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REVISITING SOVEREIGN BOND SPREADS' DETERMINANTS IN THE EMU*

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Abstract

We study the determinants of 10-year sovereign bond yield spreads of 11 EMU member states, covering the lifetime of the euro, up until the end of 2014. Panel and SUR analyses coupled with qualitative variables show that the pricing of European debt has not been static across time and EMU countries, and market participants became increasingly aware of macro-economic and fiscal fundamentals.

JEL classification: C23; E43; G12; H60; E62
Keywords: Sovereign bond spreads; panel data; EMU

* The opinions expressed herein are those of the authors and do not necessarily reflect those of their employers. Any remaining errors are the authors' sole responsibility.

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1. Introduction

There are several questions fitting to this introduction: how is sovereign debt priced, and why is it relevant to engage in such a study, notably in the context of the European Economic and Monetary Union (EMU)? In fact, it is important to understand how sovereign bonds are priced in the secondary market – hence above the first question.

The existing literature puts forward a number of plausible determinants of sovereign bond yields that are used by market participants – institutional investors as insurance companies and banks – and individual investors. Such indicators relate to a country´s macroeconomic and fiscal performance, but also to other reasons that might weight in on an investor´s mind just as much, which are country-specific unrelated.

Moreover, the EMU is a group of countries that have a political project of shared sovereignty, including a common currency. Indeed, since the foundation of the Euro in January 1999 up until the global credit crunch in August 2007, investors have not differentiated much between EMU member states' sovereign bonds. However, from the later part of 2007 onwards, the spread from an EMU member state 10-year maturity bond *vis-à-vis* the "virtually risk free" counterpart *Bund* started to increase. This increase varied from country to country. In practice, it has been argued investors started to question member states commitment to the political project and to soundness of their fiscal developments.

Therefore, in this paper we study a group of indicators as possible determinants of bond spreads, between 1999 and 2014, using a quarterly data set, for 11 members of the euro. Germany 10-year bonds are the benchmark for the spread. Our analysis aims at trying to understand if market participants have in fact regarded the EMU as a block or not, before and during the 2008-2009 economic and financial turmoil. It was also factored into the present analysis the widely discussed concepts of "core" and "peripheral" countries. The testable hypothesis is whether market participants have considered the EMU either a cohesive set of countries or as 11 distinctive ones.

The remainder of the paper is as follows. Section two reviews the related literature. Section present the methodology used in our analysis. Section four discusses the estimation results and section five concludes.

2. Literature

Arghyrou and Kontonikas (2011), through an OLS-HAC methodology, model 10-year bond yield spreads, vis-à-vis Germany, on three types of variables: credit risk, liquidity risk and common international risk factor (S&P 500 implied stock market volatility index, VIX).

It is noteworthy here because it divides analysis covers the time interval between January 1999 and February 2010 (monthly data), including three intra-interval analyses: before the Global Credit Crunch (up until August 2007), from November 2007 to February 2009 and from March 2009 until the end of the time frame. It included 10 EMU countries. Throughout these 3 sub-samples there were shifts in the expectations of market participants.

Giordano et al. (2012), study the period 2002:01-2012:05 for 10 EMU countries, and present an aggregate analysis that finds statistical significance for the primary budget balance-to-GDP ratio.

For Kilponenm et al. (2012) there is a different interpretation for the VIX indicator, it does not translate general risk appetite as much as the riskiness of the stock market. As investor restlessness increases in the stock market (corporate bonds included), sovereign bonds are perceived as a "less risky choice".

Afonso and Rault (2015) used a SUR methodology to assess the determinants of real long-run interest rates, in the period 1973-2008, with yearly data for 17 OECD economies. The authors report that for 11 countries increases in their respective debt-to-GDP ratios raise their respective real long-term interest rates. Such increases ranged from 6 to over 100 basis points (b.p.). Also, an improvement in the current account meant a reduction in interest rates for 10 economies. When the debt level is replaced by the budget balance-to-GDP ratio, this flow variable comes out performing just as well as its corresponding stock variable, reducing interest rates between 9 and almost 80 b.p. Increased sovereign liquidity was found to reduce the cost of debt servicing in diverse economies such as France, Luxembourg and Portugal.

Finally, Afonso et al. (2014), use a 2SLS panel fixed effects approach, between January 1999 and November 2010 (monthly data). They use dummy variables to allow for different time periods analysis. Among the results, the debt-to-GDP ratio (differential against Germany) doubled its effect on spreads between roughly the first decade of the euro (prior to August 2007) and the European Debt Crisis (in this sample between March 2009 and November 2010). The liquidity variable was only significant after March 2009, it being ignored by markets before that. Additionally, the VIX, despite not being significant before the Global Credit Crunch (August 2007), became increasingly relevant and went on to have a far bigger say on the spread evolution when the Sovereign Debt Crisis was in place (from March 2009 onwards).

3. Methodology

3.1. Spread determinants

This study focuses on the determinants of sovereign 10-year bond yield spreads of 11 EMU countries, *vis-à-vis* Germany´s. We model the spreads on a diversified group of variables: credit, liquidity and international risk. According to Aßmann and Boysen-Hogrefe (2009), the pricing of 10-year bonds in the Euro area relative to German bond yields reflects "traders' beliefs about default and liquidity risks rather directly". The cross-sections (*i*) are: Austria, Belgium, Finland, France, Greece, Italy, Ireland, Luxembourg, the Netherlands, Portugal and Spain. The frequency of the data is quarterly and it ranges from 1999 to 2014. There are some data shortages across the time-series and on both ends of the time frame, which are assessed for robustness by excluding Greece (see data sample in Table A1 in the Appendix).

The use of the 1^{st} and 2^{nd} lags of the spreads are meant to account for persistence, in other words how much do past spreads affect current spreads. Not including them will generate omitted variable bias. In turn, lagged spreads are correlated with the country fixed effects. However, this effect will be mitigated once the size of the panel time-series reaches 20 time series observations, which and we have (T = 4 quarters x 15 years = 60 observations). Therefore, there is a net benefit from using lags in the specification (Afonso et al., 2014).

Alternatively, monthly data would have contributed better for a higher time dimension, notwithstanding, monthly data for fiscal fundamentals is unavailable. In addition, Giordano et al. (2012) argue that it may take some time before the change in a macro variable impacts the sovereign default risk, hence a second reason why the lagged spreads for t-2 should be included. There was also a marginal benefit from adding the second period lagged spreads, as it was noted it improved significantly the Durbin-Watson statistic in our analysis.

The variation of the debt ratio is also an important indicator of a country's fiscal sustainability. In fact, rising fiscal unsustainability will tend to raise sovereign default risk and prompt a surge in sovereign risk premium.

On the other hand, the overall and the primary budget balance-to-GDP ratios are also interesting to include. Indeed, it might be useful to consider both variables to understand if investors look solely at the budget balance or more at the primary budget balance instead, discarding interests on debt. The latter measure allows assessing the budgetary performance of the government without being clouded by the payments on government debt, which tend to be mostly predetermined.

The GDP growth rate is an important indicator because a fall of the GDP growth rate will lower tax revenues in the future and in turn that will impact a country´s solvency Also, when its rate is subtracted to the yield of sovereign bonds it is an indicator of debt sustainability. If that difference is negative then public finances are on an unsustainable path (see, for instance, Afonso and Jalles, 2014).

The current account balance-to-GDP is a measure of how a country is positioned internationally, in terms of its net exports. According to Alexopoulou et al. (2009), as an economy becomes more reliant on capital inflows, it becomes more vulnerable to reversals in international flows of funding. In addition, the degree of openness (O) of the economy, computed as follows, $O = \frac{X+I}{GDP}$, represents the ability to generate the trade surpluses to secure present debt refinancing.

The use of the real effective exchange rate (REER) as a determinant is deemed fundamental because it is an indicator of a country's competitiveness (Giordano et al. 2012). An increase in domestic prices relative to Euro Area 18 trade partners´ internal prices will harm foreign competitiveness. Therefore, it allows assessing if bond investors price loss of competitiveness, as an appreciation of the REER deteriorates the terms of trade and yield spreads are expected to increase.

