні роки дохідність державних облігацій країн Південної Європи, а також Німеччини та Франції знижувалася. У статті також були побудовані векторні авторегресії (VAR) взаємозалежності між різними видами дохідності державних облігацій, їх різницею і державним боргом, державним бюджетом, ВВП аналізованих країн. Було виявлено, що в Німеччині взаємозв'язку даних показників не спостерігалося. Однак існує сильна одностороння залежність державного боргу від дохідності довгострокових і короткострокових державних облігацій, а також державного боргу від різниці дохідності. У Франції взаємозалежність спостерігається між державним боргом і дохідністю короткострокових облігацій. Тут варто відзначити сильну залежність довгострокової дохідності від державного боргу, а також вплив державного боргу на різницю. У Греції існує залежність дохідності довгострокових державних облігацій, а також різниці від всіх трьох показників. У Португалії існує сильний взаємозв'язок між дохідністю короткострокових облігації і державним боргом, а також між державним бюджетом і різницею. В Італії існує нерівномірний взаємозв'язок між дохідністю по двом видам і ВВП, а дохідність за довгостроковими і короткостроковими державними облігаціями залежить від державного бюджету. Також спостерігається сильний вплив державного боргу на різницю дохідності державних облігацій.

Ключові слова: державні облігації, боргова криза, ЄЦБ, державний борг, державний бюджет, довгострокова та короткострокова дохідність.

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TRANSFORMATION OF GOVERNMENT BOND YIELDS DURING THE DEBT CRISIS

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Abstract. The article analyzes the yield on government bonds, both long-term and short-term, the countries most affected by the debt crisis, namely Greece, Italy, Portugal, as well as the countries that have benefited most from the circumstances, namely Germany and France. There was an increase in the yield of two types of government bonds (maturity of 10 years and 1 year) for all analyzed countries (except Germany and France) during the debt crisis since late 2009. The peak yield on government bonds in Southern Europe fell in 2011. During the debt crisis, German government bonds benefited and, as a result, the yields on German and French government bonds declined. In the following years, the yield on government bonds of Southern Europe, as well as Germany and France declined. The article also constructs vector autoregressions (VARs) of interdependence between different types of government bond yields, their difference and government debt, government budget, GDP of the analyzed countries. It was found that in Germany, the relationship of these indicators was

not observed. However, there is a strong unilateral dependence of government debt on the yield on long-term and short-term government bonds, as well as government debt on the yield difference. In France, there is an interdependence between government debt and the yield of short-term bonds. It is worth noting the strong dependence of long-term profitability on government debt, as well as the impact of government debt on the difference. In Greece, there is a dependence of the yield on long-term government bonds, as well as the difference between all three indicators. In Portugal, there is a strong relationship between the yield on short-term bonds and government debt, as well as between the government budget and the difference. In Italy, there is an uneven relationship between the yield on the two types and GDP, and the yield on long-term and short-term government bonds depends on the government budget. There is also a strong impact of government debt on the difference in yields on government bonds.

Keywords: government bonds, debt crisis, ECB, government debt, government budget, long-term and short-term yield.

Introduction. The European debt crisis as Europe's struggle to pay off the debt that it has accumulated over the past decades. Five countries in the region - Greece, Italy, Ireland, Portugal and Spain - have failedto varying degrees to generate sufficient economic growth to avoid accumulating large levels of government debt. While these five countries were viewed as in immediate threat of possible default at the peak of the 2010-2012 crisis, the crisis has far-reaching consequences that extend beyond their borders to the world as a whole.

Problem statement. The purpose of this article is to study and analyze the yields on government bonds of the countries that have been most affected by the debt crisis, namely Greece, Italy, Portugal, as well as the countries that have benefited the most from the circumstances, namely Germany and France. The work used a wide range of general research methods, namely comparison methods, statistical analysis, and vector autoregression (VAR) to determine the relationship between some factors.

