Fiscal determinants of government borrowing costs: do we have only ourselves to blame?

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Abstract

The global financial crisis and the problems in peripheral EU countries resulted in increased attention to fiscal developments and their impact on borrowing costs for both public and private sector. Existing theoretical literature suggests that worsening of current and expected budget balances as well as an increase of public debt lead to a rise in short and long term interest rates for sovereign debtors. However, empirical results are inconclusive, especially for emerging market countries. This paper analyzes the factors that determine the dynamics of government bond spreads, with special emphasis on fiscal indicators. The survey covered 17 European countries, of which 9 are developed and 8 are emerging market economies, all of them members of the EU except Croatia. The empirical part of the paper employs dynamic panel data method and uses the Arellano and Bond estimator to get consistent estimates of parameters of interest. The results show that in the period 2004-2011 fiscal balance and public debt projections had a significant impact on the differences in government bond yields for emerging market countries, with the effect being much stronger during the period after the onset of financial crises. On the other hand, it seems that sovereign spread dynamics in developed countries is driven mostly by the global market sentiment.

Keywords: sovereign bond spreads, expected fiscal developments, EU countries, Croatia

1 INTRODUCTION

After several years of convergence, sovereign yield spreads of EU countries relative to the German Bund in late 2006 and early 2007 reached historically low levels. The situation changed dramatically, however, with the onset of the global financial crisis in September 2008 when emerging market EU countries' bond spreads exploded and even developed market spreads recorded a significant rise. The question arose whether such a development reflected macroeconomic fundamentals, especially the fiscal positions of countries in Europe, or simply the global market sentiment. Did investors finally start to differentiate between countries according to the riskiness they attribute to them?

Trying to answer these questions, this paper analyzes the factors determining spreads among long term government bond yields of selected European countries and the German government bond using a dynamic panel model. We cover the main spread determinants recognized in the literature: credit risk, international risk aversion and liquidity risk. The fiscal position of a given government is considered to be the most important indicator of credit risk. However, it is the future solvency of the government that matters for the current bond holders so instead of current values our model includes forecasts of government balance and public debt. Besides capturing the forward looking feature of financial markets, using forecasts also solves the problem of possible endogeneity that may arise due to simultaneous determination of fiscal variables and bond spreads. To ensure the

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robustness of the results, our analysis also includes other potential indicators of country credit risk, i.e. GDP growth and current account balance.

Given the availability of the data on government bond yields, the survey covered 17 European countries, of which 9 are developed and 8 are emerging market economies, for the 2004-2011 period. Both the analyzed period and the sample of countries contribute to the existing literature, because we include the period before as well as after the onset of the financial crisis which enables us to investigate whether the determinants of sovereign spreads have changed over that time. It is also interesting to see whether the spreads of developed and emerging market countries that are part of a common market with a high level of financial interlinkages are driven by the same factors.

The remaining part of the paper is organized as follows. The second part briefly explains the basic theoretical determinants of government bond spreads and gives a short review of the empirical literature on government borrowing costs, with special emphasis on the studies that include fiscal indicators in the analysis. The next section describes the data used in our analysis, as well as the sources and methods of calculating certain variables. It also summarizes the basic characteristics of the spread and selected fiscal indicator movements for the observed countries during the reference period. In the fourth chapter empirical methods and the results of the estimated model are presented. The conclusion and policy implications of the results are presented in the last chapter.

2 LITERATURE REVIEW

In the past decade, many studies tried to identify the main determinants of government borrowing costs over some "risk free" interest rate. Many different variables were included in empirical models, from the usual macroeconomic indicators and their expected values, such as GDP, inflation or different measures of external vulnerability, through variables indicating the quality of institutions and political risk, as well as indicators that reflect the developments in global financial markets. Although certain problems with the availability and quality of fiscal data are often mentioned, almost all the authors who explore government bond spreads use a measure of fiscal balance and the data on public debt as a primary measure of a country's credit risk, and hence one of the fundamental determinants of the required yield on government bonds.

The difference between government bond yields for different countries and the yield on a selected reference "risk free" bond represents the premium required by investors to include a certain bond in their portfolios. Financial theory suggests that this premium reflects the credit risk, liquidity risk and general risk aversion in the market at a given time. Therefore, empirical studies try to determine how much of the premium is determined by the particular type of risk and how the

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relative importance of each type of risk varies depending on the group of countries or the time period included in the analysis.

2.1 CREDIT RISK

Empirical literature indicates that at a time of financial market turmoil and in periods of greater uncertainty, market participants devote significant attention to the country credit risk focusing on macroeconomic and fiscal differences among countries.[1] This kind of risk can be broadly defined as the risk of a government's inability or refusal to make the required payments on its debt and is often called the risk of default. Creditworthiness or solvency of the country largely depends on the current and expected state of the actual and potential debt and its sustainability. Debt sustainability in turn depends on the expected budget surpluses/deficits, as well as on the expected economic activity and interest rates, which are affected both by domestic and international factors and policies (Codogno et al., 2003). If the market perceives that there is a possibility that the government will not be able fully and/or in time to meet all its financial obligations, the investors will demand a higher premium for increased credit risk.[2]

In the empirical literature it is the credit risk that gets most attention. This can be explained by the fact that variables indicating a country's creditworthiness are to some extent under the control of domestic policy makers. So countries conducting prudent fiscal policies can to some degree positively affect the cost of borrowing for both the public and the private sector. Many authors have therefore dealt with the influence of fiscal balance and public debt on the cost of government borrowing. However, econometric methods and measures of fiscal balance, public debt and long-term interest rates often differ, and therefore the results are ambiguous.

Gale and Orszag (2003) reviewed 58 studies investigating the impact of the U.S. fiscal deficit on the long-term interest rates and showed that only in slightly less than half of these studies was a significant positive impact defined. However, they state that studies that use projected instead of the current fiscal deficits more often tend to show statistically significant effects of these variables. A significant effect of fiscal policy in the U.S. on long term interest rates was found in later studies as well (see, for example, Engen and Hubbard, 2004; Dai and Phillipon, 2005; Laubach, 2009).