Inflation is also a relevant determinant since higher inflation reduces the real value of debt while subtracting to the nominal yield. It can also flag macroeconomic stability, and higher inflation may imply higher sovereign risk (Afonso and Rault (2015)).

Regarding our liquidity measure it is computed as the share of a given country´s outstanding debt in the pool of debt of the 11 EMU countries: w= $\frac{\text{outstanding amount of Central Government debt of country } i}{\sum_1^{11} \text{outstanding amount of Central Government debt of country } i}$. The more liquid is a given sovereign bond, the easier it is to sell it at any point in time.

As already seen, international risk aversion can be proxied by the VIX, aiming at capturing spread movements outside a country´s intervention area: credit risk and liquidity risk.

Table 1 shows a summary for the sign of the expected coefficients of each sovereign yield spread determinant.

[Table 1]

3.2. Panel Two Stage Least Squares

The use of 2SLS addresses to some extent the endogeneity problem, since, in our case, while fiscal developments may imping on sovereign spreads, the spreads will also have an impact of fiscal variables. For instance, and more specifically, not only the variation of the debt-to-GDP ratio influences the sovereign yield spread, but also spread behaviour might have influence on the debt-to-GDP ratio, and the same is true notably for market liquidity.

We carry out a dynamic panel analysis with the general baseline model specification as follows:

(1) $S_{it} = cons + \beta_1 \hat{S}_{it-1} + \beta_2 \hat{S}_{it-2} + \beta_3 \widehat{\Delta D}_{it} + \beta_4 \hat{G}_{it} + \beta_5 \hat{E}_{it} + \beta_6 \hat{O}_{it} + \beta_7 \hat{W}_{it} + \beta_8 \hat{H}_{it} + \beta_9 \hat{C}_{it}$

$+ \beta_{10} \hat{V}_t + \gamma_i + \varepsilon_{it}$, where

γ_I are the country fixed effects and ε_{it}, are the normally distributed error terms.

The set of exogenous independent variables $\{\hat{S}_{it-1}, \ldots, \hat{V}_t\}$ stand for the proxy variables of the endogenous independent variables $\{S_{it-1}, \ldots, V_t\}$. Such proxies are generated in the first stage of the 2SLS method. In it, we are to find an instrument variable Z_{it} that influences the endogenous regressor $\{S_{it-1}, \ldots, V_t\}$ but that S_{it} does not have influence over Z_{it}. The new estimates for $\{S_{it-1}, \ldots, V_t\}$ include the instrument variable Z_{it} and the exogenous variables from the regression above, for instance, taking the variation of the debt ratio:

(2) $\widehat{\Delta D}_{it} = \widehat{cons} + \hat{\beta}_1 S_{it-1} + \hat{\beta}_2 S_{it-2} + \hat{\beta}_3 Z_{it} + \hat{\beta}_4 G_{it} + \hat{\beta}_5 E_{it} + \hat{\beta}_6 O_{it} + \hat{\beta}_7 W_{it} + \hat{\beta}_8 H_{it} + \hat{\beta}_9 C_{it} + \hat{\beta}_{10} V_t + \nu_{it}$,

where Z_{it} is the 1-period lag of ΔD_{it}. While the 1-period lag of ΔD_{it} still has influence over S_{it}, S_{it} has no influence over the 1-period lag of ΔD_{it}. This process is replicated for all the other variables $\{S_{it-1}, \ldots, V_t \setminus \Delta D_{it}\}$, Z_{it} being the 1-period lag of each one of said variables. The second stage of the 2SLS is then to insert equation (2) back in equation (1).

Another relevant hypothesis for the analysis is the different behaviour of two groups of countries: core and peripheral EMU countries. These are two separate regressions – one bears dummy U_i and the other one takes on dummy Q_i, in order to avoid the dummy variable trap. Perfect multicollinearity occurs because dummies were defined for each category: albeit

U_i and Q_i are two separate qualitative variables, they are also the categories for each one of them. Since we aim at looking at both core and peripheral countries, both U_i and Q_i are relevant and as a result that leaves us to run two separate regressions to escape the trap. It is most worthy to determine if the countries within each group were looked upon by market participants similarly. These two groups were taken from Afonso et al. (2014): the core countries are Austria, Belgium, Finland, France, Luxemburg and the Netherlands and the peripheral countries are Greece, Italy, Ireland, Portugal and Spain.

Secondly, alternatively we also use time dummies to partition the time frame in three different time periods. This is to check if the determinants influencing spreads have shifted according to the following time periods: roughly the first decade of the Euro (1999:Q1-2007:Q2, dummy $Z01_t$), the Global Credit Crunch (2007:Q3-2009:Q1, dummy $Z02_t$) and the European Sovereign Debt Crisis (2009:Q2-2014:Q4, dummy $Z03_t$).

Again, we have 3 qualitative variables that share the same categories ($Z01_t$, $Z02_t$ and $Z03_t$), so in order to escape the dummy variable trap, either we estimate one less regression than the number of categories (2 regressions, 1 including 2 dummies), or we estimate one regression per dummy. We chose to do the later.

Thirdly, we analyse which determinants are affecting bond yield spreads for each group of countries, one sub-period at a time. Specification (3) below is an example of a baseline model including two qualitative variables: U_i and $Z01_t$, when the fiscal variable is the budget balance-to-GDP ratio. In other words, it's a specification for the peripheral EMU during the first decade of the Euro.

$$(3)\ S_{it} = cons + \beta_1\hat{S}_{it-1} + \beta_2\hat{S}_{it-2} + \beta_3\widehat{\Delta D}_{it} + \beta_4\hat{G}_{it} + \beta_5\hat{E}_{it} + \beta_6\hat{O}_{it} + \beta_7\hat{W}_{it} + \beta_8\hat{H}_{it} + \beta_9\hat{C}_{it} +$$

$$\beta_{10}\hat{V}_t + \beta_1\hat{S}_{it-1}U_iZ01_t + \beta_2\hat{S}_{it-2}U_iZ01_t + \beta_3\widehat{\Delta D}_{it}U_iZ01_t + \beta_4\hat{G}_{it}U_iZ01_t + \beta_5\hat{E}_{it}U_iZ01_t +$$

$$\beta_6\hat{O}_{it}U_iZ01_t + \beta_7\hat{W}_{it}U_iZ01_t + \beta_8\hat{H}_{it}U_iZ01_t + \beta_9\hat{C}_{it}U_iZ01_t + \beta_{10}\hat{V}_tU_iZ01_t + \gamma_i + \varepsilon_{it}$$

3.3. Seemingly Unrelated Regressions

The presence of cross-section dependency renders the OLS estimator inefficient and biased, making its estimates poor candidates for inference. Therefore SUR techniques can alleviate this problem, as long as the time series dimension is substantially larger than the number of cross-sections (Afonso and Rault, 2015), which is our case (T = 60 and N = 11). We will assume that both the dependant variable and the regressors may differ between

equations but that contemporary correlation exists between the residuals of all equations. This model single specification's is as follows:

$$(4)\ S_{it} = cons + \beta_1 S_{it-1} + \beta_2 S_{it-2} + \beta_3 \Delta D_{it} + \beta_4 G_{it} + \beta_5 E_{it} + \beta_6 O_{it} + \beta_7 W_{it} + \beta_8 H_{it} + \beta_9 C_{it} + \beta_{10} V_t$$

This model covers the entire time span. Although this allows for interesting results, it would have been interesting to carry out separate SUR systems for the time sub periods employed here. However, the quarterly frequency of the data of our study did not allow for that.

4. Empirical Analysis

4.1. Data

Table A2 in the Appendix explains the variables and respective source. Appendix Table A3 gives information on the stationarity of the variables, and it was possible to reject the null hypothesis that stationarity was not present, for the overall majority of the variables. An alternative would be to use the variables that had failed the test in 1st differences or even to calculate all variables as differentials against Germany´s data. The only variable that was transformed was the variation of the debt-level (originally the debt-to-GDP ratio) because it was the only stock variable in our set of variables.