Analysis of recent research and publications. On the securities market, Risk Perceptions and Liquidity of the International Stock Market by R. Maa, Hamish D. Anderson, Ben R. Marshall (2019) use regression analysis to quantify the impact of investor risk perception on stock market liquidity in 57 countries. The authors show, which factors at the country level have a significant impact on the ratio of risk perception and liquidity. The results indicate that investors' perceptions of risk have a greater impact on market liquidity in developed economies and in countries with greater trade openness, better governance, and no selling restrictions. This is consistent with the view that more developed countries attract more international investors, incorporate information faster, and are therefore likely to be more influenced by changes in international risk perception [1].

In Bonds, Shares and Sources of Losses, authored by D. Avramov, T. Chardia and others (2019), identified common sources of low-cost prices among stocks and bonds. Analysis shows that sentiment-driven retail and institutional investors make one particular type of pricing error: they tend to be overly optimistic about the impact of financial problems in firms with high credit risk. Moreover, investors do not seem to renew their optimistic beliefs even after the profit announcement [2].

Since the spread of financial turmoil and the sovereign debt crisis in the eurozone, it has become clear that European countries have ceased to behave in the same way, raising concerns about the preservation of the single currency. In order to understand what happened in financial markets, authors Erica G. Peregote Wessel N. Vermoulin, in a joint article "Macroeconomic Determinants of European Equity to Government Bond Ratios: A Tale of Two Regions" (2016), proposed to analyze these markets in a multidimensional way. The correlation between bond markets was found to be driven primarily by differences in debt levels and stock market volatility, a measure of financial uncertainty. Correlations of stocks and bonds between regions behave as expected, according to the theory of determinants of

cash flows on the one hand, and macroeconomic fundamentals, which indicate the relative economic performance between countries, on the other. Thus, while inflation, stock market volatility, economic growth and policy momentum are all the right signs according to theory, an additional significant effect was found on the current account in some specifications and on debt only when looking at the southern region. Finally, the north-south correlation of stock markets is mainly influenced by current account and economic growth, apart from stock market volatility, and to a lesser extent by differences in debt levels [3].

R. Betsma, F. Jong, M. Giuliodori, D. Vidihanto "Realized (co) Variation in Eurozone Sovereign Bond Yields During the Crisis: The Impact of News and the Securities Markets Program" (2017) uses realized variances and covariance based on intraday data, to measure the structure of dependence of the yields of sovereign bonds of the euro area. New news tends to increase the volatility of the yields of financially disadvantaged countries and reduce the covariance of the yields of the troubled countries with the German bond yields, suggesting a potential escape effect. General news about the euro crisis and news about specific countries tend to increase the yield covariance between troubled countries, indicating potential side effects of the crisis. The purchase of bonds by the ECB under its Securities Markets Program (SMP) mitigates negative spillovers of the crisis among troubled countries and reduces the potential outflow of securities from troubled countries to Germany [4].

A. Langenol "Securities Markets and Political Securitization: An Example of a Sovereign Debt Crisis in the Eurozone" (2017) considers the issue in an attempt to combine the theory of political securitization and financial securitization of government bonds. Conceptually, the article argues that the intervention of securities markets in the securitization of the euro can be understood as a confrontation between two types of requirements of reality. The securitization steps and the response they generate symbolically constitute a political community; this provokes a struggle between an adequate representation of this community and its security considerations. In contrast, market communications - essentially price signals - do not generate political community and cannot be semantically refuted. Because of this quality, market signals can amplify or weaken securitization steps. In the event of the ECB's sovereign debt crisis, market communications brought about the privilege of supranational securitizations, damaging national securitizations [5].

E. Gisel, J. Idier, S. Manganelli, O. Vergote "High Frequency Evaluation of the ECB Securities Markets Program" (2016) examined the case of the Securities Markets Program of the European Central Bank (ECB). If the Eurosystem's intervention was triggered by a sudden and strong fall in prices, daily price changes could lead to a decrease in the correlation between the yield and the volume of bonds purchased. Simple regressions of daily changes in yields by quantity often produce small or even positive ratios and therefore suggest that the Stock Market Program (SMP) interventions were ineffective or worse, counterproductive. The authors proposed a vector autoregression (VAR) structure estimated at multiple frequencies to better measure the impact of SMP and its robustness. The results show that SMP interventions have been effective in reducing government bond yields for participating countries [6].

