AN UPDATE OF EMU SOVEREIGN YIELD SPREADS DRIVERS IN TIMES OF CRISIS: A PANEL DATA ANALYSIS*

Marta Gómez-Puig[a], Simón Sosvilla-Rivero[b], María del Carmen Ramos-Herrera[b]
[a]Department of Economic Theory, Universitat de Barcelona. 08034 Barcelona, Spain
[b]Department of Quantitative Economics, Universidad Complutense de Madrid. 28223 Madrid, Spain

February 2014

Abstract

We empirically investigate the determinants of EMU sovereign bond yield spreads with respect to the German bund. To that end, using panel data techniques, we examine the role of a wide set of potential drivers. To our knowledge, this paper presents one of the most exhaustive compilations of the variables used in the literature to study sovereign yield spreads behaviour and, in particular, to gauge the effect of changes in market sentiment and risk aversion on them. We use a sample of both central and peripheral countries from January 1999 to December 2012 and examine whether there are significant changes after the outbreak of the euro area debt crisis. Our results suggest that sovereign risk rise in central countries can only partially be explained by the evolution of local macroeconomic variables in those countries. Besides, with not a single one exception, the marginal effects of sovereign spreads drivers increase in the crisis period compared to the pre-crisis one.

Keywords: Sovereign bond spreads, Panel data, Eurozone.

JEL Classification Codes: C33, C52, E44, F36, G15

* [a]Department of Economic Theory, Universitat de Barcelona, Av. Diagonal 696, 08034 Barcelona, Spain. E-mail: marta.gomezpuig@ub.edu. [b,c] Department of Quantitative Economics, Universidad Complutense de Madrid, Campus de Somosaguas, 28223 Madrid, Spain. E-mail: madelram@ccee.ucm.es, sosvilla@ccee.ucm.es. Corresponding author: Simón Sosvilla-Rivero, Department of Quantitative Economics, Universidad Complutense de Madrid, 28223 Madrid, Spain. T: +34-913 942 342. Fax: +34- 913 942 591.

1. Introduction

The recent European sovereign debt crisis has stimulated a new interest among academics and policy makers about the drivers of sovereign risk since its identification might help to react to similar challenges in the future. Figure 1 shows that from the start of the European Economic and Monetary Union (EMU) and before the financial crisis, spreads on 10-year sovereign bond yields relative to the German benchmark moved in a narrow range with only very slight differences across countries. Nevertheless, with the financial crisis the picture completely changed and after the outbreak of the Greek sovereign debt crisis in late 2009, sovereign risk differentials experienced a sharp rise and a fluctuating behaviour[1].

Indeed, the financial crisis put the spotlight on the macroeconomic and fiscal imbalances within EMU countries which had largely been ignored during the period of stability when markets seemed to underestimate the possibility that governments might default. Some authors (see Beirne and Fratzscher, 2013, among them) present empirical evidence that show that the price of sovereign risk has been much more sensitive to fundamentals during the euro area debt crisis than in the pre-crisis period. Others highlight the importance of other macroeconomic variables, beyond the country's fiscal position, in explaining the yield spreads rise. Mody (2009) points out that the sensitivity to the financial crisis is more pronounced the greater the loss of countries' growth potential and competitiveness, whilst the IMF (2010) and Barrios *et al.* (2009) emphasize the relevance of the deterioration of the country's net position *vis-à-vis* the rest of the world and the increase in the country's private level of indebtedness. Moreover, certain authors [Bolton and Jeanne (2011) and Allen *et al.* (2011) among them] have stated that the transmission of the crisis through the banking system can be a major issue, or stressed the increased importance, after the outburst of the crisis, of uncertainty and of variables reflecting investment confidence conditions in the crisis spill over (see, e.g. Georgoustos and Migiakis, 2013). In this sense, Gómez-Puig and Sosvilla-Rivero (2014a)[2] point out that a crisis in one country may give a "wake-up call" to international investors to reassess the risks in other countries; uninformed or less informed investors may find it difficult to extract the informed signal from the falling price and follow the strategies of better informed investors, thus generating excess co-movements across the markets[3].