It should be mentioned that for the dependent variable it was not possible to reject H_0 at a 10% level. The variable did pass this test when the test was run for the variable´s first differences. However, regressions containing spreads data in first differences did not yield good R2 statistics: either negative or unusually low statistics. We provide in Table 3 an example of the regression results in first differences. Additionally, Table A4 in the Appendix shows the results for the presence of co-integration among the 11 EMU countries used in our study.

Figure 1 shows the evolution of the 10-year bond yield spreads for the set of countries in our study. The first vertical line marks a turning point in the EMU: it was between the 2nd and 3rd quarters of 2007 that the Eurozone ceased to enjoy significant homogeneity among its member states' spreads against the benchmark, the 10-year German *Bund*. This development was due to the Global Credit Crunch that had begun in August that year with the burst of the housing bubble in the US and bad news from BNP Paribas. The second vertical line marks

March 2009 and the European Sovereign Debt Crisis, amid fears for Greek public finances, as well as for other European peripheral countries. Such fears were confirmed later in October 2009 as Greece announced a 12.5% budget deficit.

[Figure 1]

Figure 2 presents another version of Figure 1, now grouping Core EMU countries and the Peripheral EMU ones. One can see very clearly the two moments when peripheral EMU spreads jump, the first corresponding to the Global Credit Crunch and the second one owed to the Sovereign Debt Crisis. Bond market participants' called on the EMU countries for a premium on their debt was not unjustified, considering investors were uneasy about where to park their money (from 2Q2007 onwards). The increase in international risk perception also rose around those periods (Figure 3).

[Figure 2]

[Figure 3]

Also, the Eurozone, on aggregate terms, on average, ran budget deficits during the first decade of the Euro (Table 2), although i did present primary budget surpluses during that same time (Table A5 in the Appendix).

[Table 2]

Such a scenario has direct impact on their borrowing capacity. In addition, looking at the differential between GDP growth rate and the 10-year bond yields, a crucial measure regarding the sustainability of public finances, this differential was mostly negative for the 11 EMU countries' average (Figure 4). Moreover, Figure 5 shows a significant gap between the cost of debt and economic growth, yet a decreasing one for the 11 countries average, for the first decade.

[Figure 4]

[Figure 5]

In practice, the perceived risk associated in sovereign bonds relative to the safe haven of Germany increased during the global economic downturn. Taking a look at Table 2, core countries had run significant trade surpluses, while peripheral ones had run trade deficits.

Also, at the end of the first decade of the Euro, peripheral countries were already in violation of the Maastricht Criteria, while Core ones where not.

Therefore, from the Global Credit Crunch onwards spread pricing was more markedly on a "country-by-country basis". According to Arghyrou and Kontonikas (2011), little after the beginning of the European Sovereign Debt Crisis, Greece was [the first country] transferred from a regime under which there was the perception of fully guaranteed fiscal liabilities to a regime "without" fiscal guarantees. It should be said though, that bond market participants did not proceed to differentiate among the two different types of countries from the onset of the Global Credit Crunch. From Table 2, sovereign yields were only twice higher during this period, compared to 8 times higher during the Sovereign Debt Crisis.

4.2. Discussion of Estimated Results

Panel Two Stage Least Squares

Table 3 shows the results for the baseline model where the variation of the debt-to-GDP ratio, the government balance and the government primary balance interchanges.

[Table 3]

Specification (3) includes the primary balance, which is not statistically significant (also the case excluding Greece). The variation of the debt-to-GDP ratio estimate in (1) is statistically significant: if it increases by 10 p.p. the spread of the 11 EMU countries will increase by 0.14 p.p., on average, *ceteris paribus*. Specification (2) uses the budget balance ratio as the fiscal variable, and it has a greater impact on the spread than the variation of the debt level: for an increase of 10 p.p. in the budget balance ratio, i.e. an increase in the current fiscal surplus, the spreads are expected to decrease close to 0.4 p.p.

Looking at the baseline regressions, and fiscal variables aside, apart from the inflation rate, the REER and the current account balance, the other variables were not statistically significant.

The use of the interaction dummy Z01 does not provide additional relevant results (Annex Table A6), and one may conclude that market participants were not pricing any of the determinants during the first decade of the EMU. Other than this, neither the baseline nor the robust regressions carrying either the budget balance or the primary budget balance were insightful. The results for Z02 and Z03 were equally barren. This points out for yet again no active linkages between the determinants and spreads, when considering the aggregate analysis, between the 3rd quarter of 2007 and the 1st quarter of 2009 and 2nd quarter 2009 and 4th quarter of 2014, respectively.

Table 4 shows the relevant results from the dummies introduced for the Core and Peripheral groups.

[Table 4]

Looking at (1), a 10 p.p. budget balance increase relief spreads by approximately half a p.p. for the aggregate group. If considering the Core group exclusively, when said budget balance increase takes place, the spreads essentially remain unchanged, albeit with an overall small decrease, revealing that the improvement effect form the budget balance on spreads is stemming from the periphery countries. In (2), the only difference is the budget balance is replaced by the variation of the debt-to-GDP-ratio. When looking at the aggregate group, spreads increase by roughly a quarter of a p.p. when there is a variation of 1 p.p. of the debt-to-GDP ratio. So a fiscal deterioration from the point of view of the variation of debt is less impactful than from the budget balance standpoint. If considering Core countries only again, the overall effect on the spreads is virtually zero, and the previous conclusion for the budget balance still holds here. In (3) and (4) one can find more or less the same results, but less pronounced, as Greece is excluded here.

An important conclusion to take from Table 3 results is the following way: while a fiscal deterioration at the 11 EMU level worsens the spreads, Core countries' spreads seem to react less and the effect is more via the periphery country group. This is a reasonable result given that Core countries have hardly exceeded Maastricht Criteria limits throughout the lifetime of the Euro, even during the European Sovereign Debt Crisis.

Regarding the combination of dummies U and Q with the dummies Z01, Z02 and Z03, they will allow for the most drill down in this study. Before any financial turmoil, there is no evidence for the Core countries of bond market participants concern for pricing spreads. Regarding the same period, for the Peripheral group, Table 5 regression (1) shows there is once again evidence of an increase in the variation of the debt levels leading to a decrease in spreads.

[Table 5]

This is evidence in favour of the "Convergence Trade Hypothesis" with investors buying sovereign bonds of peripheral EU countries in the hope that their yields would converge with those of Germany's. It would also seem markets were not pricing correctly the worsening of EMU Peripheral´s fiscal position

For the period between August 2007 and March 2009 there was a global contraction in credit. The combination of dummies described above will test if that affected in any way the spreads any side of the EMU, or both (Table 5). For the Core of the Eurozone not much is

statistically significant As far as the Peripheral EMU countries, the outcome of the baseline regressions was equally uneventful. Once Greece is excluded, several coefficients become statistically significant (at least those from variables G_{it}, E_{it} and C_{it}). This leads one to think Greece´s debt was priced differently and separately from Southern Europe's and Ireland´s for the better part of the Global Credit Crunch.

Moreover, still in Table 5, we can see that increases in the GDP growth rate and the Real Effective Exchange rate were welcomed by investors, especially the former: a 1 p.p. increase would bring about a spread reduction of the same order of magnitude. Moreover, market participants seemed to have regarded trade surpluses in an even more favourable light: an increase in the Current Account-to-GDP ratio would have reduced spreads in these 4 countries 1 ¼ times that surplus increase. Lastly, it should be noted spreads here suffered too from international markets volatility: 1 p.p. increase in the VIX increased spreads by almost a quarter of a p.p.

Table 6 shows the results for the Peripheral EMU taking into account the period comprising the Sovereign Debt Crisis until 2014. In both regressions 1 and 2 good fiscal performance (B_{it} and D_{it}) and Economic growth (G_{it}) impact positively on EMU´s peripheral countries and therefore help explain EMU peripheral spreads developments after 2009:Q1. Inflation increase aggravates spreads: this is expected, since investors will demand a higher nominal yield as higher inflation reduces real return on sovereign bonds. Running trade surpluses has also been priced by investors. Despite of this, a higher degree of economic openness and higher market liquidity seem to aggravate spreads, as its coefficients are statistically significant. In this case the VIX estimated coefficient can be considered if one interprets VIX as a measure of stock markets volatility and bond markets a safe haven.