F. Ezer, B. Schwaab "Assessing the Impact of Unconventional Monetary Policy Measures: Empirical Evidence from the ECB Securities Markets Program" (2016) assess the impact of asset purchases on returns under the Securities Markets Program (SMP) of the European Central Bank (ECB) in five Eurozone sovereign bond markets in 2010–2011. In addition to the significant effect of the announcement, the authors found an effect of about -3 basis points over a five-year maturity for the purchase of 1/1000 of outstanding debt. Bond yield volatility and tail risk are lower on intervention days for most SMP countries. A dynamic specification indicates both temporary and long-term effects. Buying improved liquidity conditions and reduced default risk premiums, while signals of future low interest rates did not play a role [7].

Results.

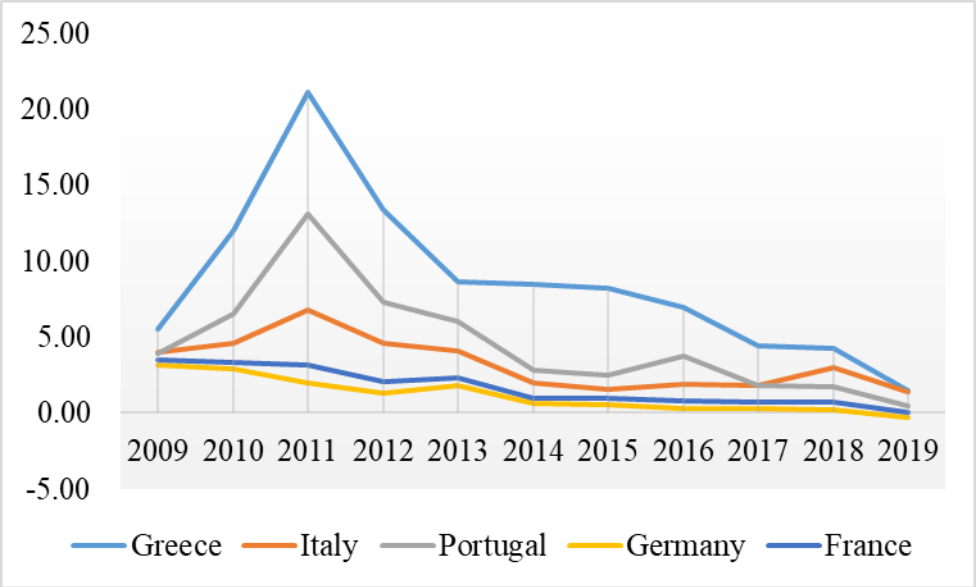

Fig.1. Yields on 10 year government bonds of Greece, Italy, Portugal, Germany and Francefor the period 2009-2019, % [8].

Analyzing the yield of long-term government bonds with a maturity of 10 years the following results was found. There is a significant increase in the yield of government bonds in all analyzed countries (except Germany and France) during the debt crisis since the end of 2009. In 2010, the yield on Greek government bonds have already increased by 6.52 percentage points and reached 12%. A similar situation in both Italy and Portugalwas observed. The peak of the yield on government bonds fell in 2011. The yield of the Greek 10-year government bonds accounted for 21.1% (+ 15.6 p.p. since the beginning of the crisis) per annum, for Portuguese 13% (+9.1 p.p. since the beginning of the crisis) and for Italian 6.8% (+2.8 since the beginning of the crisis). During the debt crisis, the German government bonds have benefited. They have historically been ranked on par with US Treasury bonds, the Swiss franc, the Japanese yen, or even gold. As a result, the profitability of the government bonds in a country like Germany is decreasing - by 1.2 percentage points in Germany (the yield in 2011 was 1.9%, against 3.1% in 2009). A similar picture was observed in France, where the profitability of the government bonds decreased by 0.4 percentage points (yield in 2011 was 3.1%, against 3.5% in 2009). It should also be noted that on average in the countries of the European Union, the profitability of the governmentbonds in2011 amounted to 4.24%, in 2009 the yield was 3.96%.