The influence of fiscal variables on long term interest rates was also estimated for other countries. Faini (2006) examines the impact of the current cyclically adjusted primary balance and public debt of 11 EMU member countries on the aggregate eurozone interest rate level and also on government bond spreads for individual countries. This model specification, according to Faini, stems from the fact that changes in domestic fiscal variables affect individual country spreads, but

[1] See for example Ejsing and Lemke (2009) and Sgherri and Zoli (2009).
[2] As can be seen in the recent Greek case.

through a spillover effect, they also affect the overall level of eurozone interest rates. The results show that changes in the EMU budget deficit have a much stronger effect on the aggregate level of interest rates than the increase in the budget deficit of individual countries on their spreads, which indicates significant spillover effects. Also, the public debt on a country level has no impact on their spreads, while for the eurozone as a whole it proved to be significant.

Baldacci and Kumar (2010) analyze the impact of fiscal balance and government debt on ten-year government bonds yields for 31 countries (developed and developing countries) for a period of almost thirty years. The authors showed that the effect of deterioration in public finances on long-term interest rates is significant and robust, but not linear. Moreover, the strength of the impact depends on the initial fiscal, structural and institutional conditions. The authors estimate that, especially in developing countries, debt servicing costs will significantly rise if reforms that leading to a reduction in government expenditure growth (e.g. pensions and health) are not carried out.

Alexopoulou et al. (2009) study the determinants of differences between bond yields for Central and Eastern European countries that are members of the EU and the average eurozone government bond yield over the period 2001 to 2008. Using a dynamic panel (error correction) model the authors conclude that the main long run determinants of spreads are external debt as a percentage of GDP, trade openness, the difference between short-term interest rates of the countries analyzed and corresponding short-term rates in the eurozone, exchange rate, inflation and global financial terms (measured by stock market volatility index). In addition, to check whether investors perceive selected countries differently, they divide them into two groups. For the first group, which is characterized by better macroeconomic fundamentals, they conclude that the main drivers of the rise in spreads are inflation rates and short-term interest rates. On the other hand, fiscal fundamentals have important influence on spreads for countries that are characterized by pronounced external vulnerability.

Nickel et al. (2009) investigated the impact of fiscal variables on government bond spreads in the Czech Republic, Poland, Hungary, Russia and Turkey. Since market expectations are important for the movement in yields, as independent variables they used projected fiscal data taken from Consensus Economics forecasts. Although the results of the panel data analysis indicate a significant impact of fiscal variables on the difference in yields, the regression analysis for each country shows that the deficit is statistically significant only for Hungary and Russia. The authors conclude that the variables used in the empirical literature to model the government bond spreads probably represent only a small fraction of the market indicators that are monitored, and they highlight indicators of domestic and external political risks as variables that are particularly important and yet difficult to measure.

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Cota and Žigman (2011) also focus on the influence of fiscal policy on government bond spreads for nine "new" EU countries and also Mexico, Russia, Turkey, Ukraine and Croatia. They estimated a regression model with panel data using a seemingly unrelated regression approach and showed that deficit and the ratio of domestic debt and total public debt have significant influence on spreads before and after the crisis.

2.2 GENERAL RISK AVERSION

The general risk aversion is associated with the overall willingness of investors to bear the risk. A higher required yield indicates a lower risk appetite or higher general risk aversion at some point in time. Even without any empirical analysis it seems that this indicator plays a very important role in determining borrowing costs for governments. This conclusion is supported by relatively similar dynamics of government bond spreads during the specific time periods, regardless of the fact that the macroeconomic and fiscal positions of the issuers sometimes differ considerably. It should be noted that there is no single or commonly accepted measure of risk aversion so empirical studies use different variables that in some way reflect market sentiment towards risk.

By using the method of principal components and information about the differences in corporate bond yields and the measure of volatility in the stock and foreign exchange markets Barrios et al. (2009) constructed an indicator of general risk aversion. They analyzed the data for ten eurozone countries in the period from 2003 until 2009 and concluded that global factors, especially the general perception of risk, are the main determinants of government bond spreads. On the other hand, the role of domestic factors such as macroeconomic fundamentals and liquidity risk associated with bonds of each country is small but not negligible. Similar results were also attained by Haugh et al. (2009) who measure general risk aversion by the difference between yields on corporate and government bonds of the eurozone. They show that, even though fiscal variables have a statistically significant effect on the dependent variable, in the majority of specifications the indicator of general risk aversion can explain most of the differences in yields and it considerably amplifies the effects of other variables included in the model.

The importance of market sentiment was also confirmed by Ebner (2009) who used data on Central and Eastern Europe government bond spreads. He shows that market sentiment measured by VDAX-NEW index, the ECB reference rate and market liquidity have a dominant effect on selected countries spreads, while variables that reflect macroeconomic and fiscal developments in most countries showed not to be statistically significant. Codogno et al. (2003) also analyze European countries in the period before and after the introduction of a common currency. As a measure of risk aversion they use the difference in yields of U.S. high-grade corporate bonds and the U.S. ten-year government bond. Their results imply that the difference between government bond yields of these countries in

relation to the German government bond could only in Italy and Spain partially be explained by domestic macroeconomic factors, while in other observed countries spread movements are explained by external factors, in other words, a risk aversion indicator.

Based on the data for eight European emerging countries, Dumičić and Ridzak (2011) investigated to what extent the latest financial market turmoil that affected sovereign bond spreads could be related to the changes in risk appetite and the nature of the impact of domestic macroeconomic variables, with a special focus on external imbalances. They show that spread movements can be explained both by market sentiment measured by Deutsche Börse volatility index (VDAX) and macroeconomic fundamentals, emphasizing that external imbalances did not result in any significant effect before the crisis, but became very important after the crisis broke out.

2.3 LIQUIDITY RISK

The impact of liquidity risk, one of the theoretical determinants of the differences in yields, has also been the subject of numerous investigations. A liquid market is defined as a market with a sufficiently large number of orders for purchase and sale (market depth) and where large transactions have no significant impact on the price (market breadth). As with credit risk and general risk aversion, empirical research does not give the same answer to the question of how liquidity affects the differences on government bond yields.

