Determinants of sovereign risk premia for European emerging markets

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Abstract

This paper analyses the determinants of the changes in sovereign bond spreads in emerging European markets before and during the recent global financial crisis. In particular, these determinants are associated with changes in market sentiment and in domestic macroeconomic fundamentals. The model was estimated on panel data for eight central and eastern European countries between Q1:2000 and Q2:2010, using least squares and controlling for serial correlation. The results show that the dynamics of spreads can be explained by both market sentiment indicators and macroeconomic fundamentals. In particular, the external imbalances did not exert any discernible effect on spreads prior to the crisis, but became increasingly significant as the crisis broke out.

Keywords: sovereign bond spreads, emerging markets, central and eastern Europe, global financial crisis, market sentiment, macroeconomic fundamentals

1 INTRODUCTION

Funding costs for all Central and Eastern European countries (CEECs) generally trended downward during most of the past decade.[1] After a major deterioration of the global economy following the turbulence in the US sub-prime mortgage market and especially in the aftermath of the Lehman Brothers collapse, investors' risk aversion increased significantly, raising funding costs for CEECs. In addition, as investors started to differentiate among countries on the basis of perceived riskiness, the cost of financing for some countries in the region increased significantly, while for others the increase was much less pronounced.

From the economic policy perspective, it is important to identify and understand the driving forces of the sovereign spread dynamics, and to be aware of the relative contribution of the factors that can be influenced by economic policy tools, as well of those that cannot be affected by domestic policies. This paper tests to what extent the recent sharp widening of sovereign bond spreads could be attributed to changes in market sentiment or by domestic fundamentals, and also to external imbalances. Our model was estimated on panel data by using ordinary least squares and including fixed effects. The results suggest that the spread dynamics prior to the crisis can be explained only by market sentiment indicators and macroeconomic fundamentals. The external imbalances did not exert any discernible effect on the spreads prior to the crisis, but became increasingly important after the crisis broke out.

The rest of the paper is organized as follows. Section two provides a summary of the relevant literature discussing the determinants of sovereign bond spreads. Sections three and four describe some stylized facts about recent movements in sovereign bond spreads of CEECs, and describe the data used in the analysis and the potential impact of each variable on the spreads. This is followed by a description

[1] Bulgaria, Croatia, the Czech Republic, Hungary, Lithuania, Poland, Romania and Slovakia.

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of the model and the presentation of estimation results in Section five. Section six concludes.

2 LITERATURE REVIEW

The interest in the determinants of the cost of financing is not new. It is common for this topic to become especially interesting in periods of turmoil in financial markets and the real economy. In order to explain the behaviour of spreads, various authors have analyzed different macroeconomic fundamentals; government finance indicators; external liquidity indicators; political, social and legal factors; and financial market variables. What is more, some authors have used credit ratings as a proxy for all available country fundamentals (e.g. Hartelius et al., 2008).

One of the first authors to deal with this topic was Edwards (1983), who analyzed the relationship between foreign debt and country default risk. He showed that lenders took into account some of the risk characteristics of the borrowers, but also emphasized that markets were not successful in pricing risk for countries that eventually ended up with serious debt servicing difficulties.

Using data of about one thousand bonds issued by developing countries, Eichengreen and Mody (1998) tried to investigate how much of the spread variation could be explained by fundamental factors in comparison to the influence of the general market sentiment. According to their results, economic fundamentals did not seem to be the main driving force of spread movements over time, suggesting they were highly influenced by market sentiment. A similar conclusion was presented by Ebner (2009), who gave an overview of the development of euro-denominated sovereign bonds in the CEE region, and showed that higher market volatility is the most important factor influencing spreads.

A somewhat different result was reached by Ferrucci (2003), who investigated the determinants of emerging market bond spreads in secondary markets, and tried to discover how far the changes in spreads could be explained by changes in fundamentals. Using a panel of EMBI data and macroeconomic variables and the pooled mean group technique, he found that the spreads were highly influenced by the fundamentals, but that non-fundamental factors, especially market sentiment, could not be neglected.

In recent years, several papers have analysed the determinants of bond spreads for Central and Eastern European countries in the context of EU accession. Luengnaruemitchai and Schadler (2007) pointed out that EU accession might have a positive impact on spreads, an effect known as the “EU halo”. They did not model this effect explicitly, but concluded that it was the result of policy anchors brought by the EU accession process.

Nickel et al. (2009) focused their analysis on the impact of fiscal variables on bond spreads. They used forecasted values of macroeconomic variables to capture market expectations, and showed that the fiscal deficit had a significant influence on bond spreads. However, in country-specific regressions they found that this link was not pronounced, as it could be confirmed in only two out of five emerging market countries.