[Table 6]

From regressions (3) and (4) there is some evidence of market different pricing treatment for Greece that had been found during the Global Credit Crunch somewhat changed, judging by the statistical significance of some variables' coefficients.

Seemingly Unrelated Regressions

The SUR exercise presents further evidence that Greece has been perceived by markets differently from the rest of the EMU Periphery. Recalling Figure 1, it can be seen that Greece was the EMU member state which saw its spreads peak the most. Additionally, the second country to have its spreads peak the highest was Portugal, although only around half of Greece's.

Firstly, in Table 8 A, yield spreads in Greece are influenced by developments in the Real Effective Exchange rate, while from looking at Table 5 (3) the average of the EMU Periphery (Greece excluded) had its spreads influenced by developments in the Current Account, on average. Albeit arguments for the strong correlation between terms of trade and net exports, namely a real depreciation of the Real Effective Exchange rate leading to an improvement in the Current Account, there is little evidence supporting that (Chinn and Lee, 2006).

[Table 8 A]

Secondly, Table 8 A points to markets having priced sovereign debt according to the specific member state. When exploring this SUR system, investors priced the sovereign debt of Austria, Belgium, Finland, France, Luxemburg and the Netherlands after international markets volatility, but so too those of Italy´s and Portugal´s. However this is not evidence contrary to country-specific pricing, as the VIX does not reflect country-specific data. Furthermore, comparing Table 4 (2) and Table A7, other than investor fear (VIX) and spreads persistence (S_{it-1}), neither the Core group nor the EMU Periphery share, in a consistent manner, any of the determinants.

Thirdly, the fact that VIX was reported to have taken a toll on some country´s spreads and not on others, relates to the intuition of the VIX by Attinasi et al. (2010): in times of heightened uncertainty it could be higher for some euro area countries than for others.

Table 8 B resembles the SUR analysis above with a slight difference: data for the three interest rate spreads variables is in first differences. Just as in the two stage least squares first difference exercise, it bears no fruits: R^2 stats are about half of those displayed in table 8 A.

5. Conclusion

We have conducted Panel and SUR analyses to attempt to unveil meaningful determinants of 10-year Sovereign Bond yield spreads for 11 EMU member states, between 1999 and 2014, using quarterly data.

According to our results, there is evidence that most yield spread determinants were not being priced before August 2007. Also, Greece was priced differently from the remainder of the EMU periphery during the Global Credit Crunch. Furthermore, good fiscal performance and economic growth are favourably taken into account.

We have also found that, on average, for the full sample, a 10 p.p. increase in the budget balance, decreased yield spreads by nearly half a p.p. In addition, there is some

evidence that capital markets did not regard the primary fiscal balance in their pricing of sovereign debt and there was strong evidence for the "Convergence Trade Hypothesis".

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Table 1: The expected sign of regressors' estimates

Variable classification	Spreads´ persistence		Credit Risk								Liquidity Risk	International Risk
			Fiscal and Macroeconomic Fundamentals									
			Fiscal Position			Economic Activity		External Competitiveness				
Independent Variable	S_{it-1}	S_{it-2}	ΔD_{it}	B_{it}	P_{it}	G_{it}	H_{it}	O_{it}	C_{it}	E_{it}	W_{it}	V_t
Expected influence on the Dependent Variable	+	+	+	–	–	–	+	–	–	+	–	+/-

Table 2

Time period	11 EMU average	EMU Core average	EMU Peripheral average	AT	BE	FI	FR	GR	IE	IT	LU	NL	PT	SP
Budget balance-to-GDP ratio (%)														
Z01	-1.32	-0.35	-2.48	-2.61	-0.66	3.80	-2.49	-6.59	1.19	-3.02	0.55	-0.69	-4.54	0.57
Z02	-1.39	0.57	-3.74	-1.58	-0.41	4.76	-2.86	-8.50	-3.31	-2.42	3.50	0.03	-3.46	-1.01
Z03	-5.62	-3.02	-8.74	-3.05	-3.97	-2.11	-5.39	-10.47	-13.29	-3.64	0.21	-3.84	-7.42	-8.88
Current Account balance-to-GDP ratio (%)														
Z01	0.15	4.26	-4.71	1.13	3.32	5.73	0.85	-7.19	-1.37	-0.94	10.42	4.97	-9.00	-5.06
Z02	-2.37	2.79	-8.56	4.35	-1.08	2.34	-1.63	-14.17	-5.26	-2.72	8.62	4.16	-11.78	-8.88
Z03	0.17	2.36	-2.32	2.30	-0.69	-0.23	-1.53	-5.44	2.37	-1.21	6.01	8.29	-5.03	-2.29
Debt-to-GDP ratio (%)														
Z01	62	56	70	70	105	40	62	104	31	105	6	50	59	50
Z02	61	53	70	68	91	33	67	107	34	102	10	47	70	37
Z03	88	68	113	81	104	50	87	154	102	121	21	63	112	74
10-year bond yield spreads averages (p.p.)														
Z01	0.14	0.05	0.25	0.14	0.18	0.13	0.08	0.54	0.12	0.26	-0.34	0.08	0.20	0.14
Z02	0.51	0.39	0.67	0.40	0.44	0.32	0.26	0.94	0.70	0.70	0.64	0.26	0.58	0.41
Z03	2.35	0.54	4.52	0.57	0.98	0.34	0.62	9.74	3.39	2.31	0.39	0.36	4.74	2.39

Table 3: Spreads are modelled on the variables below. Baseline model: Specifications (1), (2) and (3).

	(1)	(2)	(3)	(1) First differences	(2) First differences	(3) First differences
cons	-1.865643	-4.344690***	-4.614988	-0.161284	-0.983513	-0.315657
S_{t-1}	1.317044***	1.284170***	1.372468***	1.242710***	1.252734***	1.199932***
S_{t-2}	-0.411749***	-0.384024***	-0.470422***	-0.558390***	-0.568151***	-0.549492***
ΔD_{it}	0.013521***			0.007550*		0.041004
B_{it}		-0.040137***			-0.004972	
P_{it}			-0.110926			
G_{it}	-0.021272	-0.014027	0.022319	0.003262	-0.001022	-0.025853
E_{it}	0.014868	0.039209***	0.044372	0.001219	0.009356	0.001420
O_{it}	0.168992	0.060548	-0.108775	-0.096716	-0.127121	0.021224
W_{it}	2.818663	2.315382	0.671531	2.116434	2.693363	4.283015
H_{it}	0.053360**	0.068247***	0.173396	0.022732	0.012122	-0.046942
C_{it}	-0.017373	-0.010885	0.029010	-0.030312*	-0.027540*	-0.044002
V_t	-0.005141	-0.000824	-0.004750	-0.006135	-0.005355	-0.005448
Adj. R^2	0.96	0.96	0.93	0.19	0.18	0.09

2SLS country fixed effects; [1999:Q1,2014:Q4]; N=11; The instruments are the 1 period lag of each regressor; The asterisks *** ** * indicate significance at the 1, 5 and 10 % level, respectively

Table 4: Spreads are modelled on the variables below. Baseline model: Specifications (1) budget balance and (2) variation of debt-to-GDP ratio; Robustness model: (3) budget balance and (4) variation of debt-to-GDP ratio (all 4 with Core dummy)