The reasons for such a sharp increase in government bond yields need to be considered in more detail. High level of budget deficit, as well as governmentdebt (at the end of 2009 the budget deficit in Greece was 15%, Italy - 5%, which is the highest in the last 10 years) undermined investor confidence, causing bond spreads to widen to unacceptable levels. Fears quickly spread that fiscal positions and debt levels in several eurozone countries were volatile. Due to the increased risk, investors demanded an increase in Greek bond yields, which increased the cost of the country's debt burden and prompted a series of rescue measures from the European Union and the European Central Bank (ECB). Markets also began to pick up bond yields in other heavily indebted countries in the region, anticipating problems similar to those in Greece.

As a result, the situation worsened in banks, which were large holders of sovereign debt. The EU was forced to take short-term measures such as a banking sector bailout. The ECB expanded its toolkit for unconventional monetary policy measures, namely, providing the banking sector with long-term liquidity, buying government bonds and other securities in secondary markets in order to support local authorities, lower interest rates, creating demand.

In 2010, the ECB announced the Securities Market Program. This program consisted of buying government bonds in secondary markets and actually preceded quantitative easing. The ECB's goal was to push down government bonds yields in order to prevent self-fulfilling market panics. Through its peculiar "Securities Market Program", the European Central Bank has generated billions of profits for creditor member states such as France and Germany. In a Eurogroup meeting in 2012, finance ministers of the Eurozone reached an agreement where all member states would return the SMP profits made since 2013 to Greece. In practice, member states transferred their national profits into a segregated account managed by the European Stability Mechanism (ESM), with the exception of the profits made by the Bank of Greece (which were directly transferred to the Greek government). However, since the end of 2011 - the beginning of 2012 yields began to decline every year and in 2019 was 1.42%. Also thanks to the measures of the ECB, the yield on the Portuguese and Italian government bonds fell to 0.41% and 1.37%, respectively.

It should be noted that the yield on German government bonds fell another 1% in 2019 and it was negative, namely - (-0.3%). It is an unattractive proposition for most bond investors, even those with long time horizons, because holding negative-yielding debt to maturity means incurring a loss. These bonds are not bought by institutional investors, but by Central Banks, especially in recent months. Unlike conventional asset managers, central banks are less sensitive to direct yields. The purchase of bonds was for monetary policy or for holding foreign exchange reserves.

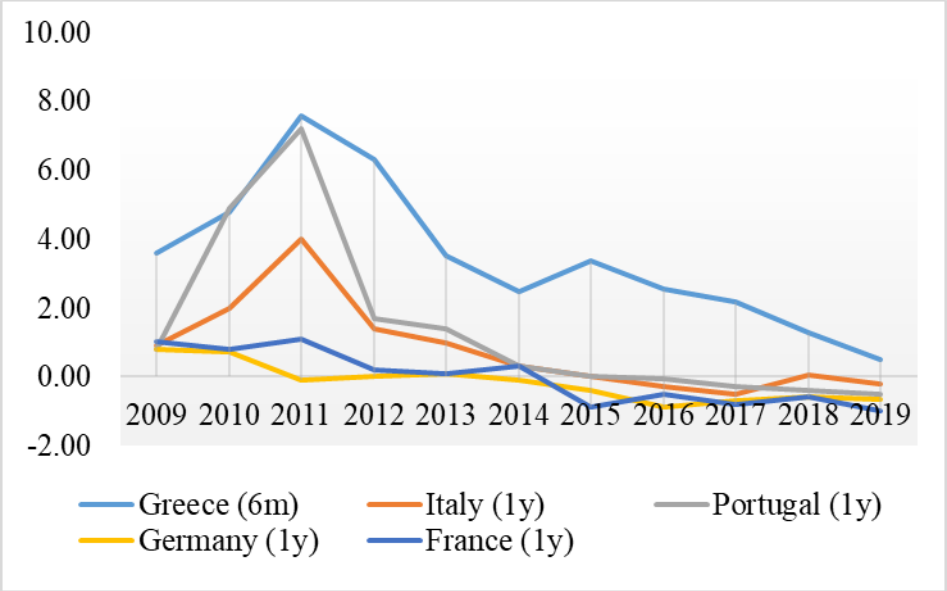

Fig. 2. Yields on short-term government bonds of Greece, Italy, Portugal, Germany and France for the period 2009-2019, % [8].