Alexopoulou et al. (2009) used a dynamic panel error correction model to analyze the role of fundamentals in the determination of government bond spreads for eight new EU member states. They concluded that external imbalance, fiscal balance, the exchange rate, inflation, the degree of trade openness and short-term interest rate spreads influenced the cost of funding in the long run. They divided countries in two sub-groups and emphasized the importance of fiscal fundamentals for countries with high external imbalances.

As movements of spreads on different emerging market bonds usually have similar patterns, it could be concluded that they were to a large extent determined by one or more common factors. McGuire and Schrijvers (2003) used principal component analysis to identify these factors, and found that a single common factor explained approximately 80% of the common variation. This factor is interpreted as investors' risk aversion. There was also evidence of a second common factor appearing in recent years, but the authors do not link it to any fundamental explanation.

A similar approach was used by Sløk and Kennedy (2004), who differentiated between two main factors in explaining the changes in spreads: the perception of borrowers' economic conditions; and the general economic conditions characterized by low global interest rates, which encouraged investors to go for a "yield hunt", causing a sharp decrease of risk premia. One of their conclusions was that the role of general economic fundamentals, combined with the high global liquidity, had greater influence on the lowering of spreads than the country-specific factors. Similar conclusions were also reached by Ciarlone et al. (2007), who showed that the emerging market spreads decreased more than they should have solely on the basis of improved fundamentals. This made many countries vulnerable to sudden changes in financial market conditions.

The empirical part of our paper is similar to the research done by Özatay et al. (2009), who used daily data and investigated the impact of US macroeconomic news and macroeconomic indicators on spread movements in 18 emerging market countries (only three of them were from Europe). They used ordinary least squares panel data estimation, but also expanded the analysis by the common correlated effects method. Their main conclusion was that the spreads were mainly determined by global financial conditions in the long run. Positive domestic macroeconomic indicators contributed to the lower risk premia by decreasing the probability of default.

In summary, various authors have identified market sentiment and macroeconomic fundamentals as the main determinants of spread movements. In addition, research on the new EU member states stressed the positive impact of the EU accession process.

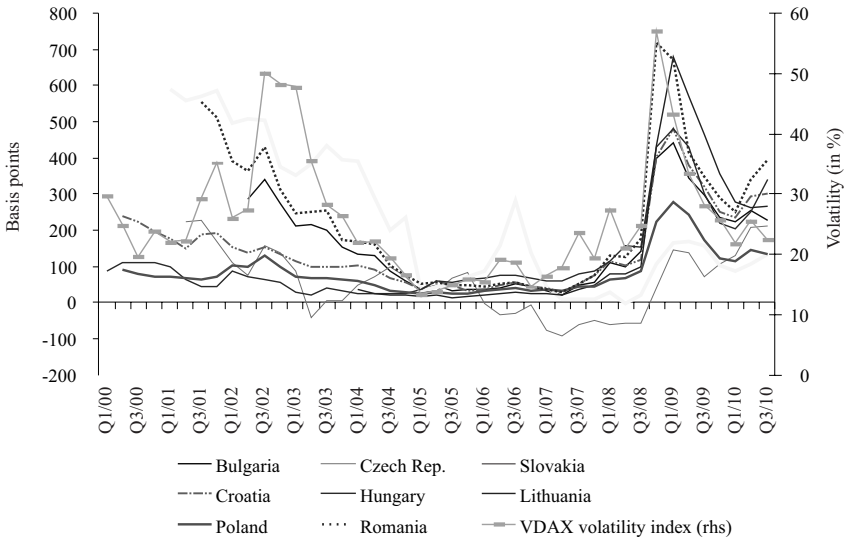
3 STYLIZED FACTS AND DATA

The spread on a bond represents investors' perceptions of the issuers' risk of default relative to some benchmark risk-free bond, taking into account the issuer's past, current and future expected economic performance. In addition to affecting the cost of government debt, the spread is also an important reference for all private sector loans, mostly because private issuers face the same macroeconomic risk as the sovereign. The spread is also used in cross-country studies as a measure of country risk premium (see Damodaran, 2010).

As shown in figure 1, the cost of foreign currency borrowing in international markets declined steadily for emerging market countries until the third quarter of 2008. Measures of market sentiment such as VDAX (defined below) indicated that global investors saw the overall financial market risks as sharply reduced. These trends were reversed in the second half of 2007 with the emergence of problems in the US sub-prime mortgage market. The escalation of the crisis after the collapse of Lehman Brothers in September 2008 led to a flight to quality and a drastic rise in yields on emerging market Eurobonds.