	(1)	(2)	(3)	(4)
cons	-2.984464	-1.523978	-2.456973**	-0.534712
S_{t-1}	1.146400***	1.236449***	1.235260***	1.420487***
S_{t-2}	-0.249062***	-0.325590***	-0.329997***	-0.481583***
ΔD_{it}		0.024338***		0.005548*
B_{it}	-0.057904***		-0.052458***	
G_{it}	-0.082201**	-0.056373*	0.015566	-0.013093
E_{it}	0.038585	0.006427	0.033200*	-0.009725
O_{it}	1.619883**	1.841730**	1.571242***	1.354823**
W_{it}	3.323186	3.392205	-1.084854	1.899561
H_{it}	0.142776***	0.108729***	0.088898***	0.014972
C_{it}	-0.065245**	-0.060331**	-0.020791	-0.041762**
V_t	-0.013387	-0.007777	0.007408	-0.001511
$S_{t-1}*Q$	0.018957	-0.222860	-0.069903	-0.406898
$S_{t-2}*Q$	-0.065040	0.162310	0.015895	0.318303
$\Delta D_{it}*Q$		-0.024533***		-0.005744
$B_{it}*Q$	0.052894**		0.047449***	
$G_{it}*Q$	0.088785**	0.061268	-0.008983	0.017988
$E_{it}*Q$	-0.037712	-0.008327	-0.032327	0.007825
$O_{it}*Q$	-1.206312	-1.409949	-1.157671**	-0.923041
$W_{it}*Q$	-2.557601	-2.714275	1.850440	-1.221631
$H_{it}*Q$	-0.123188**	-0.087857	-0.069309**	0.005900
$C_{it}*Q$	0.066602*	0.064604	0.022147	0.046036*
V_t*Q	0.019426	0.014627	-0.001369	0.008362
Adj. R^2	0.96	0.96	0.97	0.96

2SLS country fixed effects; [1999:Q1,2014:Q4]; N=11 (1) (2) and N=10 (3) (4); Robustness model excludes Greece; The instruments are the 1 period lag of each regressor; Core countries are AT, BE, FI, FR, LU, NL; The asterisks *** ** * indicate significance at the 1, 5 and 10 % level, respectively

Table 5: Spreads are modelled on the variables below. (1) Baseline regression with Peripheral and Z01 time period dummies, (2) robustness regression with Peripheral and Z02 time period dummies and (3) robustness model with Periphery dummy

(1)		(2)		(3)	
cons	-2.289558	*cons*	-0.155451	*cons*	-0.534712
S_{t-1}	1.296397***	S_{t-1}	1.537574***	S_{t-1}	1.013589*
S_{t-2}	-0.399164***	S_{t-2}	-0.621817***	S_{t-2}	-0.163280
ΔD_{it}	0.019819***	ΔD_{it}	0.000710	ΔD_{it}	-0.000195
G_{it}	-0.013105	G_{it}	0.000140	G_{it}	0.004895
E_{it}	0.020433	E_{it}	-0.004641	E_{it}	-0.001900
O_{it}	-0.026571	O_{it}	0.384714	O_{it}	0.431782
W_{it}	4.067818	W_{it}	3.005238	W_{it}	0.677930
H_{it}	0.081054***	H_{it}	-0.007196	H_{it}	0.020872
C_{it}	-0.024360	C_{it}	0.001929	C_{it}	0.004274
V_t	-0.008536	V_t	-0.001318	V_t	0.006851
S_{t-1}*Z01*U	0.087544	S_{t-1}*Z02*U	13.70126**	S_{t-1}*U	0.406898
S_{t-2}*Z01*U	-0.096729	S_{t-2}*Z02*U	-49.11148**	S_{t-2}*U	-0.318303
ΔD_{it}*Z01*U	-0.021651*	ΔD_{it}*Z02*U	-0.232250	ΔD_{it}*U	0.005744
G_{it}*Z01*U	0.044163	G_{it}*Z02*U	-0.972949*	G_{it}*U	-0.017988
E_{it}*Z01*U	0.010037	E_{it}*Z02*U	-0.199957**	E_{it}*U	-0.007825
O_{it}*Z01*U	-0.895988	O_{it}*Z02*U	6.784358*	O_{it}*U	0.923041
W_{it}*Z01*U	-1.833715	W_{it}*Z02*U	39.22786**	W_{it}*U	1.221631
H_{it}*Z01*U	0.025776	H_{it}*Z02*U	0.625533	H_{it}*U	-0.005900
C_{it}*Z01*U	0.091987	C_{it}*Z02*U	-1.263334*	C_{it}*U	-0.046036*
V_t*Z01*U	-0.007329	V_t*Z02*U	0.229739**	V_t*U	-0.008362
Adj. R^2	0.96	Adj. R^2	0.84	Adj. R^2	0.96

2SLS country fixed effects; [1999:Q1,2014:Q4]; (1) N=11 (2) (3) N=10; Robustness model excludes Greece; The instruments are the 1 period lag of each regressor; (1) Peripheral countries are GR, IE, IT, PT, SP; (2) (3) Peripheral countries are IR, IT, PT, SP; Z01 refers to [1999:Q1,2007:Q2]; Z02 refers to [2007:Q3,2009:Q1]; The asterisks *** ** * indicate significance at the 1, 5 and 10 % level, respectively; *Spreads data in first differences

Table 7: Spreads are modelled on the variables below. Baseline regressions: Budget balance-to-GDP ratio (1) and variation of Debt-to-GDP ratio (2); Robustness regressions: budget balance-to-GDP ratio (3) and variation of debt-to-GDP ratio (4) (all with Peripheral and Z03 period time dummies)

	(1)	(2)	(3)	(4)
cons	-0.687812	-2.660050	1.412162	0.216366
S_{t-1}	1.252531	0.619842	1.830739**	1.375919*
S_{t-2}	-0.454030	0.054169	-0.849597	-0.492770
ΔD_{it}		-0.000631		1.38E-05
B_{it}	-0.021737		-0.008931	
G_{it}	0.008026	0.001245	-0.006963	-0.006081
E_{it}	-0.000419	0.015321	-0.013651	-0.003430
O_{it}	0.689706	0.845293	0.215782	0.330612
W_{it}	-2.065902	0.268965	-2.624219	-2.627262
H_{it}	-0.013279	-0.031277	-0.003093	-0.007993
C_{it}	0.008214	0.002520	0.011167	0.002919
V_t	0.012072	0.017549	0.000727	0.004858
S_{t-1}*Z03*U	-0.224219	0.712194	-0.794983	-0.031196
S_{t-2}*Z03*U	0.310555	-0.409158	0.595797	-0.101792
B_{it}*Z03*U	-0.078555**		-0.099604***	
ΔD_{it}*Z03*U		0.108495***		0.068770***
G_{it}*Z03*U	-0.146132**	0.014012	-0.146146***	-0.062601
E_{it}*Z03*U	-0.004873	-0.007457	-0.000532	0.009921*
O_{it}*Z03*U	1.916469***	1.688171***	1.544498***	1.492657***
W_{it}*Z03*U	4.772986**	6.054893***	3.031950*	1.855615
H_{it}*Z03*U	0.234121***	0.105142	0.396092***	0.297292***
C_{it}*Z03*U	-0.303332***	-0.280956***	-0.236141***	-0.195211***
V_t*Z03*U	-0.163528***	-0.165575***	-0.149576***	-0.163790***
Adj. R^2	0.94	0.94	0.92	0.93