Schwartz (2010) analyzes the movements in yield differences of eurozone member countries during the last financial crisis and seeks to determine whether the result of their increase is a consequence of a higher credit risk or reduced market liquidity, that is, increased liquidity risk. The author concludes that liquidity risk can explain a great share of the increase in yield differences during the last financial crisis, in some cases up to 90%. She believes it is possible that the investors assumed EMU would not allow a default of its members, which then reduced the credit risk. In addition, she believes this high contribution of liquidity risk to spread increase is a result of the used liquidity measure, which, besides the transaction costs, also includes the price of liquidity risk. In contrast, Codogno et al. (2003) show that in the model specifications in which a measure of liquidity risk is statistically significant, its contribution to yield spreads is weak.

3 DESCRIPTION AND ANALYSIS OF THE DATA

3.1 CHOICE OF VARIABLES

The empirical analysis covers the period from the first quarter of 2004 until the fourth quarter of 2011, capturing the period before and after the financial crisis. Even though the original intention was to include all countries of the EU plus

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Croatia, due to data availability our sample was reduced to 17 European countries, nine of which are developed and the rest are emerging market economies.[3]

The dependent variable in our model is the average quarterly sovereign spread relative to Germany. It is calculated as the difference between yield to maturity of comparable generic eurobonds for each country in the sample and the yield to maturity of a comparable benchmark generic German government bond on the basis of daily data. Data on yield to maturity for generic government bonds have been taken from the Merrill Lynch database. Generic bonds are used to create artificially yield to maturity time series, which is formed by connecting bonds with certain characteristics (currency, maturity, etc.). In this way, the yields on individual bonds are not monitored, since they change due to, inter alia, the changes in bond's time to maturity. Therefore, we use yields on bonds which do not exist in reality, but enable us to track the cost of long-term borrowing for individual countries over time.

To account for the credit risk the emphasis was put on developments in public finances and the main indicators used in the model were fiscal balance and public debt to GDP ratios.[4] However, since financial theory suggests that it is expected future rather than current developments that are more relevant for yield formation, we have used European Commission (EC) fiscal projections as a measure of market expectations. Given that the EC publishes its detailed projections twice a year, quarterly series are constructed in such a way that in the second and the fourth quarter, when projections are published, the variable takes the average value of the published projections for the current year and subsequent periods (in the second quarter that is one year ahead and in the fourth quarter two years ahead)[5]. On the other hand, the data for the first and the third quarter were obtained as the average of the calculated values for the previous and subsequent quarter.[6] In such a way we capture, at least to some degree, medium-term market expectations of fiscal developments, but we also allow the possibility that market participants will change their expectations in between two EC projections as the rational expectations theory would suggest.[7]

Besides fiscal indicators we have also used some other macroeconomic variables that reflect the credit riskiness of a country. To take into account a country's exte-

[3] Countries can be divided into two groups: the developed countries and emerging market countries. Developed countries from our sample are: Austria, Belgium, Denmark, Spain, Finland, France, Italy, Netherlands, and Sweden. Emerging market countries are: Bulgaria, Croatia, Hungary, Latvia, Lithuania, Poland, Romania and Slovakia. We decided to include in our analysis only those countries that have maintained market access in the whole sample period.

[4] To assure fiscal data consistency we have used fiscal data from the Eurostat which are shown according to ESA 95 methodology.

[5] E.g. for the second quarter of 2010 our observation is an average EC's forecast for 2010 and 2011. For the last quarter of the same year the average also includes 2012.

[6] E.g. our observation for the first quarter of 2010 is an average of our observations for the last quarter of 2009 and the second quarter of 2010.

[7] GDP and current account data were obtained and constructed in the same way as fiscal variables.

rnal vulnerability, the expected current account expressed in percent of GDP was introduced in the model. The larger the current account the more vulnerable country is to a slowdown in capital inflows or sudden stops, so investors can be expected to demand higher yields on its bonds. Expected real GDP growth was also included in some model specifications. Higher GDP growth, *ceteris paribus*, means that the taxable base is expected to expand in the future and thus exert a positive influence on government solvency. This variable could also serve as a proxy for quality of economic policy making process in a referent country, so higher growth is expected to result in lower sovereign bond spreads.

Following the common practice in the literature we have used the Chicago Board Options Exchange Volatility Index (CBOE_VIX) as an indicator of risk aversion (or investor sentiment) on global financial markets. CBOE_VIX measures implied volatility of the S&P500 index option prices and is commonly used as a measure of market expectations and global investor sentiment.

Since we have used the spreads on generic bonds in our model, the usual direct liquidity indicators for market instruments such as bid-ask spreads or trading volumes for a specific bond are not available. Therefore, we have decided to use an indirect liquidity indicator, following Barbosa and Costa (2010), who calculated the relative size of each country's government bond market. Using the data on the structure of public debt, we have calculated the share of an outstanding amount of a specific government's bonds in the total amount of outstanding debt securities issued by the observed countries in a certain period. Another possible solution might be to try to obtain information on the underlying bonds used for calculating the generic bonds for each country, but it is still questionable whether data obtained in such way would provide information on the liquidity of country bonds.[8]

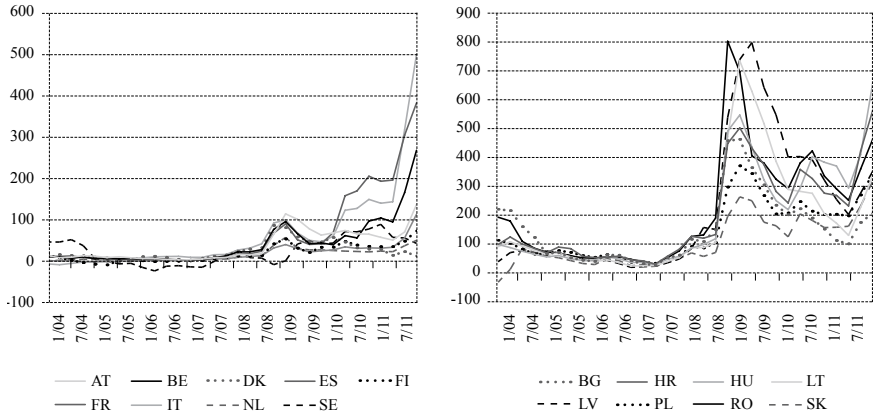
3.2 DATA DESCRIPTION

In the period from 2004 until the crisis, sovereign yield spreads to German government bond generally co-moved and converged to the historically low levels reached during 2006 and 2007. However, after the escalation of the financial crisis in the last quarter of 2008 emerging market countries' bond spreads exploded. After a few months they started to decline again, but remained at levels higher than in the period before the turmoil in financial markets. Spreads for the majority of developed European countries also increased at the onset of the crisis, but in much smaller amounts. The exceptions are the spreads for Spain and Italy and partly Belgium, where risk premiums increased significantly due to investors' concerns about the long-term sustainability of their budget deficits and public debts, which increased substantially during the recession, as well as because of the political uncertainty.