[1] Gruppe and Lange (2013) and Katsimi and Moutos (2010) examine the euro debt crisis from a Spanish and a Greek perspective, respectively.
[2] In this paper, the authors analyze contagion using an approach that is based on the channels of transmission that are used to spread the effects of the crisis [(Masson, 1999) and Kaminsky and Reinhart (2000) among others]. Concretely, they examine whether the transmission of the recent crisis in euro area sovereign debt markets was due to "fundamentals-based" or "pure contagion". Their results suggest the importance of both variables proxying market sentiment and macrofundamentals in determining contagion and underline the coexistence of "pure contagion" and "fundamentals-based contagion" during the recent European debt crisis.
[3] The degree of non- anticipation of a crisis by investors or sudden shifts in market confidence and expectations have been identified as important factors causing "pure contagion" (see Masson, 1999 and Mondria and Quintana-Domeque, 2013).

These events raised some important questions to be addressed for economists. What explains the disparities and shift in the pricing of sovereign debt risk during the crisis period? Have the drivers of yield spreads and their relevance changed after the crisis? Are there important differences among peripheral and central countries?

The contribution of this paper to the existing literature is threefold. The first is methodological and refers to the adoption of an eclectic approach to empirically assess, using a general-to specific modelling strategy with panel data techniques, the relevance of the highest number of variables that have been proposed in the recent theoretical and empirical literature as potential drivers of EMU sovereign bond yield spreads. To that end, we provide an updated review of the literature on the determinants of sovereign bond spreads and gather a comprehensive data base (see Section 4 and Annex A) with potential drivers including not only variables that measure macroeconomic fundamentals (both at local and regional level) and banking linkages, but also those that capture changes in market sentiment: either idiosyncratic, regional or global. To our knowledge, this paper presents one of the most exhaustive compilations of the variables used in the literature to examine sovereign yield spreads behaviour and, in particular, to gauge the effect of changes in market sentiment and risk aversion on yield spreads, whose importance has specially been stressed by the literature after the outburst of the recent debt crisis. The second contribution is related to the political relevance of the sample examined, i.e. both central (Austria, Belgium, Finland, France and The Netherlands)[4] and peripheral (Greece, Ireland, Italy, Portugal and Spain) countries from January 1999 to December 2012, which allows us to disentangle possible different behaviour among the two groups of countries within the EMU. Lastly, following the broad literature that re-emerged with the euro area sovereign debt crisis, the third contribution is related to the analysis of the time-varying pricing differences of the same spread drivers by market participants after the crisis outbreak. In the last years, many authors have focused their study on this topic using different methodologies [Gerlach *et al.* (2010), Bernoth and Erdogan (2012) or Georgoustos and Migiakis (2013) to name a few]. So, this paper aims to represent an updated analysis of sovereign yield spreads drivers in times of crisis.

The rest of the paper is organized as follows. The next section offers a literature review. The econometric methodology is explained in Section 3. The dataset used to analyze sovereign spreads determinants is described in Section 4. Section 5 presents the empirical findings, whilst Section 6 offers some concluding remarks.

2. Literature review

Euro area sovereign bond markets initially attracted the interest from academia in order to assess the impact of the EMU on the process of financial integration [see Codogno *et al.* (2003), Baele *et al.* (2004), or Gómez-Puig (2006 and

[4] This classification between EMU central and peripheral countries follows the standard division presented in the literature. However, it is worth noting that, in a very recent paper, Basse (2013) provides some evidence that might be interpreted as a sign for bond markets not believing anymore that France is belonging to this prestigious group of EMU central member states.

2008), to name a few]. In these first studies, the standard definition of sovereign risk included their two main domestic components, market liquidity and credit risk, and an international risk factor which reflected investors' risk aversion. Subsequently, some of the research focused on the analysis of the relative importance of systemic *versus* idiosyncratic risk factors in explaining yield spreads in Europe after the introduction of the common currency, even though the empirical evidence was not conclusive. Several studies [Geyer *et al.* (2004) or Pagano and Von Thadden (2004), among others] stressed the importance of systemic risk on the behaviour of yield differentials in EMU countries, while others showed that the idiosyncratic risk component in the movements of spreads became larger than the systemic one [e.g., Goméz-Puig (2009), Dötz and Fischer (2010) and Favero and Missale (2012)]. All in all, studies whose data end before the global financial crisis agree that euro area bond markets shared a high degree of financial integration (see, e.g., Abad *et al.*, 2010).