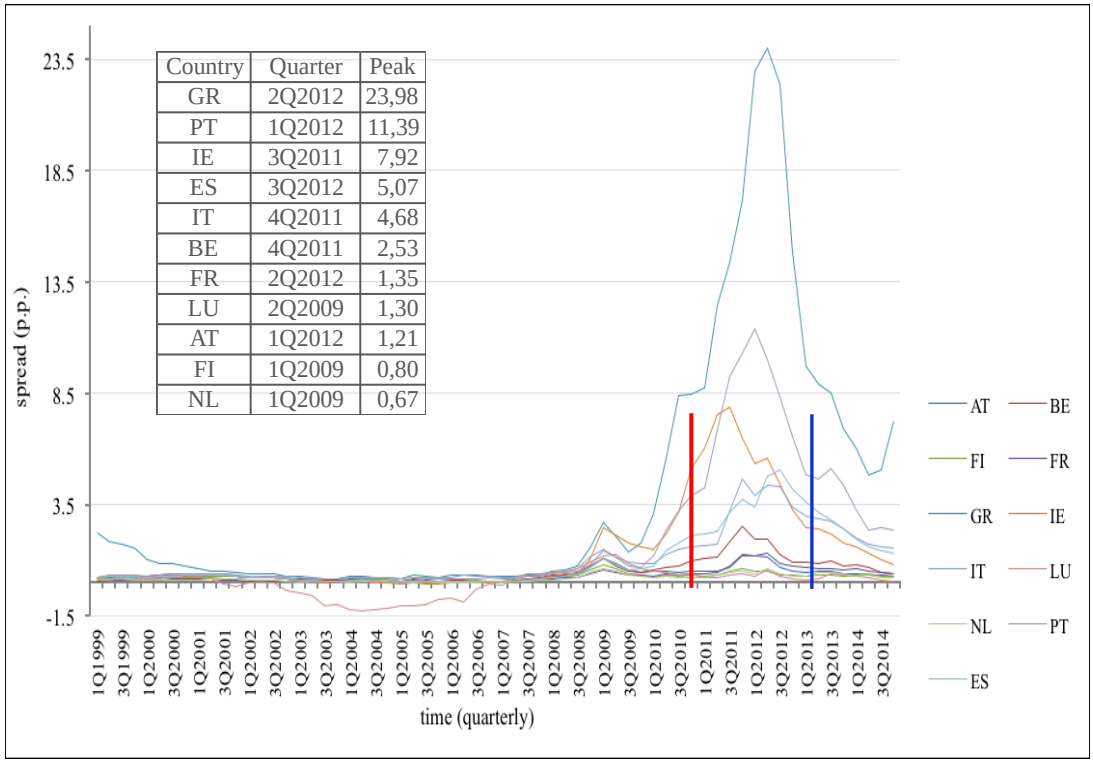
2SLS country fixed effects; [1999:Q1,2014:Q4]; N=11 (1) (2) and N = 10 (3) and (4); Robustness model excludes Greece; The instruments are the 1 period lag of each regressor; Peripheral countries are GR, IE, IT, PT, SP; Z03 refers to [2009:Q2,2014:Q4]; The asterisks *** ** * indicate significance at the 1, 5 and 10 % level, respectively; *Spreads data in first differences

Table 8: Spreads are modelled on the variables below.

8 A	AT	BE	SP	FI	FR	GR	IE	IT	LU	NL	PT
cons	-1.694739	-3.424466	-2.554782	-1.409619	-2.189952	-64.96017	1.013107	-7.655407*	-2.090313	1.126169	-25.25026***
S_{t-1}	0.995861***	0.749869***	1.285301***	0.697034***	0.906117***	1.138763***	1.267278***	0.925645***	0.831098***	0.494870***	0.882952***
S_{t-2}	-0.319275***	-0.088249	-0.411632***	-0.164952**	-0.106720	-0.420023***	-0.582214***	-0.123502*	-0.015645	-0.205082**	0.015152
ΔD_{it}	0.001887	0.000126	0.001195	0.001376	0.001175	-0.046910	0.053097***	0.001579	0.020353	0.005380*	0.131032***
G_{it}	-0.007936	0.019091*	-0.008379	-0.003913	0.002116	-0.172096	0.024134	0.029333*	0.013172	-0.021971**	0.175817***
E_{it}	0.012398	0.041962*	0.023829	0.008964	0.012827	0.628377*	-0.023342	0.082418**	0.007880	-0.017124*	0.224087**
O_{it}	0.825459***	-0.077102	-1.227905	0.594572***	1.194636	4.915476	0.531278	1.651760	0.406269	0.473247***	4.106234
W_{it}	-10.67342	-10.85707**	5.864837	0.131776	0.749594	-41.77323	31.94280	-5.014964*	-222.6310**	0.314294	-61.05920
H_{it}	0.007531	0.016184	0.043672	0.001847	0.000558	-0.257724	0.134564**	0.069479*	-0.038410	0.017097***	0.092946
C_{it}	-0.001312	-0.004785	-0.017423	-0.002471	-0.008506	-0.127133	0.016938	0.022126	-0.002539	-0.001305	-0.043129
V_t	0.008337***	0.011994***	0.007042	0.007115***	0.006143***	-0.000151	-0.005211	0.021094***	0.007700*	0.003562**	0.035628***
R^2	0.91	0.90	0.95	0.88	0.91	0.95	0.98	0.95	0.94	0.88	0.97
8 B - Spreads data in first differences											
cons	2.390599	2.963004	3.864691	-0.919743	2.638869	3.294443	-26.54247***	-0.860533	-5.921267*	-0.976995	-5.384966
S_{t-1}	0.277909***	-0.013545	0.280171***	-0.108519	0.051087	0.650882***	0.314384***	0.122546	0.063049	-0.131914	0.610137***
S_{t-2}	-0.350616***	-0.270132***	-0.106984	-0.236920***	0.025043	-0.256436	-0.201030*	-0.356050***	-0.155516	-0.279542***	-0.239020**
ΔD_{it}	0.011516	-0.000336	-0.080922***	0.006597	0.001900	-0.072656	-0.064839***	-0.039018	0.033978	0.007259	-0.128477***
G_{it}	0.003026	0.017631	0.069605	0.001737	0.013387	-0.105451	0.017452	0.030443*	0.002188	0.001946	0.008320
E_{it}	-0.024667	-0.021055	-0.048686	3.79E-05	-0.025452	-0.054018	0.260585***	0.015481	0.069486	0.005067	0.029830
O_{it}	0.141871	-0.274232	0.581609	0.788837***	-0.697769	0.489294	0.273901	-0.537820	-0.302401	0.244621**	2.774613
W_{it}	-5.044381	-10.05571*	-0.924797	12.98040*	0.473001	8.725218	17.34853	-3.300572	-210.9775*	1.435451	-42.98122
H_{it}	0.014140	0.035246**	0.024979	-0.011996	0.012840	0.177302	0.020254	0.108145***	-0.012168	0.002159	0.084818*
C_{it}	-0.000963	0.003026	-0.045383*	-0.003744	-0.012649	-0.053562	0.079018**	-0.014540	-0.003988	-0.002428	-0.063088*
V_t	0.006392***	0.011120***	0.009595	0.005919***	0.005089***	-0.007909	-0.003537	0.018363***	-0.001898	0.004374***	0.009430
R^2	0.47	0.27	0.33	0.34	0.21	0.54	0.56	0.39	0.14	0.28	0.63

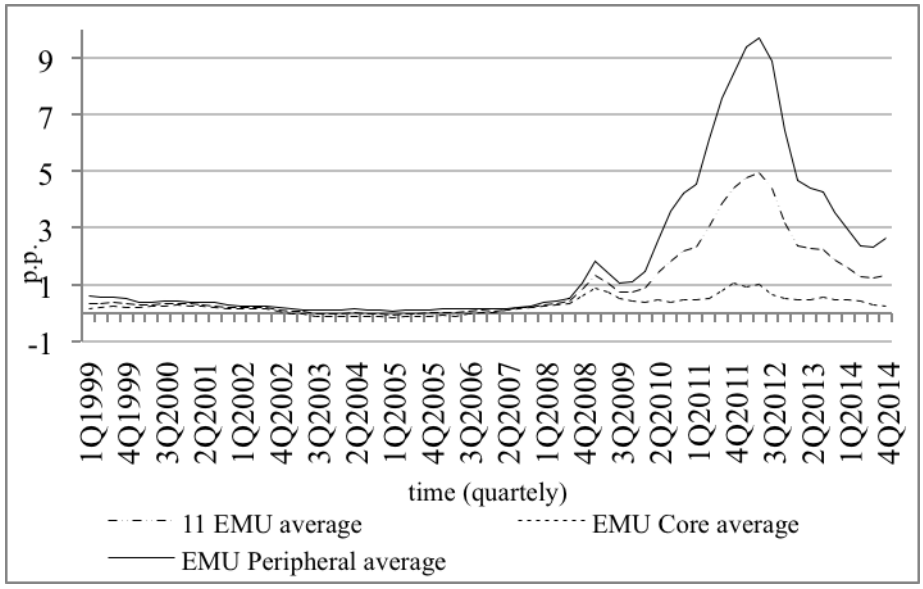
Seemingly Unrelated Regressions system of equations; [1999:Q1,2014:Q4]; N=11; The variation of the debt-to-GDP ratio is the fiscal performance variable; Table 12 A uses level data for the spreads, while 12 B uses first differences data; The asterisks *** ** * indicate significance at the 1, 5 and 10 % level, respectively