FIGURE 1

Spreads on emerging market sovereign bonds and financial market volatility[1]



[1]*Spreads are measured by JP Morgan's Emerging Market Bond Index (EMBI); volatility by Deutsche Börse Volatility Index (VDAX).*

Sources: JP Morgan; Bloomberg.

After the drastic deterioration in market conditions, investors' behaviour changed, the compression of spreads was quickly reversed, and major differences in spreads emerged among CEE countries. This region is of particular interest in this context because it went through a period of rapid growth and increasing economic and financial integration into the EU before the crisis. In some countries, this process resulted in the build-up of significant external imbalances, which were mostly perceived by financial markets as part of the convergence process, and at the time did not result in higher yields. This took place against the backdrop of relatively benign international financial conditions and abundant liquidity on the global level. However, these external conditions deteriorated dramatically as the crisis broke out.

Our panel consists of data for eight CEECs for the period between the first quarter of 2000 and the second quarter of 2010. Countries in our sample are: Bulgaria, Croatia, the Czech Republic, Hungary, Lithuania, Poland, Romania and Slovakia. The data panel is not balanced because of the data availability problems.

As indicators of yield spreads for the observed countries, for six countries from the sample we used the JP Morgan Euro EMBI Global indices, which represent an average spread on long-term bonds not issued in local currency. These indices are considered to be reliable indicators of yield movements and total returns for emerging market bonds. To ensure their representative quality and mutual comparability, the EMBI indices include only euro-denominated, straight fixed-coupon bonds issued by sovereign and quasi-sovereign entities with a remaining maturity of over 2.5 years. In order to assure that prices of the instruments included are reliable, JP Morgan requires that brokers and dealers in the secondary market regularly quote them.

For the Czech Republic and Slovakia, the EMBI index was not available; the series for the Czech Republic start only from 2Q:2004 and end in Q4:2008, and for Slovakia there is no EMBI index. For these two countries, we calculated interest rate spreads on long-term government bonds used for the Maastricht interest rate criterion versus German government bonds of comparable maturity. It should be noted that these bond yield series are based on local currency bonds. This could pose problems when they are compared with EMBI spreads for other countries, as the latter are calculated for bonds denominated in foreign currency. In order to ensure that exchange rate risk was not neglected in the case of the Czech and Slovakian bonds, we checked the 12-month forward premium for the Czech koruna and Slovak koruna versus the euro. As the appendix figure A1 shows, except at the beginning of the sample, when the foreign exchange market was pricing depreciation for the Czech koruna (around 1 per cent) and Slovak koruna (around 2 per cent), the premium remained in a narrow range around zero. Although this shows that the exchange rate risk would not be neglected by using the spreads on local currency bonds, we added the forward premium to the spreads to take account of the few instances when the exchange rate risk was present. This way we created

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synthetic bonds denominated in foreign currency: investors would buy domestic bonds and insure against the exchange rate risk with a forward FX contract. In markets where arbitrage works, this synthetic bond would give the same rate of return as the equivalent bond denominated in foreign currency.

The yield on an emerging market government bond is equal to the yield on a benchmark risk-free bond such as the German or the US Treasury bond, plus the country risk premium. The risk premium is in turn determined by the probability of a country's default and the expected rate of recovery of the face value of the bond. The size of these two spread components depends on the economic performance of the country and the enforceability of international contracts.

4 CHANNELS OF IMPACT

As figure 1 shows, changes in risk premia are too volatile to be explained by the above-mentioned factors alone. The premium also depends on investor sentiment, which might lead to an underestimation of risk in periods of financial market upturn, and an overestimation in periods of downturn. This is the reason why researchers regularly include some measure of market sentiment in studies of the determinants of bond spreads. In this paper, we divide the explanatory variables into four groups: macroeconomic indicators; sovereign and external solvency indicators; the EU convergence dummy; and measures of global financial monetary sentiment. [2]

4.1 MACROECONOMIC INDICATORS

The first group of variables relates to macroeconomic indicators, which strongly affect investors' perceptions of a country's creditworthiness. The variables we use are real GDP growth rate and inflation rate. GDP growth is the key measure of overall macroeconomic performance, and is positively correlated with tax revenues, which are ultimately used to repay the debt (Cantor and Packer, 1996; Ferrucci, 2003). The rate of inflation is another key measure of macroeconomic performance. A higher rate of inflation normally widens government bond spreads because it reduces the real value of government debt.