However, the sovereign debt crisis in Europe that began in late 2009 has reignited the literature on euro area sovereign spreads drivers and given an increased importance to uncertainty and variables reflecting investment confidence conditions and perceptions for the upcoming economic activity (see, e.g. Georgoustos and Migiakis, 2013). In this sense, Favero and Missale (2012) find that the credit risk component has increased in importance as a determinant of sovereign bond spreads because of the adverse market sentiment conditions after the global financial crisis, whilst Büchel (2013) provides evidence suggesting that, during the crisis, dovish official statements displayed a somewhat weaker pattern, regarding sign and significance, on bond yields spreads than hawkish ones, which might indicate an asymmetric response of the sovereign bond market to good and bad news, respectively. Similar arguments can be found in other recent studies using data that extend beyond the crisis period [see, among others, Palladini and Portes (2011) or Beirne and Fratzscher (2013)]. Besides, as it has been explained in the Introduction, many authors have stressed the importance of other fundamental variables beyond the country's fiscal position to explain yield spreads behaviour after the outbreak of the crisis [Mody (2009), Barrios *et al.* (2009), the IMF (2010), Bolton and Jeanne (2011) and Allen *et al.* (2011), to name a few]. In addition, comparing these findings to the ones with data samples ending before the crisis period provides evidence of potential in-sample changes in the specification of the spreads. So, several studies have highlighted other determinants, such as the dynamic properties of sovereign spreads over time [see, e.g., Pozzi and Wolswijk (2008), Gerlach et *al.* (2010), Aβmann and Boysen-Hogrefe (2012) and Bernoth and Erdogan (2012)].

In this framework, this paper aims to contribute to the literature by empirically assessing, by means of panel data techniques, the relevance of the highest number of variables that have been proposed in the recent theoretical and empirical literature as potential drivers of EMU sovereign bond yield spreads since the outburst of the crisis, and to

examine whether their significance has changed, not only before and during the crisis period, but also across central and peripheral countries. To that end, we provide an updated review of the literature on the determinants of sovereign bond spreads and gather a comprehensive data base with potential drivers including not only variables that measure the country's fiscal position, but also other macroeconomic fundamentals (both at the local and the regional level) along with the degree of leverage in the private sector, the impact of international banking linkages and a wide set of variables that may capture changes in market sentiment and risk aversion (either idiosyncratic, regional or global), in times of crisis. These variables are presented in Section 4, when the independent variables in our analysis are described.

3. Econometric Methodology

As mentioned in the Introduction, we adopt an eclectic approach and apply a general-to-specific modelling strategy to empirically evaluate the relevance of the highest number of variables that have been proposed in the recent theoretical and empirical literature as potential drivers of EMU sovereign bond yield spreads. To that end, a general unrestricted model is formulated to provide a congruent approximation to the "local" data generation process (namely, the joint distribution of the subset of variables under analysis), given the previous theoretical and empirical background. The empirical analysis commences from this general specification and, after testing for mis-specifications, if none are apparent, is simplified to a parsimonious, congruent representation, each simplification step being checked by diagnostic testing.

Given the relative short sample available since the introduction of the euro in 1999, we use panel data econometrics to combine the power of cross section averaging with all the subtleties of temporal dependence (see Baltagi, 2008). An analysis of the advantages and limitations of using panel data sets is presented by Hsiao (2003). The main advantages with respect to a single cross-section or time series data are the following: a) more accurate inference of model parameters, b) greater capacity for capturing the complexity of economic relationships, c) more informative results, d) allowing to controlling for individual unobserved heterogeneity, and e) simplifying computation and statistical inference. Indeed, this methodology has already been used in the literature to examine EMU sovereign spreads determinants [see, e.g. Schuknecht *et al.* (2009), Von Hagen *et al.* (2011) or Gómez-Puig (2006 and 2008)].

Our data set consists of a large number of variables that are observed on a sequence of successive moments in time forming a panel data. To estimate such panel, we consider three basic panel regression methods. The first one is the fixed-effects (FE) method based on the following regression:

$$y_{it} = \alpha_i + x_{it}^{'}\beta + \varepsilon_{it} \quad \text{for } i=1, \ldots,N, \; t=1, \ldots,T \qquad (1)$$

where x_{it} is a (k-1)x1 vector of explanatory variables that does not include a constant term, α_i are random country-specific effects, and ε_{it} are idiosyncratic errors with ε_{it} ~IID(0,σ^2). The model is based on the following assumptions about unobserved terms (α_i and ε_{it}):

- α_i is freely correlated with x_{it}
- $E(x_{it}\varepsilon_{is}) = 0$ for s=1, …,T (strict exogeneity)

Therefore, this first estimation method accounts for differences between countries and the constant terms α_i are allowed to vary among them. These constant terms stand for all unobserved aspects that distinguish the countries from each others (i. e., they capture the country heterogeneity). The model has (N+k) parameters: N for α_i, (k-1) for β, and 1 for σ^2.