[8] For potential problems see Barbosa and Costa (2010:9).

FIGURE 1

Difference in government bond yields of selected European countries and the benchmark German government bond



Sources: Merrill Lynch; authors' calculation.

Similar developments (relatively positive till 2007 and adverse afterwards) were recorded also in the area of public finances in most of the selected countries. The fact is that the most of the observed countries were in a long expansion that lasted till 2007 and had a favorable effect on budget revenues. Therefore, in this period countries generally exercised relatively low levels of budget deficit and some even a budget surplus. It should be pointed out that cyclically adjusted budget balance figures show less favorable developments. Nevertheless, relative debt indicators for most of the countries were more favorable at the end of 2007 than at the beginning of the observed period.

However, the escalation of the financial crisis and its spillover into the real sector of the economy ultimately led to the deepest recession in the post-war period. In such circumstances the influence of the automatic stabilizers led to a sharp fall in government revenues. Additionally, the fiscal authorities of the most developed EU countries tried to alleviate and reverse the adverse economic trends by implementing different fiscal stimulus packages, and many of them had to inject substantial funds into the financial system to preserve its stability. This resulted in an increase in state spending. On the other hand, the countries of Central and Eastern Europe generally could not afford significant stimulation of their economies with their budget resources. Smaller packages of fiscal stimulus were recorded only in Slovakia, Slovenia and Poland while countries like Hungary, Croatia, Romania and Latvia trying to stabilize their public finances actually implemented pro-cyclical measures. This was also demanded by the international financial institutions that provided conditional financing during crisis period.

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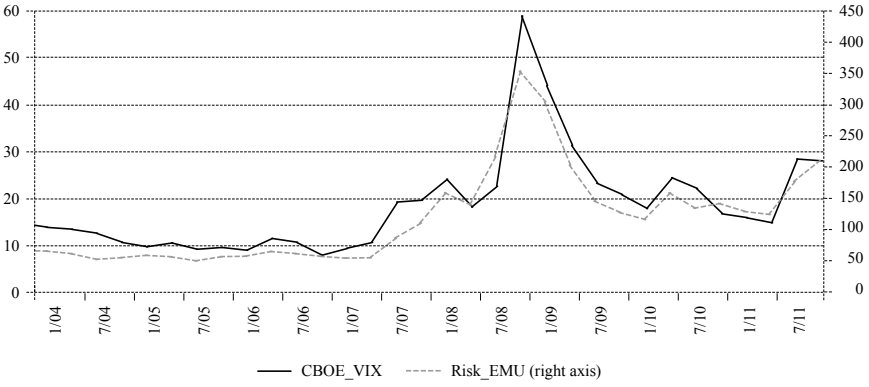
After the collapse of Lehman Brothers risk aversion on the global financial markets increased significantly. Figure 2 shows two indicators of risk aversion. The first one measures the difference between yields on generic corporate bonds in the eurozone countries, excluding financial companies, and the yield on comparable generic German bonds (Risk_EMU). The second one is the Chicago Board Options Exchange Volatility Index (CBOE_VIX), which measures implied volatility of S&P500 index option prices and is used in this paper to capture investors' risk aversion.[9] Figure 2 shows that even before the onset of the financial crisis in Europe risk aversion indicators started to rise due to adverse developments in the U.S. subprime mortgage market. In the first months after the collapse of Lehman Brothers the level of risk premium reached a prohibitively high level and some of the countries in our sample lost access to international capital markets. In such circumstances, to avoid defaulting on their debt, countries like Hungary or Latvia got international financial help but were forced to implement severe saving measures.

FIGURE 2
Risk aversion indicators



Sources: Bloomberg, authors' calculation.

Regardless of whether it was the effect of automatic stabilizers on the revenue side and/or increased costs due to the banks rescue and stimulation of economy, in all countries under review there was a noticeable deterioration in fiscal balance, and consequently the public debt (figure 3). Average projected fiscal deficit in the period from 2004 to 2007 was around 1.5%, but in the next three years increased to 4.2% of GDP, while projected public debt increased by about 8 percentage points. Looking at the end of 2010 public debt was on average about 18 percentage points higher than at the end of 2007.

[9] By using CBOE_Vix we avoid the problem of endogeneity which might be present if Risk_EMU is used instead.

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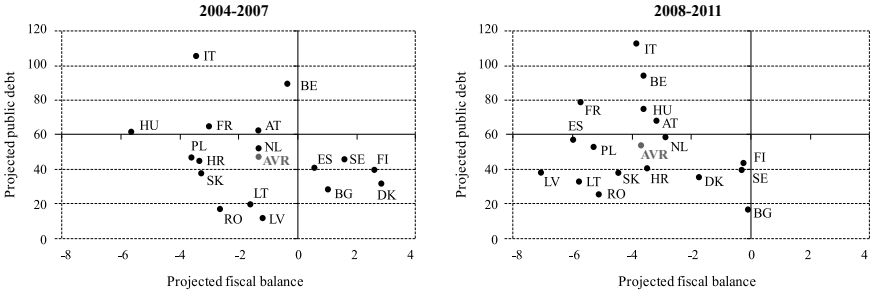
FIGURE 3

Fiscal developments before and after the onset of global financial crisis

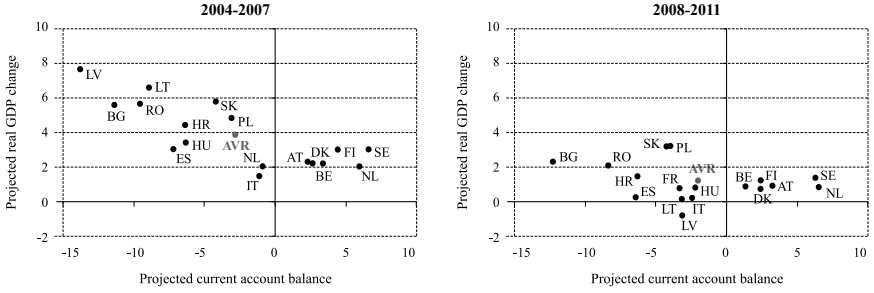


Note: Left panel shows average expected fiscal balance and public debt in the 2004-2007 period while right panel shows figures for the same variables in the 2008-2011 period. AVR = average.