Analyzing short-term government bonds, it should be noted that, as with long-term government bonds, the highest peak in yield was in 2011. Yield of 6-month Greek government bonds in 2011 amounted to 7.58%, a similar yield was also of Portuguese bonds (with a maturity of 1 year) - 7.2%. A curious point is the spread of short-term governmentbonds in Greece and Portugal, which in 2011 amounted to 0.4%. The spread of

long-term bonds in Greece and Portugal was 8%. Yield of Italian government bonds (with a maturity of 1 year) in 2011 amounted to 4%.

Unlike Southern Europe, the yields on short-term government bonds in Germany in 2011 fell and even became negative (-0.1%). Investors in the euro area are looking for security - and willing to pay for it. In 2011, short-maturity bonds in Germany achieved a partial negative yield. This difference can be interpreted as a benefit to the German federal government through the safe haven effect. They probably would not exist if other countries were not in trouble. It can be argued that the ten years prior to the crisis were“normal” in terms of interest rates and business cycle dynamics. Accordingly, the average interest rates over this period can be used as a guideline. The calculation for all promissory notes and bonds issued since 2009 by Germany shows that the current interest payments already in 2012 were about 10 billion euros lower than in the baseline scenario. Already in 2013, the corresponding figure increased slightly. In subsequent years, the low profitability for such a long time significantly eased the government budget in Germany. This relief is especially noticeable for the federal government, which is responsible for about half of Germany's national debt. The payoff for the federal government can be particularly noticeable because the bonds it holds can serve as a safe haven during Europe's debt crisis. Other German public debtors also benefit from low yields, but to a somewhat lesser extent.

As in the situation with long-term government bonds in Southern Europe, since 2012, there has been a drop in yields for a number of main reasons that were discussed earlier. For all analyzed countries in 2019, the yield on short-term government bonds was negative, except for Greece, the yield was 0.51%. In Germany and France, the yield on short-term government bonds fell to (-0.6%) and (-1%), respectively.

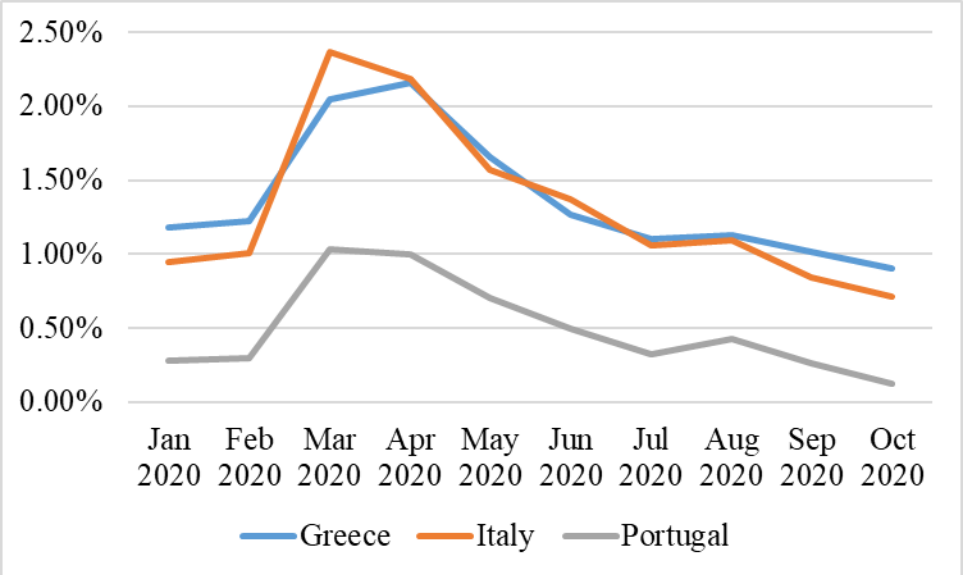

Fig. 3. Yields on 10-year government bonds of Greece, Italy, Portugal, Germany and France in2020, % [8].