The second estimation method is the random effects (RE) model and is based on the following assumptions about unobserved terms:

- α_i is uncorrelated with x_{it} : $E(x_{it}\alpha_i) = 0$
- $E(x_{it}\omega_{is}) = 0$ for s=1, …,T (strict exogeneity)

In this case, it is assumed that α_i ~IID(α, σ_α^2) and that these effects are independent of the disturbances ε_{it}. Then we can write $\alpha_i = \alpha + \eta_i$, with η_i ~IID(0, σ_α^2), and

$$y_{it} = x_{it}^{'}\beta + \omega_{it} \quad \text{for } i=1, \ldots,N,\ t=1, \ldots,T \qquad (2)$$

where $\omega_{it} = \varepsilon_{it} + \eta_i$.[5]

As in the panel model with FE, it is assumed that all country-specific characteristics are captured by the intercept parameters α_i, but in the RE specification it is assumed that the constant terms α_i consist of independent drawings from an underlying population. The above model has k regression parameters, as compared to (N+k) in the panel data model with FE. However, compared with the FE model, the disturbances ω_{it} are more complex, as (within countries) they are correlated over time.

Finally, the third method is the pooled-OLS and is based on the following assumptions about unobserved terms:

[5] Because the RE regression error in (2) has two components, one for the country and one for the regression, the RE model is often called an error components model.

- α_i is uncorrelated with x_{it} : $E(x_{it}\alpha_i) = 0$
- $E(x_{it}\varepsilon_{it}) = 0$ (x_{it} predetermined)

In this third estimation method, the data for different countries are pooled together, and the equation is estimated ordinary least squares (OLS).

In order to determine the empirical relevance of each of the potential methods for our panel data, we make use of several statistic tests. In particular, we test FE *versus* RE using Hausman test statistic to test for non-correlation between the unobserved effect and the regressors (see Baltagi, 2008, chapter 4). Additionally, to choose between to test pooled-OLS and RE, we use the Breusch and Pagan (1980)'s Lagrange multiplier test for testing for the presence of an unobserved effect. Finally, we use the *F* test for fixed effects to test whether all unobservable individual effects are zero, in order to discriminate between pooled-OLS and RE.

4. Data

The dependent variables in our empirical analysis are bond yield spreads, derived as differences between 10-year sovereign bond yields of EMU-founding countries along with Greece and yields of the equivalent German bund. Therefore, our sample contains both central (Austria, Belgium, Finland, France and the Netherlands) and peripheral EMU countries (Greece, Ireland, Italy, Portugal and Spain) [6].

We use monthly data from January 1999 to December 2012 collected from Thomson Reuters Datastream. Figure 1 plots the evolution of daily 10-year sovereign bond spreads for each country in our sample. A simple look at this figure indicates the differences in the yield behaviour before and after the outbreak of the Greek sovereign debt crisis at the end of 2009.

[Insert Figure 1 here]

Specifically, it is striking that between the introduction of the euro in January 1999 and November 2009, when it became clear that the Greek economy faced the bleak reality of being unable to finance its sovereign debt, spreads on bonds of EMU countries moved in a narrow range with only slight differentiation across countries. In fact, the stability and convergence of spreads was considered a hallmark of successful financial integration (see, e.g. Abad *et. al.*, 2010) inside the euro area (neither the subprime crisis nor the Lehman Brothers collapse bit significantly into euro sovereign spreads).

Nevertheless, once the global financial crisis began to affect the real sector, the imbalances within euro area countries were plain to see. Spreads, which had reached levels close to zero between the launch of the euro and October 2009

[6] Luxembourg is exempted from the present analysis, because of its very low level of outstanding amount of sovereign bonds.