Another macroeconomic variable of interest to investors is the real exchange rate. According to Ebner (2009), a stronger domestic currency makes it easier to repay external debt and therefore increases investors' confidence in the country, narrowing the spreads. By analogy, a weaker domestic currency makes it more difficult to repay external debt and therefore widens the bond spreads.

4.2 SOVEREIGN RISK AND EXTERNAL SOLVENCY VARIABLES

The indicators of sovereign risk and external solvency that we consider include general government debt, external debt, short-term external debt, international reserves and the current account balance, all expressed as a percentage of GDP.

[2] See appendix 1 for details.

When investing in government bonds, investors are interested in the risk-return profile of bonds, which depends on the government's ability and willingness to repay the debt at maturity. Investing in government bonds is thus similar to investing in corporate bonds, with the difference that it is very difficult or sometimes impossible to force governments into receivership. This is why investors look with great caution at macroeconomic fundamentals. Lower growth and higher fiscal deficit increase the risk of bond default, and investors consequently require higher returns to hold such bonds. If a government issues too much debt, it has a greater incentive – or could be forced – to default if investors refuse to roll over the maturing debt. Hence, higher government debt increases the risk of default and the cost of debt.

External sustainability involves additional considerations. As well as the tax revenues and the level of government debt, a country's ability to issue bonds in foreign currency has an important role in the determination of bond spreads. Slowdowns and sudden stops in capital inflows or outflows of foreign capital increase the probability of a financial crisis. This could manifest itself in prohibitively high borrowing costs on the international market, especially for countries that have depended on foreign funding for longer periods (see e.g. Ozkan and Unsal, 2010). Therefore countries with large current account deficits and external debt, or high short-term external debt are, *ceteris paribus*, more vulnerable to external shocks than those with moderate external positions. By contrast, higher international reserves increase a country's capacity to service its debts.

Sustainability of government and external debt depends on the GDP growth rate through a simple accounting identity: if interest payments on debt as a share of GDP become greater than the growth rate of nominal GDP, the level of debt has to increase (Obstfeld and Rogoff, 1996, pp. 63-66). This is not possible in the long run, as it would imply that a country can increase its indebtedness without limit. Therefore we expect a negative and significant relationship between GDP growth and sovereign bond spreads. Similarly, we expect a positive relationship between the level of public debt and external vulnerability indicators on the one hand and bond spreads on the other.

4.3 EU/EUROZONE CONVERGENCE PROCESS

The third factor we used as a potential explanation of spread movements is an indicator of EU and eurozone convergence. Countries in our sample have either finished their EU accession process or are on the way to the EU or EMU. Therefore it makes sense to consider how this process may have influenced market perceptions of country risk. Accession to the EU and the eurozone implies, among other things, that investor protection and the rule of law are considered to be at a very high level. Although eurozone membership proved insufficient to discipline member states, as seen from the example of Greece, or shelter them from negative market sentiment (except maybe in the early days of the monetary union), for the

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observed group of countries it can be expected that EU and eurozone accession improves the overall credibility and quality of macroeconomic policies. This should be in turn manifested in lower spreads on government bonds. To take account of this effect we constructed a dummy variable that takes the value of 1 when the country becomes an EU member.

4.4 GLOBAL RISK AVERSION AND INTERNATIONAL ENVIRONMENT

Unlike bonds issued by major advanced economies, which usually serve as safe havens for investors in periods of financial turbulence, emerging markets bonds usually lose their value in times of crisis and behave like equities. Erb et al. (2000) explore the risk and return characteristics of emerging market bonds using the EMBI index and show a very high correlation (around 0.8) with the S&P 500 index and emerging market equity indices. Many studies therefore use volatility indices calculated on developed market equity indices as proxies for investor sentiment (e.g. Hartelius et al., 2010; Ebner, 2009; Luengnaruemitchai and Schadler, 2007).

The most widely used equity market volatility index is the Chicago Board Options Exchange Volatility Index (VIX). It measures implied volatility of the S&P 500 index option prices, and is often used as an indicator of global financial market sentiment. In a way similar to VIX, the Deutsche Boerse calculates the DAX volatility index, which shows implied volatility of equity prices for the German market. We use this volatility index as it might be more appropriate for the European countries studied in this paper. Like the VIX, this index pointed to low volatility in the German equity market between 2004 and 2008. Also, it rose sharply at the onset of the crisis in September 2008. The VDAX is expected to be positively correlated with the risk premium on emerging market bonds.