Sources: Eurostat, MF, CNB.

FIGURE 4

Growth prospects and external imbalances before and after the onset of global financial crisis



Note: Left chart shows average current account balance and average real GDP change in the 2004-2007 period while right panel shows figures for the same variables in the 2008-2011 period. AVR = average.

Sources: Eurostat, CNB, authors' calculation.

Not only fiscal indicators showed significant worsening during the last crisis. Average GDP growth decreased significantly during the crisis. During the 2004-2007 period it amounted to 4.5% annually and then plunged to -1.0% on average during the subsequent three years. As can be seen from figure 4 average projected GDP growth also significantly decreased. It is worth pointing out that in 2010 most of the countries in the sample experienced a mild growth, and only Romania and Croatia were still on a downward trend. Overall, such a development added to investors' concerns regarding medium-term sustainability and could partly explain the high level of yield spread in that period. On the other hand, external imbalances measured by the current account balance somewhat shrank, especially in

the emerging market countries mostly due to a significant fall in imports. It seems, however, that this did not offer much comfort to global investors since external indebtness continued to rise.

Before econometric analysis it is useful to look at linear correlation coefficients between sovereign yield spreads on one side and potential explanatory variables on the other for two subperiods. Table 1 shows that for emerging market countries correlation coefficients between indicators of credit risk (except current account), liquidity risk and general risk aversion on the one side and government bond yield spreads on the other mainly show expected signs both before and after the onset of financial crisis. What is interesting is that correlation between fiscal variables and spreads for most countries was much stronger before than after the crisis. On the other hand, correlation coefficients suggest a more important role of general risk aversion after the onset of the crises. This is to some extent contrary to the general belief in non-discriminating financial markets before the crisis. However, it is impossible to say whether this was really the case without a detailed econometric analysis that takes into account all the interlinkages between the explanatory variables.

Results for developed countries indicate that before the crisis investors' risk aversion played the most important role in determining the spreads, while results for other variables are mixed with both positive and negative signs of correlation coefficients. And even if the sign is right, correlations are weaker than for emerging market countries. However, this is something that might have been expected. It should be borne in mind that prior to the crisis most developed countries in our sample had the highest credit rating (only Belgium and Italy had a double A rating). Investors probably saw these bonds as close substitutes and did not pay too much attention to the macroeconomic and fiscal developments. Data on spreads seem to support such conclusion; in only five percent of the cases in this period were spreads larger than 10 basis points. So it seems that decreasing level of risk aversion played a more important role in this period, as suggested by the relatively high correlation coefficient between sovereign spreads of most of the countries and the VIX index. The financial and sovereign debt crisis in the EU seem to change that significantly. In most cases, correlation coefficients between fiscal indicators, especially public debt, and sovereign spreads now have the expected sign, and it seems that the relation is somewhat stronger than before. On the other hand, it seems that correlation between general risk aversion and spreads has weakened.

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Table 1

Correlation coefficients between sovereign spreads and selected variables

	Projected fiscal balance		Projected public debt		Projected GDP growth		Projected current account balance		Indicator of risk aversion-VIX		Liquidity indicator	
	04-07	08-11	04-07	08-11	04-07	08-11	04-07	08-11	04-07	08-11	04-07	08-11
Austria	-0.26	-0.54	0.56	0.55	-0.56	-0.45	-0.44	-0.63	0.26	0.36	0.29	-0.14
Belgium	-0.13	-0.23	0.22	0.37	0.02	0.23	0.56	0.10	0.74	0.15	0.43	-0.64
Denmark	-0.46	0.14	0.22	-0.40	-0.39	-0.62	0.14	-0.61	0.60	0.74	0.39	-0.05
Spain	-0.38	-0.21	0.66	0.74	-0.61	0.26	0.84	0.74	0.48	-0.10	0.58	0.85
Finland	0.33	-0.27	-0.21	0.24	-0.32	0.00	0.37	-0.48	0.59	0.35	-0.11	0.58
France	0.68	-0.14	-0.69	0.54	-0.02	0.06	-0.67	-0.15	0.71	0.17	0.60	-0.07
Italy	0.25	0.24	-0.20	0.52	-0.08	0.25	-0.57	-0.54	0.19	0.05	-0.61	-0.70
Nether-lands	0.16	-0.25	-0.19	0.30	0.21	-0.41	0.11	-0.40	0.50	0.62	-0.26	0.36
Sweden	-0.66	-0.24	0.47	0.34	-0.65	0.47	-0.38	0.46	0.35	-0.64	0.60	-0.23
Bulgaria	-0.68	0.24	0.86	-0.38	-0.68	-0.29	0.68	-0.46	0.26	0.86	0.97	-0.03
Hungary	0.64	0.40	-0.63	0.39	0.18	-0.27	-0.16	0.27	0.34	0.52	-0.78	-0.65
Lithuania	-0.90	-0.39	0.80	-0.07	-0.31	-0.79	0.54	0.19	0.23	0.63	-0.71	-0.23
Latvia	-0.61	-0.81	0.72	0.28	-0.78	-0.88	0.68	0.42	0.06	0.51	0.53	-0.63
Poland	-0.87	-0.32	0.60	0.42	-0.48	-0.69	0.27	0.04	0.21	0.58	-0.85	-0.86
Romania	-0.09	-0.08	0.77	-0.03	-0.52	-0.08	0.71	0.14	0.30	0.86	-0.56	-0.07
Slovakia	-0.01	-0.44	0.11	0.44	0.04	-0.55	0.15	-0.04	-0.04	0.44	0.13	0.46
Croatia	-0.43	-0.27	0.60	0.19	-0.16	-0.49	0.56	0.28	0.31	0.61	0.29	0.05

Source: Authors' calculation.