Figure 1: 11 EMU 10-year bond yield spreads *vis-à-vis* Germany´s



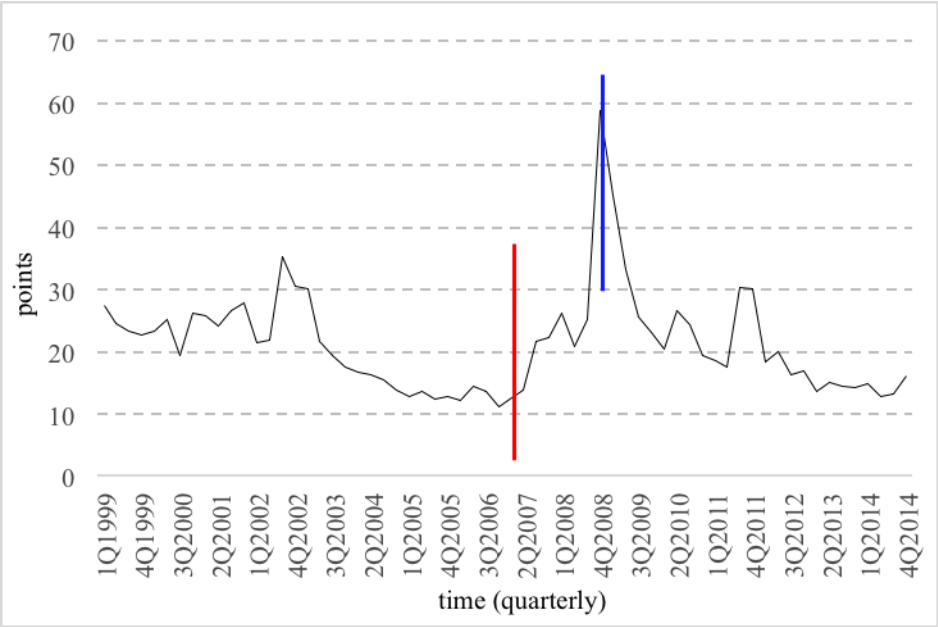
Note: the in-figure table (top-right corner) displays the peak for each time series and the time at which it peaked (e.g.: Portugal´s spread vis-à-vis Germany´s peaked in the 2nd quarter of 2012 at 11,39 p.p.

Figure 2: EMU 10-year bond yield spreads vis-à-vis Germany´s



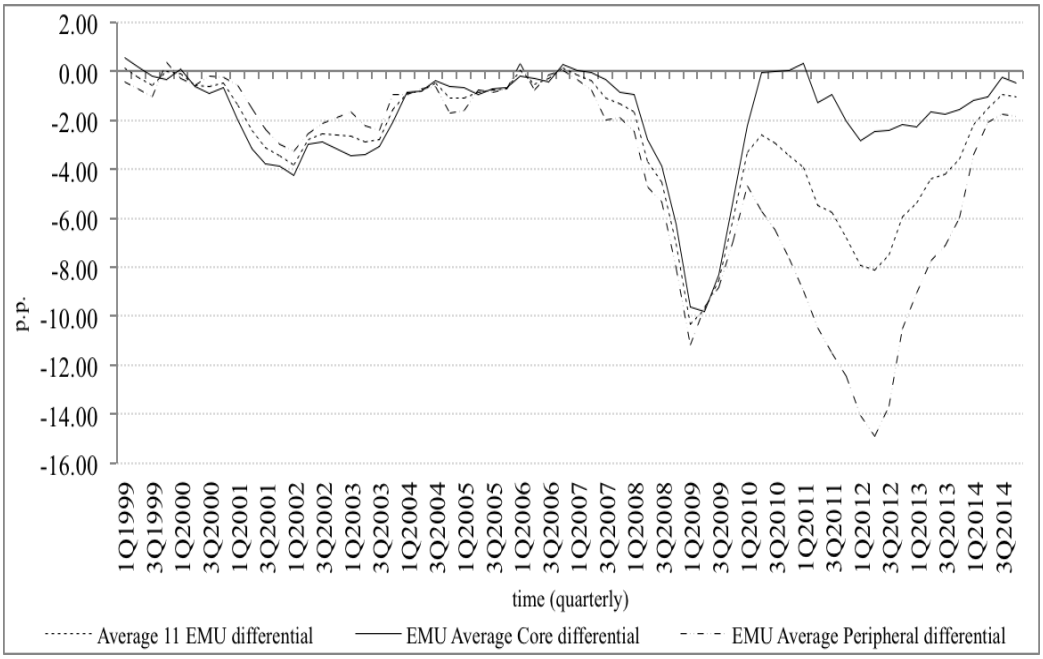
Note: Core countries are AT, BE, FI, FR, LU, NL and Peripheral countries are GR, IE, IT, PT, SP.

Figure 3: CBOE VIX



Note: CBOE VIX stands for Chicago Board Options Exchange Volatolity Index, "to reflect investors' consensus view of future expected stock market volatility"; The first vertical line marks 2007:Q2, roughly the first decade of the euro, and the onset of the Global Credit Crunch. The second vertical line marks 2009:Q1, which stands for the beginning of the European Sovereign Debt Crisis.

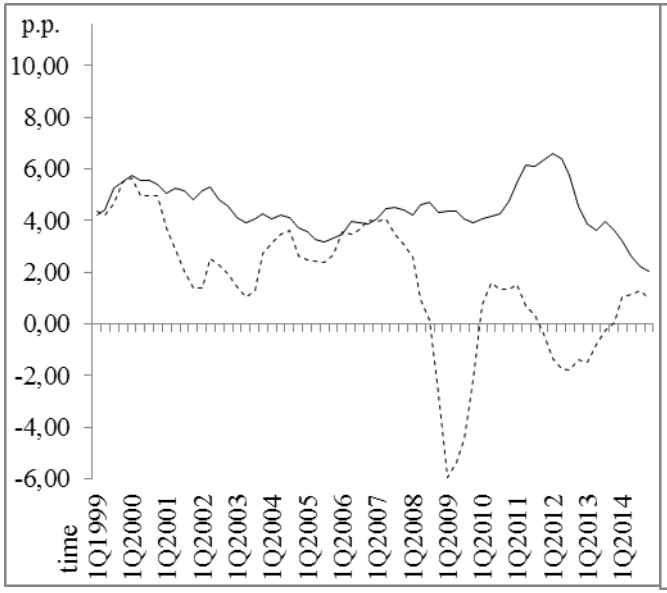
Figure 4: Differential between GDP growth rate and 10-year bond Yield



Note: The differential is computed as the difference between the GDP growth rate minus the 10-year bond yield, for the 11 EMU countries, EMU Core countries and EMU Periphery countries, separately. Core countries are AT, BE, FI, FR, LU and NL. Peripheral countries are GR, IT, IE, PT, SP.

Figure 5: Average GDP growth rate and average 10-year bond yield for 11 EMU, Core EMU and Peripheral EMU countries

5a



Average 11 EMU 10-year bond yields (full line). Average 11 EMU GDP growth rate (dashed line). 11 EMU countries are AT, BE, FI, FR, GR, IE, IT, LU, NL, PT, SP.

5b

EMU average Core 10-year bond yields (full line). EMU average Core GDP growth rate (dashed line). Core countries are AT, BE, FI, FR, LU, NL

5c

EMU average Peripheral 10-year bond yields (full line). EMU average Peripheral GDP growth rate (dashed line). Peripheral countries are GR, IE, IT, PT, SP.