We also constructed an additional dummy variable (CRISIS_DAX), which takes on the value of 1 when the VDAX index exceeds the sum of sample mean (25.8) and one sample standard deviation (10.3, see figure 2). The rationale for this variable is to identify periods when global markets were in a state of greater uncertainty, and thus facilitate the interpretation of interaction terms presented bellow, whose purpose is to model possible non-linear relationships between bond spreads and their determinants during the crisis.

In order to assess to what extent bond spreads dispersed after September 2008 as a result of investors' differentiation among countries, in a few specifications we included in the model interaction terms between the changes in the VDAX index and the crisis dummy or external vulnerability indicators. Special attention is given to external imbalances, which could be important in assessing the debt-servicing ability of many countries in the region. The interaction terms might pick up some non-linearity that could exist between external imbalances and market sentiment. The intuition behind this approach is that markets might ignore external

vulnerabilities in periods of low volatility, but start paying attention to them in periods of heightened volatility.

FIGURE 2

Deutsche Boerse VDAX index

Sources: Bloomberg; authors' calculations.

As an alternative measure of market sentiment and global risk aversion we used the difference between the yield to maturity on high-grade European non-financial corporate bonds (AAA) and the yield to maturity on comparable generic German government bonds.

We also used the ECB reference rate as an indicator of general financing conditions. Ebner (2009) emphasizes that a rate hike increases investors' risk aversion, and therefore reduces exposure to riskier markets, thereby widening government bond spreads for such countries. A higher reference rate could also reduce the ability of debtor countries to service their external debt, thereby widening the bond spreads.

Table 1 summarizes basic descriptive statistics for the variables used in the regressions. Before conducting the regression we checked the stationarity of all variables, and the series were differenced where needed. GDP and current account balances were seasonally adjusted, as in some countries they exhibit strong seasonal patterns.

TABLE 1
Descriptive statistics

	Quarterly change in spread	Annual GDP growth rate (percentage points)	Annual CPI growth rate (percentage points)	Current account balance (% of GDP)	Quarterly change in share of external debt in GDP	Change in share of international reserves in GDP	Quartely change in share of gen. gov. debt in GDP	Quarterly change in real exchange rate indeks	Quartely change in VDAX	Change in ECB rate
Mean	-0.32	3.74	5.58	-4.75	1.42	0.18	0.09	0.63	-0.17	-0.06
Median	-2.40	4.40	4.00	-4.09	1.00	0.05	-0.10	0.74	-1.14	0.00
Maximum	539.28	13.40	49.00	7.15	20.53	16.14	10.30	8.91	32.24	0.75
Minimum	-253.37	-15.90	-1.30	-23.93	-6.94	-9.46	-8.30	-14.76	-13.79	-1.75
Std. Dev.	66.42	3.69	6.53	5.58	3.25	2.04	1.99	3.15	7.91	0.41
Observations	294	336	344	344	228	296	317	336	336	336

Source: Authors' calculations.

5 ESTIMATION AND RESULTS

According to the above considerations, we estimated the following equation:

$$\Delta spread_{i,t} = \alpha_i + \sum_j \beta_{j1} M_{j(i,t)} + \sum_j \beta_{j2} S_{j(i,t)} + \beta_3 E_{i,t} + \sum_j \beta_{j4} R_{jt} + u_{i,t}$$

where the residuals are represented by an AR(1) process:

$$u_{i,t} = \rho\, u_{i,t-1} + e_{i,t}$$

where $M_{j(i,t)}$ is a matrix with macroeconomic indicators j in rows and values for country i at time t in columns; $S_{j(i,t)}$ is the equivalent matrix of solvency and sovereign risk indicators; $E_{i,t}$ is the EU convergence dummy for country i at time t; and $R_{j,t}$ is a vector of market sentiment indicators (the VDAX index, corporate spread or the crisis dummy).

Because of the relatively short time series and missing observations at the beginning of the sample, we estimated this data panel with ordinary least squares and included country fixed effects α_i, which should account for all unobserved country heterogeneity. This is a common approach to explaining the determinants of spreads in cross-country studies (see Özatay et al., 2009, and references therein). However, the chi-square test showed that the fixed effects were redundant. This is theoretically plausible because we are estimating determinants of spreads, so one would think that investors would react similarly to changes in fundamentals in

each country, although the country-specific spread might be different and influenced by many variables.