4 THE ECONOMETRIC MODEL AND ANALYSIS OF THE RESULTS

Taking into account high persistency in sovereign spreads, as government bond spread in current quarter depends among other things on the prior spread level, in the empirical part of the paper we employ a dynamic panel model. If static models were to be estimated and the underlying dynamics ignored, significant information might be lost, resulting in poor estimation results. When a dynamic model is estimated, even if we have no interest in the coefficient on the lagged dependent variable, dynamics are allowed for in the underlying processes, which might be essential for the recovery of consistent estimates of other parameters (Bond, 2002). The inclusion of lagged quantities, in addition to accounting for rigidities in adjustment, also lessens the problem of omitted variables.

4.1 DYNAMIC PANEL ANALYSIS

The linear dynamic model is specified as:

$$y_{i,t} = \gamma_1 y_{i,t-1} + \ldots + \gamma_p y_{i,t-p} + \beta x_{i,t} + \alpha_i + \varepsilon_{i,t} \quad (1)$$

where $y_{i,t}$ is a dependent variable in time t, and $y_{i,t-1}$ lagged dependent variable, α_i is an individual fixed effect, $x_{i,t}$ is a vector of explanatory variables for unit i in

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period t, and $\varepsilon_{i,t}$ is the disturbance term. It is assumed that $E\{\varepsilon_{i,t}\} = 0$ and $E\{\varepsilon_{i,t}, \varepsilon_{j,s}\} = \sigma^2$ if $i=j$ and $s=t$, and 0 otherwise. The objective is consistently to estimate γ_1 to γ_p and β when α_i is a fixed effect. Since $y_{i,t-1}$ is correlated with α_i OLS and random effect estimators are both inconsistent. It can be shown that the within estimator is also inconsistent and suffers from the so called Nickell bias which can be substantial and disappears only if $T \to \infty$.

If the model is transformed by first differencing to eliminate fixed effects we again introduce correlation between differenced lagged dependent variable and differenced error term so instrumental variable approach should be used.

The transformed model is then given by:

$$\Delta y_{i,t} = \gamma_1 \Delta y_{i,t-1} + \ldots + \gamma_p \Delta y_{i,t-p} + \beta \Delta x_{i,t} + \Delta \varepsilon_{i,t} \tag{2}$$

where $\Delta y_{i,t} = y_{i,t} - y_{i,t-1}$.

In the case of the lagged dependent variable, valid instruments will be those which are correlated with $\Delta y_{i,t-1}$ and uncorrelated with $\Delta \varepsilon_{i,t}$. The Anderson-Hsiao estimator could be used but even though it is consistent, it is not asymptotically efficient. Arellano and Bond (1991) showed that the most appropriate framework for obtaining estimates in this context is the generalized method of moments (GMM). GMM estimation uses a different number of instruments for the lagged dependent variable (and other endogenous variables) for each period, depending on how many are available, which increases the efficiency of the GMM estimator.[10]

The Arellano-Bond estimator, employed in this paper, uses lagged levels of the endogenous variables as instruments. So, for example, if t=3 the instrument for $\Delta y_{i,t-2}$ would be $y_{i,t-1}$; if t=4 instrument for $\Delta y_{i,t-3}$ will be $y_{i,t-2}$ but also $y_{i,t-1}$, and so on. The Arellano-Bond estimator uses instrument matrix that takes the following form

$$Z_i = \begin{bmatrix} y_{i1} & 0 & 0 & \ldots & 0 & \ldots & 0 \\ 0 & y_{i1} & y_{i2} & \ldots & 0 & \ldots & 0 \\ . & . & . & \ldots & . & \ldots & . \\ 0 & 0 & 0 & \ldots & y_{i1} & \ldots & y_{i,T-2} \end{bmatrix} \tag{3}$$

and then exploits the moment conditions $E[Z_i', \Delta\varepsilon_i] = 0$ for $i = 1, 2, \ldots, N$. The asymptotically efficient GMM estimator based on this set of moment conditions minimises the criterion

$$J_N = \left(\frac{1}{N}\sum_{i=1}^{N} \Delta v_i' Z_i\right) W_N \left(\frac{1}{N}\sum_{i=1}^{N} Z_i' \Delta v_i\right) \tag{4}$$

[10] The estimation may include other variables which are exogenous and therefore need not be instrumented.

In the paper we use a one-step estimator based upon an optimal weighting matrix in the presence of homoskedasticity, and robust standard errors. The weighting matrix in this context is

$$W_{1,N} = \left[\frac{1}{N} \sum_{i=1}^{N} \left(Z_i' H Z_i \right) \right]^{-1} \tag{5}$$

which does not depend on any estimated parameters.[11,12]

If the explanatory variable x is endogenous, it is treated symmetrically with the lagged dependent variable $y_{i,t-1}$ (Bond, 2002).[13]

One has to keep in mind that if T > 3 the model is overidentified so the validity of instruments should be tested using the standard GMM Sargan test of overidentifying restrictions. Also, the assumption of no serial correlation in error term in the original equation has to be tested by assuming no second-order serial correlation in the residuals of the first differenced equation.

4.2 THE EMPIRICAL MODEL AND THE RESULTS

This section presents and comments on the estimation results of specified models obtained by employing econometric strategy outlined in the previous section. General model is given by the following equation

$$spread_{i,t} = \gamma_1 spread_{i,t-1} + \beta_1 credit\_risk_{i,t} + \beta_2 risk\_aversion_{i,t} + \beta_3 liquidity_{i,t} + \alpha_i + \varepsilon_{i,t} \tag{6}$$

All model specifications use CBOE_VIX as an indicator of global risk aversion and our measure of liquidity described in section 3.1. Regarding credit risk, two basic specifications use only fiscal variables, namely, expected government budget balance (specification 1) and expected public debt (specification 3). We do not include fiscal balance and public debt in the same equation in order to avoid problem of collinearity. These two general specifications are than expanded by including projected GDP growth that is also expected to be an important sovereign spread determinant.[14] Each model specification was estimated for three different time periods: the overall period; Q1 2004 – Q4 2011; the period before the onset of the crisis, Q1 2004 – Q4 2007; and the period during and after the crisis; Q1 2008 – Q4 2011 and for three different groups of countries (all countries, developed countries and emerging market countries). Tables 2 to 4 summarize the results of estimated models.