Further, after analyzing 2020 (statistics for 10 months are used) there is clearly an increase in the yield of long-term government bonds in the period from February to April. The peak of profitability was in March 2020, while Italy and Greece showed the highest profitability - 2.37% and 2.05%, respectively. In Portugal, during the same period, the yield rose to 1.03%. The sharp increase in profitability was due to a new test for the world in 2020, namely the coronavirus pandemic. Italy became the first country in Europe to introduce

isolation (due to a sharp increase in the incidence). Bond yields rose sharply after investors realized that the ECB president could provide support, prompting fears of a new debt crisis in the euro area. In March 2020, amid a pandemic, the ECB launched the PEPP (pandemic emergency purchase program) program. In anticipation of an emergency revision of the ECB's policy in Italy, there was a sharp increase in yields and spreads. Italy offered the highest yield in the region, and 10-year bonds are even higher than Greek bonds, which have been disappointing for a long time (2.37% versus 2%). The demand for Italian bonds has increased, due to high yields and low volatility, despite forecasts for a decrease in the economy caused by COVID-19.

However, in May 2020, yields on Southern European government securities began to decline again. In October 2020 for the first time, the yield on government bonds in Greece fell below 1% (0.9%), in Italy - 0.7%, in Portugal - 0.12%. Thanks to the country's efforts to ease tight budget conditions imposed on financial aid lenders. The yield in Greece fell to 0.9%, but remains one of the highest rates in the eurozone. The constant drop in Greek bond yields is already an indicator of market confidence and the prospects for the Greek economy, as well as the country's economic policy. However, some investors are wary, citing illiquidity.

Table 1

Vector autoregression of interdependence of government bond income (long-term / short-term) and government budgets, government debt, GDP of Greece, Portugal, Italy, Germany and France

Country	Indicators (dependent)	Granger				
		Yield (long-term)	Yield (short-term)	Government-debt	Government-balance	GDP
	Yield (long-term)			6.63 (0.16)*	0.42 (0.52)*	10.35 (0.07)*
	Yield (short-term)			5,22 (0.39)*	8,42 (0.13)*	3,39 (0.64)*
	Government-debt	14,02 (0.007)***	23,87 (0.000)***			
	Governmen-balance	1,78 (0.19)*	22,3 (0.001)***			
Germany	GDP	63,02 (0.000)***	11,29 (0.046)**			
		Yield (long-term)	Yield (short-term)	Government-debt	Government-balance	GDP
	Yield (long-term)			33.56 (0.000)***	4.74 (0.45)*	1.06 (0.59)*
	Yield (short-term)			23 (0.000)***	1.51 (0.83)*	6.32 (0,04)**
	Governmentdebt	6.11 (0.3)*	10.37 (0.006)***			
	Government-balance	13.72 (0.017)**	42.84 (0.000)***			
France	GDP	10.6 (0.005)***	17.42 (0.000)***			

		Yield (long-term)	Yield (short-term)	Government-debt	Government-balance	GDP
	Yield (long-term)			8.91 (0.03)**	7.18 (0.007)***	12.7 (0.002)***
	Yield (short-term)			5.73 (0.33)*	62.46 (0.000)***	10.99 (0.004)***
	Governmentdebt	4.07 (0.25)*	1.47 (0.92)*			
	Governmentbalance	1.16 (0.28)*	15.09 (0.01)**			
Greece	GDP	0.14 (0.93)*	0.6 (0.74)*			
		Yield (long-term)	Yield (short-term)	Government-debt	Government-balance	GDP
	Yield (long-term)			99.6 (0.000)***	1.07 (0.3)*	14.29 (0.01)**
	Yield (short-term)			72.04 (0.000)***	1.13 (0.29)*	22.94 (0.000)***
	Governmentdebt	3.95 (0.56)*	2.87 (0,58)*			
	Governmentbalance	0.54 (0.46)*	0.49 (0.49)*			
Italy	GDP	28.41 (0.000)***	12.83 (0.025)**			
		Yield (long-term)	Yield (short-term)	Government-debt	Government-balance	GDP
	Yield (long-term)			166.18 (0.000)***	25.15 (0.0001)***	12.45 (0.03)**
	Yield (short-term)			32.37 (0.000)***	21.08 (0.000)***	9.4 (0.09)**
	Governmentdebt	3.64 (0.46)*	45.68 (0.000)***			
	Governmentbalance	0.67 (0.41)*	0.26 (0.61)*			
Portugal	GDP	10.04 (0.02)**	49.54 (0.000)***			

Note: ***, **, * represent up to 1, 5, and 10 % significance levels, respectively. In parentheses, p values are given. – denotes deleted insignificant variable from equation

Source: compiled by the author based on [8].