Considering the nature of our data, errors among the countries (cross sections) could be correlated, implying that large errors for one country will often be associated with large errors for another country in quarter *t*, for example, when during the crisis all spreads increase simultaneously. To account for this estimation problem we used robust standard errors suggested by Beck and Katz (1995) that account for cross-sectional correlation and heteroskedasticity.[3]

An additional problem with our model is serial correlation of the residuals (within cross-section), which makes least squares estimates biased. Hence, similarly to Obstfeld and Taylor (2003) we included an AR(1) specification for the residuals, which proved adequate according to the autocorrelation tests for residuals.

Table 2 shows the estimation results for several specifications in order to assess the robustness of results. Four specifications differ in the variable used as a proxy for the global financial market conditions and the use of interaction terms to describe a non-linear link between external vulnerability indicators and change in government spread. The first two specifications use the VDAX; and the third and fourth use the spread on European non-financial corporate bonds.

Estimation results broadly confirm the postulated relationships between various explanatory variables and the sovereign bond spreads.

Table 2
Estimation results

Eq Name:	**Specification**			
	1	**2**	**3**	**4**
Dep. Var:	**Change in government spreads**			
Constant	-7,119	-5,654	4,476	8,275
	[7.50]	[6.59]	[6.59]	[5.45]
GDP growth	-4,599	-5,107	-5,24	-5,904
	[2.08]*	[1.93]**	[1.83]**	[1.65]**
CPI growth	3,41	3,878	0,527	0,476
	[1.71]*	[1.46]**	[1.49]	[1.28]

[3] Using Monte Carlo studies, Beck and Katz (1995) showed that applying the OLS to panel data and correcting the errors for cross-sectional correlation and heteroskedasticity produces more efficient results than using feasible generalized least squares, which might lead to overconfidence by producing artificially low standard errors.

Current account balance (% of GDP)	-0,649		-0,663	
	[0.73]		[0.60]	
Change in share of external debt in GDP	-0,586		-0,232	
	[1.33]		[1.08]	
Change in share of international reserves in GDP	-8,549	-7,105	-6,809	-4,502
	[2.25]**	[1.91]**	[2.25]**	[1.93]*
Change in share of gen. gov. debt in GDP	2,852		4,071	
	[2.56]		[2.42]	
Change in real exchange rate index	1,211	-0,121	2,43	1,045
	[1.57]	[1.46]	[1.38]	[1.28]
EU dummy	-2,885	2,949	-8,229	1,48
	[12.78]	[11.44]	[10.94]	[9.32]
Change in VDAX	3,753	1,641		
	[0.57]**	[0.61]**		
Change in ECB rate	-34,332	-27,979	-1,141	0,904
	[13.89]*	[12.94]*	[12.81]	[11.09]
Δ(VDAX)×(share of CAB in GDP)		-0,314		
		[0.08]**		
Δ(VDAX)×(change in gen. gov. debt in GDP)		0,37		
		[0.15]*		
Δ(VDAX)×(change in ext. debt in GDP)		0,313		
		[0.11]**		
Change in corporate spreads (ΔCorp)			1,035	0,618
			[0.11]**	[0.11]**
ΔCorp×(share of CAB in GDP)				-0,056
				[0.01]**
ΔCorp×(change in gen. gov. debt in GDP)				0,065
				[0.02]**
ΔCorp×(change in ext. debt in GDP)				0,067
				[0.02]**
Observations	193	193	193	193
R-squared	0,55	0,60	0,64	0,69

Standard errors are in parentheses.
** Indicates 5% significance level; ** indicates 1% significance level.*

Source: Authors' calculations.

Based on Specification 2, a 1 percentage point higher GDP growth rate lowers spreads on average by 5 basis points. A 1 percentage point higher inflation widens the spreads on average by 4 basis points. Reserves held by the central bank are also important; increasing reserves by 1 percentage point of GDP decreases spreads on average by 7 basis points. Thus, it seems that markets indeed rewarded growing economies in which inflation is under control with lower sovereign bond spreads.

In contrast to the results of Luengnaruemitchai and Schadler (2007) our estimates of the EU dummy are statistically insignificant in all specifications. This suggests that the EU accession process had no noticeable impact on changes in government bond spreads of CEE countries. Also, somewhat surprisingly, the change of real effective exchange rate exerts no significant influence on the spreads.

With the exception of changes in reserves to GDP, our regression results suggest that external vulnerability indicators have not been significant determinants of sovereign bond spreads. However, as the interaction terms show, in crisis periods the current account balance, changes in external and in government debt become statistically significant in explaining the spreads. If VDAX jumps by 10 percentage points and if the share of general government debt in GDP increases by 5 percentage points the model suggests that spreads on average increase by 19 basis points (estimates from specification 2).