[11] Where H is (t-2) square matrix with 2's on the main diagonal, -1's on the first off-diagonals and 0's elsewhere (Bond, 2002).
[12] Simulations show that asymptotic standard errors tend to be too small for two-step estimators.
[13] Important to note is the fact that lagged levels will convey meaningful information on subsequent changes in the variable only if the variable is not close to a random walk, which was pointed out by Blundell and Bond (1998).
[14] We also tried to estimate the model with expected current account balance as an additional credit risk indicator but that did not yield any meaningful results. For that reason these results are not shown in tables 2-4.

TABLE 2

Results of dynamic panel model estimation, all countries

Period	04-11				04-07				08-11			
	Model specification				Model specification				Model specification			
Variables	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**
Spread (t–1)	0.57***	0.65***	0.56***	0.62***	0.78***	0.77***	0.71***	0.71	0.64***	0.57***	0.65***	0.54***
Projected fiscal balance	-1.70***	-4.07***	–	–	-0.30	0.11	–	–	-5.08***	-3.46***	–	–
Projected public debt	–	–	1.09***	1.09***	–	–	0.87***	0.82***	–	–	1.31***	1.59***
Projected GDP growth	–	6.40***	–	4.37***	–	-1.95***	–	-0.62*	–	-5.70***	–	-9.29***
Risk aversion indicator–VIX	5.85***	5.63***	6.02***	5.65***	1.95***	1.95***	2.07***	2.06***	4.84***	4.67***	4.87***	4.58***
Liquidity indicator	-15.42	-44.48	-16.25	-59.79	-5.94***	-5.20***	-6.67**	-5.36*	-4.89	-35.31	-45.87	-54.84
Constant	-0.02	146.39	-43.13	195.77	12.02*	21.49**	-25.02	-28.87	-12.66	187.99	158.82	242.76
AR2 – probabiltiy values-H0: no autocorrelation	0.09	0.10	0.07	0.10	0.53	0.57	0.57	0.57	0.46	0.56	0.37	0.65

*Notes: AR2 – second order autocorrelation; significance level – * 10%, ** 5%, *** 1%.*

Source: Authors' calculation.

TABLE 3

Results of dynamic panel model estimation, developed countries

Period	**04-11**				**04-07**				**08-11**			
	Model specification				**Model specification**				**Model specification**			
Variables	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**
Spread (t–1)	1.22***	1.22***	1.25***	1.22***	1.14***	1.29***	1.26***	1.24***	1.23***	1.20***	1.22***	1.18***
Projected fiscal balance	4.16**	1.81	–	–	3.50	9.44	–	–	3.45**	0.17	–	–
Projected public debt	–	–	-0.57	-0.15	–	–	-1.19	-1.26	–	–	-0.18	0.16
Projected GDP growth	–	5.32**	–	6.99***	–	0.93	–	-1.52	–	18.19***	-	8.56***
Risk aversion indicator–VIX	0.94***	1.16***	0.89***	1.22***	0.47***	0.44***	0.36**	0.32**	1.07***	1.38***	1.16***	1.42***
Liquidity indicator	-6.77	-4.94	-7.31	-4.07	-17.11	-19.87*	-22.50**	-20.90	-16.90**	-9.49*	-18.50**	-8.51
Constant	53.94	18.74	89.75	13.08	177.51	205.65**	297.75	287.40**	148.29	49.76	162.86**	28.18
AR2 – probabiltiy values-H0: no autocorrelation	0.23	0.23	0.13	0.25	0.40	0.68	0.72	0.68	0.05	0.07	0.06	0.08

*Notes: AR2 – second order autocorrelation; significance level – * 10%, ** 5%, *** 1%.*

Source: Authors' calculation.

TABLE 4

Results of dynamic panel model estimation, emerging market countries

Period	04-11				04-07				08-11			
	Model specification				Model specification				Model specification			
Variables	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**
Spread (t–1)	0.45***	0.54***	0.48***	0.49**	0.71***	0.68***	0.58***	0.59***	0.45***	0.55***	0.50***	0.50***
Projected fiscal balance	-10.88*	-13.76**	–	–	-3.70*	-2.80	–	–	-12.02*	-15.34**	–	–
Projected public debt	–	–	2.73*	2.80*	–	–	2.01***	1.66**	–	–	3.47*	3.52*
Projected GDP growth	–	6.55	–	0.61	–	-6.87***	–	-3.49	–	7.15	–	-0.06
Risk aversion indicator–VIX	8.72***	8.81***	8.83***	8.83***	2.77***	2.91***	2.90***	2.95***	9.59***	9.71***	10.07***	10.08***
Liquidity indicator	-65.47	-58.73	-66.83	-65.02	-13.32	-8.51	-14.01	-12.67	55.62	51.40	54.16	56.90
Constant	-73.70***	-129.04**	-142.88**	-151.25**	-25.74**	12.02	-77.38***	-47.58	-182.49***	-235.37***	-296.00***	-300.64**
AR2 – probabiltiy values-H0: no autocorrelation	0.20	0.23	0.20	0.20	0.61	0.69	0.82	0.87	0.14	0.17	0.15	0.15

*Notes: AR2 – second order autocorrelation; significance level – * 10%, ** 5%, *** 1%.*

Source: Authors' calculation.

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The first lag of the dependent variable is highly significant in all three observed periods and in all three groups of countries, justifying the usage of a dynamic panel model. Also, the results suggest there is no second order autocorrelation in the first-difference version of different model specifications at the usual significance level, indicating they are well specified.

Table 2 shows panel results when all countries are included in our sample. If the whole period is considered, results indicate that fiscal variables and general risk aversion played an important role, with the latter indicator having the largest influence on sovereign spreads dynamics. The results also suggest that projected fiscal balance has larger impact on spreads than public debt, which is in line with the results presented in empirical literature. For projected GDP growth we get a counterintuitive result. Estimation results show that it is significant but it has a wrong sign.

When the sample is split in two periods; Q1 2004 – Q4 2007 and Q1 2008 – Q4 2011, it seems that results from full sample panel estimation are greatly determined by the reaction of the spreads in the crisis period. Namely, before the crisis, projected fiscal balance is insignificant, while public debt and projected GDP seem to be the main indicators of country credit risk, but relatively low coefficients next to them indicate that they did not have an important role in determining the spreads. It could be concluded that liquidity risk and general risk aversion were the most important drivers of sovereign spread dynamics.