Based on the constructed model in Table 1, in Germany, the relationship between these indicators was not observed. However, there is a strong one-sided dependence of government debt on the yield of long-term and short-term government bonds (the error is 0.7% and 0%, respectively). In addition, the German government budget depends on 1y government bond yield, while GDP depends on long-term (0% error) and slightly on short-term (4.6% error).

Regarding France, there is an interdependence between government debt and short-term bond yields, as well as a weaker relationship between GDP and short-term bond yields, the first indicator is more dependent (error is 0%). It is worth noting the strong dependence of long-term yields on government debt. The government budget and GDP of France depend on the yield of the two types of analyzed bonds, less strongly on long-term ones (error 1.7% and 0.5%, respectively).

In Greece, the yield on long-term government bonds is observed on all three indicators: GDP, debt and budget. However, government debt has a weaker impact than other indicators, since the error is 3% (for the budget - 0.7%, for GDP - 0.2%). The yield on short-term government bonds of the country depends on the government budget and GDP, and the dependence on the latter is weaker. Greece's government budget is slightly dependent on 6m government bond yield.

In Portugal, there is a strong relationship between short-term bond yields and government debt (for both cases, the error is 0%). In general, profitability (short-term and long-term) depends on all three indicators for this country, but the dependence on GDP is slightly less (error 9% and 3%, respectively) than on public debt and budget (error is everywhere 0%). However, GDP also depends on two types of profitability (the error for the long-term is 2%, for the short-term it is 0%).

In Italy, based on this model, there is an uneven relationship between the yield on the two types and GDP (stronger GDP from long-term and short-term from GDP). In general, the yield on long-term and short-term government bonds depends on the government budget and GDP).

Based on Table 2, in Germany again there is no interdependence of these indicators. There is only a strong dependence of government debt on the difference in profitability. Weaker dependence of the government budget on the difference, since the error is 2%. Also the impact of government debt and GDP on the difference in profitability (6% and 8%, respectively).

In France, there is a weak relationship between the government budget and the difference in profitability (for both cases, the error is no more than 3%). There is a strong effect of government debt on the difference.

In Greece, there is also no relationship between these indicators. However, there is a one-sided dependence of the difference in government bond yields on all three indicators: government debt, government budget and GDP. The government budget has the least impact, since the error is 2%, while for others it is 0%.

In Portugal, it is worth noting the strong interdependence between the government budget and the profit margin. An uneven relationship is also observed for the difference with GDP, however, the difference affects GDP less (2% error) than GDP for the difference (almost 0% error).

For Italy, there is only a strong influence of government debt on the difference in government bond yields. There is also a weak relationship between the difference in profitability and government GDP.

Table 2

Vector autoregression of the interdependence of the difference between the yields of long-term and short-term government bonds and government budgets, government debt, GDP of Greece, Portugal, Italy, Germany and France