Variations in the VDAX index and corporate bond spreads have a strong influence on the dynamics of sovereign bond spreads even without interaction terms. Changes in spreads can be attributed to a large extent to changes in this variable – on average a 1 percentage point increase in the VDAX widens the spreads by 4 basis points (specification 1) and a 1 basis point increase in average corporate spread in the Euro area increases government spread on average by 1 basis point (specification 3).

Results are broadly stable across all specifications and there is no significant difference in magnitude or significance of the estimated coefficients, except for the change in ECB rate, which is significant in specifications 1 and 2 but not in specifications 3 and 4. We believe that the specifications 2 and 4 (with interaction terms) explain the real data generating process better, due to the non-linear effects captured by the interaction terms. R-squared statistics are broadly similar across specifications but it should be noted that the specifications with interaction terms explain more variation of the dependent variable in the sample used in this research.

For a better comparison of the quantitative impact of four groups of variables on spread changes, tables 3 and 4 show the contributions of statistically significant variables to the modelled spread changes in two periods, using specification 4. Table 3 shows the main drivers of the spread changes between Q1:2007 and

Q3:2008. In this period, GDP for the economies in our sample was still expanding, and one could expect that the main determinant of the widening of spreads was instability in the global financial market, where turbulence started in August 2007. The results in table 3 confirm this, as macroeconomic factors still contributed to spread compression, but the spreads widened due to worsening in market sentiment and also due to the rise in the European corporate spreads and markets' concern about external vulnerabilities and the government fiscal stance.

Table 3

Contributions to the modelled spread changes from Q1:2007 to Q3:2008 (bps)

Macroeconomic factors	-105
External vulnerability & government finance indicators	11
European corporate spreads	71
Modelled spread change	77
Actuall spread change	58

Source: Authors' calculations.

Table 4 shows the main drivers of the spread changes from the third quarter of 2008 to the second quarter of 2009. In terms of contributions to modelled spreads, in this period, contrary to the previous period, macroeconomic fundamentals contributed to spread expansion as recession worsened the macroeconomic fundamentals. On the positive side, the contracting economy also lowered external vulnerabilities (current account deficits). Borrowing costs for European firms were very high after the markets froze when Lehman Brothers went in to Chapter 11 in September 2008, but as the panic abated the borrowing costs decreased, which decreased spreads directly and through interaction terms (specification 4). Unlike in the previous period when spreads increased due to financial market-related variables (European corporate spreads) and external vulnerabilities in this period the spreads increased due to worsening fundamentals while the above two factors contributed to the spread compression in the period from Q3:2008 to Q1:2009.

Table 4

Contributions to modelled spread changes from Q3:2008 to Q2:2009 (bps)

Macroeconomic factors	76
External vulnerability & government finance indicators	-79
European corporate spreads	-62
Modelled spread change	-65
Actuall spread change	-18

Source: Authors' calculations.

In summary, after a period of optimism marked by the emphasis on the positive aspects of the convergence process in emerging Europe, the tide turned in late 2008 and investors' attention turned towards imbalances that were built up before the crisis. For instance, the IMF GFSR (October 2007) identified macroeconomic vulnerabilities in a number of emerging European countries that could lead to a cut-off in external financing in the event of a deterioration in the external environment. By their nature, macroeconomic indicators are less volatile than financial variables and, as expected, have a smaller impact on short-term changes in yield spreads. For example, a GDP growth of 2.3 per cent (one sample standard deviation) would lower the spreads on average roughly by 14 basis points in the studied period. On the other hand, increase in European corporate spreads by 70 basis points (one sample standard deviation) increases the spreads on average by 43 basis points, which is three times more. After the initial increase in spreads for European emerging economies caused by the market turmoil, the worsening macroeconomic indicators contributed significantly to higher spreads in the latter period, when the impact of market turmoil slowly started abating.

5 CONCLUSION

The main conclusion of this research is that spread changes for bonds issued by selected emerging countries from Central and Eastern Europe are affected by both market sentiment and macroeconomic fundamentals. In the same time, external imbalances were not shown to have any significant effect on spreads prior to the crisis, but became increasingly significant as the crisis broke out. Somewhat surprisingly, the EU and eurozone convergence process turned out not to be a significant determinant of spread movements.

The influence of variables that proxy financial market sentiment is particularly important for the explanation of sudden moves in spreads in the short run, as the financial market environment can change abruptly. Therefore, it could be concluded that deterioration in the global financial market might negatively affect even countries with sound macroeconomic indicators and prudent fiscal policy, meaning that factors that domestic policymakers cannot affect could result in a significant increase in the cost of external financing.