After the onset of the financial crisis all credit risk indicators are significant and have the expected sign while the liquidity risk indicator lost significance. Apart from that, their influence on spreads is much larger than before, indicating that in the crisis period investors started to pay more attention to country-specific macroeconomic and fiscal developments and to differentiate more between the countries.

However, the significance of credit risk indicators seems to be due to the reaction of spreads to the macroeconomic and fiscal factors of emerging market countries; the results for developed countries (displayed in table 3) show that their credit risk indicators are either insignificant or have counterintuitive signs in all three different periods. It seems that risk aversion and liquidity risk were main determinants of spread dynamics for developed countries before and after the onset of the crisis, although the liquidity indicator lost significance in some model specifications. These results are somewhat contrary to those presented in for example Barrios et al. (2009), where the authors concluded that fiscal variables together with market liquidity and general risk aversion played important roles in determining the spreads of developed EU countries in the recent period. An answer to these different estimations could lie in the construction of fiscal variables. Namely, explanatory variables in Barrios et al. (2009) are expressed relative to

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Germany, while we use original data. So it is possible that when it comes to developed EU countries, investors compare country-specific factors with those of Germany. In that case we could expect to see an increase in sovereign spreads if, let us say, the expected public debt for a certain country increases more than for Germany, and if it increases less, spreads should fall despite there being a derioration in fiscal indicators.

On the other hand, the estimation results presented in table 4 suggest that credit risk factors are very important in determining the bond spreads of emerging markets countries. Projected fiscal balance and projected public debt are both significant and with the right sign before and after of the onset of the financial crisis in most model specifications. Projected fiscal balance only loses its significance when projected GDP growth is included in the Model 2 in the pre-crisis period, but then projected GDP growth is significant and with the expected sign. Also, coefficients next to fiscal variables are much higher than those obtained for the whole sample of countries. Table 4 shows that the relatively high coefficient next to fiscal balance in the whole sample period is primarily the consequence of a several-times-larger reaction of spreads to fiscal balance in the period after the onset of financial crisis.

The risk aversion component for emerging market countries is highly significant in all three different periods and its impact is even higher in the crisis period. Results also suggest that it has a larger influence on emerging market countries than on developed countries, especially in the crisis period. On the other hand, the liquidity risk seems to have no influence on movements in sovereign spreads of emerging market countries before and after the onset of crisis.

5 CONCLUSION

The crisis has changed the world we live in, or at least our perception of it. After they reached historically low levels in the pre-crisis period, sovereign spreads exploded in late 2008 and early 2009. For some countries the increase was so dramatic that it pushed them into a sovereign debt crisis. By analyzing data for 17 European countries with a special focus on fiscal variables this paper tried to answer what the main drivers of such developments were. Did the macroeconomic and fiscal situations really become so much worse? Or did investors simply start to pay more attention to previously ignored factors?

Simple descriptive data analysis shows that macroeconomic and fiscal situations really did worsen significantly with the onset of the crisis. After several years of robust growth and declining fiscal imbalances Europe was hit by the worst recession in more than sixty years. Fiscal deficits reached a level not seen in years and public debt figures skyrocketed in some countries. At the same time, growth prospects for many countries became much weaker. Such developments have an adverse effect on government solvency so it is reasonable to expect that spreads

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should be affected. In addition, it seems that investors started to pay much more attention to factors neglected during times of prosperity, such as fiscal sustainability. Even in the period 2004-2007, macroeconomic and fiscal developments were not homogenous, but this has not been reflected in the different spread levels among countries, as their differences were negligible.

Econometric analysis was conducted using dynamic panel data model and the Arellano-Bond estimator which is in our opinion the most appropriate for the purpose. The results for the entire sample (all countries and the whole period) confirm our prior belief and are also in line with the empirical literature. Both general risk aversion and fiscal variables as indicators of credit risk are proven to be statistically significant determinants of sovereign yield spreads. The results are robust to the use of different fiscal indicator, that is, fiscal balance vs. public debt. The liquidity indicator, on the other hand, statistically does not differ from zero, even though it has the expected sign.

All model specifications offer some interesting insights when estimated on two sub-periods (2004-2007, 2008-2011). It seems that spreads reacted much more strongly to changes in overall market risk aversion after the onset of the crises. The initial shock triggering the crisis (Lehman Brothers) never died away completely, and many subsequent events resulted in spreads remaining on much higher level than before the crisis (almost on 100 percent higher level regardless of the indicator used to measure general risk aversion). In such an environment these results are in line with expectations. Also as expected, credit risk indicators were shown to be much more important determinant of spreads during 2008-2011 period. The results confirm that markets like both saving and growth. So if the expected growth went up or the fiscal policy were projected to become more prudent, the markets were demanding lower spreads.

Estimating the model separately for developed and emerging market countries suggests that the aforementioned results are mostly driven by the latter. It seems that the general risk aversion is the most important determinant of developed countries' bond spreads and the credit risk indicators were either statistically insignificant or had a wrong sign. One possible explanation would be that investors do not react to changes in macroeconomic or fiscal situation, but to the changes compared to a "referent" country, in this case Germany. On the other hand, the crisis changed the way markets react to expected macroeconomic and fiscal developments in emerging market countries in the sample. Coefficients next to fiscal and general risk aversion indicators are much higher in 2008-2011 period than before. Such results would suggest that emerging market countries came under the magnifying glass of investors while developed countries got into trouble a little bit later.

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At the end, one could conclude that countries should only partly blame themselves for increased borrowing costs. Even though there is not much a single country can do to change market sentiment, evidence suggest there is a certain manoeuvring space for the domestic policy makers to contribute with their actions to a decline of their borrowing cost, and consequently to support the long-term sustainability of public finances. This is an important lesson for policy makers. There is, however, a lesson for financial markets as well, as their role in adequate risk pricing should be played with much greater caution. By neglecting important signs of unsustainable imbalances and signalling that countries are in "a good shape" they failed to act as a corrective of unsound policies. The future will show whether these lessons have been learned.

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