Country	Indicators (dependent)	Granger			
		Difference	Governmentbalance	Governmentdebt	GDP
	Difference		4.09 (0.39)*	10.54 (0.06)*	9.81 (0.08)*
	Governmentbalance	11.44 (0.02)**			
	Governmentdebt	35,85 (0.000)***			
Germany	GDP	5.73 (0.33)*			
		Difference	Governmentbalance	Governmentdebt	GDP
	Difference		9.38 (0.021)**	64.89 (0.000)***	0.11 (0.74)*
	Governmentbalance	9.02 (0.029)**			
	Governmentdebt	3.13 (0.68)*			
France	GDP	2.22 (0.14)*			
		Difference	Governmentbalance	Governmentdebt	GDP
	Difference		5.28 (0.02)**	27.38 (0.0001)***	43.31 (0.000)***
	Governmentbalance	0.66 (0.42)*			
	Governmentdebt	6.79 (0.15)*			
Greece	GDP	3.47 (0.63)*			
		Difference	Governmentbalance	Governmentdebt	GDP
	Difference		5.03 (0.41)*	23.48 (0.0003)***	10.44 (0.06)*
	Governmentbalance	2.92 (0.71)*			
	Governmentdebt	3.47 (0.63)*			
Italy	GDP	12.97 (0.024)**			
		Difference	Governmentbalance	Governmentdebt	GDP
	Difference		20.48 (0.001)***	16.24 (0.006)***	24.02 (0.0002)***
	Governmentbalance	26.34 (0.0001)***			
	Governmentdebt	2.6 (0.76)*			
Portugal	GDP	13.43 (0.02)**			

Note: ***, **, * represent up to 1, 5, and 10 % significance levels, respectively. In parentheses, p values are given. – denotes deleted insignificant variable from equation

Source: compiled by the author based on [8].

Conclusions. In general, analyzing the yield of long-term government bonds with a maturity of 10 years, the following was revealed: there is a significant increase in the yield of government bonds for all analyzed countries (except Germany and France) during the debt crisis from the end of 2009 The peak of yield on government bonds of Southern Europe fell in 2011. During the debt crisis, German government bonds have benefited that have historically been ranked on par with US Treasury bonds, the Swiss franc, the Japanese yen, or even gold. As a result, the profitability of the government bonds of Germany and France were down. In subsequent years, the yield on 10-year government bonds of Southern Europe declined, while the yield on long-term German government bonds also declined and was negative (-0.3%).

Analyzing the short-term government bonds, it should be noted that, as with long-term government bonds, the highest peak was in 2011. Unlike Southern Europe, the rate of return on short-term government bonds in Germany in 2011 fell and even became negative (-0.1%). This difference can be interpreted as a benefit to the German federal government through the safe haven effect. They probably wouldn't exist if other countries weren't in trouble. As in the situation with long-term government bonds in Southern Europe, since 2012, there has been a drop in yields. For all analyzed countries, except for Greece, in 2019 the yield on short-term government bonds was negative.

After analyzing 2020. (statistics for 10 months are used) there is clearly an increase in the yield of long-term government bonds in the period from February to April. The peak of profitability was in March 2020, while Italy and Greece showed the highest profitability. The sharp increase in profitability was due to a new test for the world in 2020, namely the coronavirus pandemic.

Based on the first constructed model, regarding the relationship between the yield of government bonds and government debt, government budget, GDP, in Germany, the relationship of these indicators was not observed. However, there is a strong one-sided dependence of government debt on the yield of long-term and short-term government bonds. In addition, the German government budget depends on 1y government bond yield, while GDP depends on long-term yield. In France, there is an interdependence between government debt and short-term bond yields, and a weaker relationship between GDP and short-term bond yields. It is worth noting here the strong dependence of long-term profitability on government debt. In Greece, the yield on long-term government bonds is observed on all three indicators: GDP, debt and budget. The yield on a country's short-term government bonds depends on the government budget and GDP. In Portugal, there is a strong relationship between short-term bond yields and government debt. In general, profitability (short and long term) depends on all three indicators for that country. In Italy, based on this model, there is an uneven relationship between the yield on the two types and GDP (stronger GDP from long-term and short-term from GDP). In addition, the yield on long-term and short-term government bonds depends on the government budget.

Based on the second built model, regarding the interdependence between the difference in the yield of government bonds and the government debt, the government budget, GDP, in Germany again there is no interdependence of these indicators. There is only a strong dependence of government debt on the difference in profitability. In France, there is a strong effect of public debt on the difference. In Greece, there is a one-sided relationship between the differences in government bond yields on all three indicators: government debt, government budget and GDP. In Portugal, it is worth noting the strong interdependence between the government budget and the profit margin. An uneven relationship is also observed for the difference with GDP. For Italy, there is only a strong influence of government debt on the difference in government bond yields. There is also a weak relationship between the difference in profitability and government GDP.

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