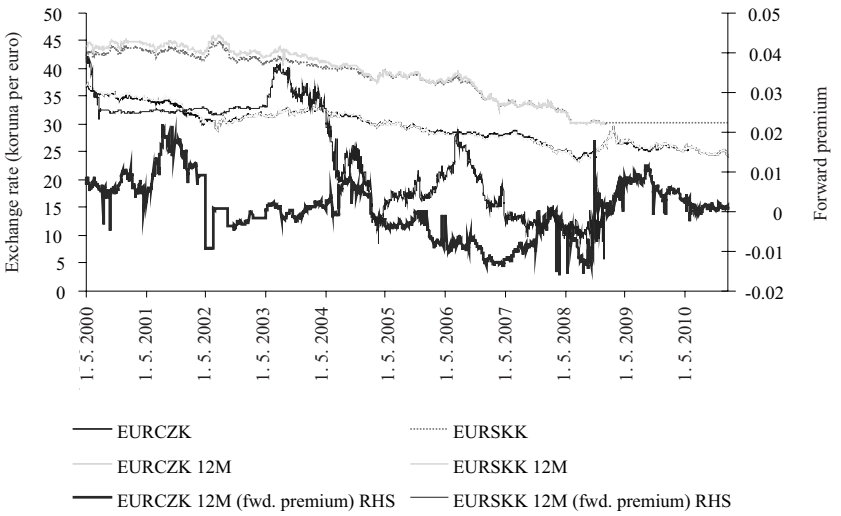
The results presented in this paper also imply that there was a significant non-linear link between external imbalances and increases in spreads in the observed countries. The countries that had higher external deficits experienced much larger increases in their spreads. It seems there was a tendency among investors to group countries of similar characteristics from the same geographical region before the crisis, but this effect vanished during the crisis, as the focus of international investors and analysts shifted from the benefits of the convergence process to the external vulnerabilities of individual countries. This means that the countries with high external vulnerabilities (including Bulgaria, Croatia, Hungary, Lithuania and Romania) enjoyed an extended period of favourable borrowing terms, which qui-

ckly reversed after the crisis broke out. From the macroeconomic and financial stability perspectives, it should be noted that the period of low financing costs had contributed to the build-up of significant imbalances and misallocation of resources in some of these countries.

APPENDIX

FIGURE A1

Exchange rates and forward premia for the Czech koruna and Slovak koruna



Sources: Eurostat; Bloomberg.

TABLE A1
Data description and sources

Variable	Source	Description
Dependant variable		
Spread	Bloomberg, Eurostat.	JP Morgan Euro EMBI Global indices for all countries, except for the Czech Republic and Slovakia for which we calculated the interest rate spreads on long term government bonds used for Maastricht criteria versus German government bonds of comparable maturity. Please find more detailed explanation in the text on pages 7 and 8. Quarterly averages of daily data were used.
Group 1 – Macroeconomic indicators		
GDP	Eurostat.	Annual rate of change.
CPI	Eurostat.	Annual rate of change.
Exchange rate	BIS.	Effective exchange rate indices.
Group 2 – Sovereign and external solvency variables		
Current account balance / GDP	Eurostat.	As the data frequency is quarterly, in order to remove systematic calendar related variation associated with the time of the year, the X-11 seasonal adjustment method developed by U.S. Census Bureau was used to smooth the GDP and the current account data.
External debt / GDP	The Quarterly External Debt Database, World Bank and IMF; Eurostat.	
International reserves / GDP	Eurostat.	The level of international reserves at the end of each period was devided by GDP moving average of four past quarters.
General government debt / GDP	Eurostat.	
Group 3 – EU accession process		
EU dummy	Authors' calculation.	The EU dummy variable has a value of 1 in periods when a country is a memebr of the EU. Otherwise it is 0.

Group 4 – Global risk perception		
VDAX	Bloomberg.	The VDAX volatility index is provided by Deutsche Boerse and presents an indication of the expected volatility of the DAX stock index for the next thirty days. It is calculated by using the DAX options that are traded on the Eurex electronic trading system. Quarterly averages of daily data were used.
CRISIS	Authors' calculation.	The CRISIS variable has a value of 1 if average quarterly value of VDAX index exceeds one standard deviation above its average value marked during the whole observed period. Otherwise it is 0.
Corporate spread	Merryll Lynch, Bloomberg, authors' calculation.	The difference between yield to maturity on European non financial generic corporate bonds with maturity between 1 and 10 years and the yield to maturity on a comparable generic German government bond.

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