Appendix

Table A1: Data shortages time intervals

Cross-sections / Time-series	AT	BE	GR	IE	IT	FI	FR	LU	NL	PT	SP
S_{it}											
S_{it-1}	(1Q1999)										
S_{it-2}	[1Q1999,2Q1999]										
ΔD_{it}	[1Q1999,4Q2000]		[1Q1999,4Q2006]	[1Q1999,4Q2000]		[1Q1999,4Q2000]		[1Q1999,3Q2001] ∪ (4Q2014)	[1Q1999,4Q2000]		
B_{it}	[3Q2002,1Q1999]		[1Q1999,3Q2006]	[1Q1999,3Q2002]	[1Q1999,3Q1999]			[1Q1999,3Q2002] ∪ (4Q2014)	[1Q1999,3Q1999]		[1Q1999,3Q2002]
P_{it}	[1Q1999,4Q2001]		[1Q1999,4Q2005]	[1Q1999,4Q2001]				[1Q1999,4Q2001] ∪ (4Q2014)			[1Q1999,4Q2001]
G_{it}											
E_{it}											
O_{it}											
W_{it}											
H_{it}											
C_{it}	[2Q2014,4Q2014]		[3Q2014,4Q2014]			[2Q2014,4Q2014]		[1Q1999,4Q1999] ∪ [2Q2014,4Q2014]	[2Q2014,4Q2014]		[3Q2014,4Q2014]
V_t											

Time intervals refer to missing data periods for the corresponding variable and country; The grey coloured area indicates no data is missing for the entire time frame ([1999:Q1,2014:Q4])

Table A2: Variable definition and sources

Variables		Original frequency	Source	Specifications
Full name	Short name			
10 year bond yield spread vis-à-vis Germany	S_{it}	Monthly	ECB	Long-term [nominal] interest rate for convergence purposes; Debt security issued; 10 years maturity; Own calculations: average of monthly rates
Lagged spreads	S_{it-1} or S_{it-2}	Monthly	ECB	Same period, 1 or 2 years lagged
Variation of Government Debt-to-GDP ratio	ΔD_{it}	Quarterly	ECB	Same quarter of previous year; End of period data.
Government Budget Balance-to-GDP ratio	B_{it}	Quarterly	ECB	Summed through period
Government Primary Budget Balance-to-GDP ratio	P_{it}	Quarterly	ECB	
Nominal GDP growth rate	G_{it}	Quarterly	OECD	Same quarter previous year; seasonally adjusted
Real Effective Exchange Rate	E_{it}	Monthly	DG ECFIN	Base year: 2005; REER vs. EA 18; HCPI deflator; Own calculations: average of monthly rates
Openness Index	O_{it}	Quarterly	OECD	Own calculations
Share of outstanding debt	W_{it}	Monthly	ECB	Outstanding amounts of securities other than shares, excluding financial derivatives; Central government; End of period; Own calculations: average of monthly shares
Inflation	H_{it}	Monthly	Eurostat	Annual rate of change; Base year: 2005; All-Items HICP; Own calculations: average of monthly rates
Current Account Balance-to-GDP ratio	C_{it}	Quarterly	OECD	
VIX	V_t	Daily	CBOE	Own calculations: quarterly averages from daily prices
Geography qualitative variables	U_i (peripheral)	1 if country $i \in$ {GR, IE, IT, PT, SP}, 0 otherwise		
	Q_i (core)	1 if country $i \in$ {AT, BE, FI, FR, LU, NL}, 0 otherwise		
Time qualitative variables	$Z01_t$	1 if $t \in$ [1999:Q1,2007:Q2], 0 otherwise		
	$Z02_t$	1 if $t \in$ [2007:Q3,2009:Q1], 0 otherwise		
	$Z03_t$	1 if $t \in$ [2009:Q2,2014:Q4], 0 otherwise		

Table A3: Fisher-Augmented Dickey-Fuller (ADF) for Individual Unit Root

Variable	Probability	H_0
Sit	0.12	Not rejected
ΔDit	0.00	Rejected
Bit	0.51	Not rejected
Pit	0.57	Not rejected
Git	0.00	Rejected
Eit	0.01	Rejected
Oit	0.01	Rejected
Wit	0.63	Rejected
Hit	0.00	Rejected
Cit	0.00	Rejected
Vt	0.00	Rejected

Model of the Fisher-ADF test is Trend and Intercept; Schwarz Criterion for number of lags; H_0: Variable is not stationary is rejected at a 10% level. H_1: Not H_0

Table A4: Kao Residual Cointegration Test

Variable	Probability	H_0
Sit	0.02	Rejected
ΔDit		
Bit		
Pit		
Git		
Eit		
Oit		
Wit		
Hit		
Cit		
Vt		

Trend assumption: No deterministic trend; Schwarz Criterion for number of lags; H_0: No cointegration is rejected at a 5% level. H_1: Not H_0

Table A5: Primary budget balance-to-GDP ratio (%)

Time period	EMU avg	EMU Core avg	EMU non-core avg	AT	BE	FI	FR	GR	IE	IT	LU	NL	PT	ES
Z01	1,67	2,41	0,79	0,65	4,51	5,94	0,13	-1,61	2,17	2,26	1,26	1,98	-1,48	2,59
Z02	0,14	1,88	-1,96	0,87	1,71	4,76	-1,23	-5,10	-4,19	1,49	3,29	1,90	-1,21	-0,81
Z03	-2,57	-1,04	-4,41	-0,24	-0,48	-1,06	-2,73	-4,77	-9,41	1,23	0,51	-2,25	-2,97	-6,15

Table A6: Spreads are modelled on the variables below. Baseline regression (1) and Robustness regression (2), in period Z01

	(1)	(2)
cons	-8.710510	-0.352593
S_{t-1}	1.361706***	1.339922***
S_{t-2}	-0.443593***	-0.486935***
ΔD_{it}	0.074035***	0.034906***
G_{it}	0.031477	0.013876
E_{it}	0.048993	-0.007123
O_{it}	2.482409	0.891948
W_{it}	3.236360	-0.909502
H_{it}	0.086006	0.082944*
C_{it}	-0.023611	-0.007104
V_t	0.008311	-0.001129
S_{t-1}*Z01*	-10.40794	-2.541023
S_{t-2}*Z01*	9.735352	2.608559
ΔD_{it}*Z01*	-0.078082***	-0.035860***
G_{it}*Z01*	0.118714	0.014754
E_{it}*Z01*	-0.001144	0.000568
O_{it}*Z01*	0.258837	0.023953
W_{it}*Z01*	0.207287	-0.013595
H_{it}*Z01*	-0.072740	-0.059984
C_{it}*Z01*	-0.001413	0.031235*
V_t*Z01*	0.011976	-0.000131
Adj. R^2	0.93	0.96

2SLS country fixed effects; [1999:Q1,2014:Q4]; N=11 (1) and N=10 (2); Robustness model excludes Greece; The instruments are the 1 period lag of each regressor; Z01 refers to [1999:Q1,2007:Q2]; The asterisks *** ** * indicate significance at the 1, 5 and 10 % level, respectively.

Table A7: Spreads are modelled on the variables below. Robustness model with Periphery dummy

	(1)
cons	-0.534712
S_{t-1}	1.013589*
S_{t-2}	-0.163280
ΔD_{it}	-0.000195
G_{it}	0.004895
E_{it}	-0.001900
O_{it}	0.431782
W_{it}	0.677930
H_{it}	0.020872
C_{it}	0.004274
V_t	0.006851
$S_{t-1}*U$	0.406898
$S_{t-2}*U$	-0.318303
$\Delta D_{it}*U$	0.005744
$G_{it}*U$	-0.017988
$E_{it}*U$	-0.007825
$O_{it}*U$	0.923041
$W_{it}*U$	1.221631
$H_{it}*U$	-0.005900
$C_{it}*U$	-0.046036*
V_t*U	-0.008362
Adj. R^2	0.96

2SLS country fixed effects; [1999:Q1,2014:Q4]; N=10; Robustness model excludes Greece; The instruments are the 1 period lag of each regressor; Periphery countries are IE, IT, PT, SP; The asterisks *** ** * indicate significance at the 1, 5 and 10 % level, respectively.