(the average value of the 10-year yield spread against the German bund moved between 10 and 47 basis points in the case of France and Greece, respectively), have risen ever since. Indeed, the risk premium on EMU government bonds increased strongly from November 2009, reflecting investor perceptions of upcoming risks. Figure 1 shows that by late 2011 and beginning 2012 it reached maximum levels of 4680 basis points in Greece, 1141 in Portugal, 1125 in Ireland, 635 in Spain and 550 in Italy. This widespread increase in sovereign spreads meant that certain euro area Member States were under enormous pressure to finance their debt, and funding costs rose significantly. This led to an increase in rollover risk as debt had to be refinanced at unusually high costs and, in extreme cases, could not be rolled over at all, which triggered the need for a rescue (see Caceres *et. al.*, 2010).

With regard to the independent variables, as it has been explained in Section 2, we include variables that measure macroeconomic fundamentals beyond the country's fiscal position (both at the local and the regional level), some potential financial channels of crisis transmission along with variables that may capture changes in market sentiment: either idiosyncratic, regional or global. A summary with the definition and sources of all the explanatory variables used in the panel models is presented in Appendix A. All the variables included in the estimation that capture both macroeconomic fundamentals or financial linkages are in relative terms to the German ones, as our dependent variable is the difference between the 10-year sovereign yield of each country over Germany.

Concretely, according to Dornbusch *et al.* (2000), reasons that may explain the evolution of sovereign yields spreads can be divided into two groups: fundamental-based reasons on the one hand, and investor behaviour-based reasons on the other. While fundamental-based transmission works through real and financial linkages across countries, behaviour-based is more sentiment-driven. Therefore, in our analysis we use instruments that capture both of them. Following the literature, in order to measure the impact of fundamental variables (at both the local and the regional level) on sovereign spreads behaviour, we use instruments that gauge not only each country's fiscal position, but the market liquidity in each country, its foreign debt, its potential rate of growth, and the loss of competitiveness as well. The private sector level of indebtedness has been added in the analysis of the effect of local fundamental variables and, finally, we have included foreign claims on sectoral private debt and cross-border banking system linkages as measures of the degree of crisis transmission through the financial system (see Gómez-Puig and Sosvilla-Rivero, 2013).

Specifically, the variables used to measure the country's fiscal position are the government debt-to-GDP and the government deficit-to-GDP. These two variables have been widely used in the literature by other authors (see, e.g., Bayoumi *et al.*, 1995) and present an advantage over the credit rating in that they cannot be considered *ex post* measures

of fiscal sustainability. Since they are measures of credit risk, they should be directly related with sovereign spreads increase.

Regarding the liquidity premium in each sovereign debt market, empirical papers examining the influence of market liquidity in bond markets use a variety of measures to gauge its three main dimensions of tightness, depth and resiliency. These measures include trading volume, bid-ask spreads, the outstanding amount of debt securities, and the issue size of the specific bond. However, several studies have shown that all liquidity measures are closely related to each other [Gómez-Puig (2006), Korajczyk and Sadka (2008), and Gerlach *et al.* (2010), to name a few]. Therefore, we think that the overall outstanding volume of sovereign debt – which is considered a measure of market depth because larger markets may present lower information costs as their securities are likely to trade frequently, and a relatively large number of investors may own or may have analysed their features – might be a good proxy of liquidity differences between markets. Since liquidity premium decreases with market size, we would expect a negative effect of this variable on sovereign spreads.

Besides, the current-account-balance-to-GDP ratio is the instrument used as a proxy of the foreign debt and the net position of the country *vis-à-vis* the rest of the world. Note that this variable is defined as the difference between exports and imports. Therefore an increase would signal an improvement in the net position of the country towards the rest of the world, reducing sovereign spreads. The importance of this variable has been underlined by the IMF (2010) and Barrios *et al.* (2009). In view of Mody (2009)'s argument that countries' sensitivity to the financial crisis is more pronounced the greater the loss of their growth potential and competitiveness, we include instruments that measure these features. The unemployment rate is the variable used to capture the country's growth potential, whilst the Harmonized Index of Consumer Prices monthly interannual rate of growth is the inflation rate measure that we use as a proxy of the appreciation of the real exchange rate and, thus, the country's loss of competitiveness. An increase in either unemployment or inflation represents a deterioration of growth potential and competitiveness; so, it should augment sovereign spreads.

To assess the role of private debt in the euro area sovereign debt crisis, we also incorporate instruments that capture the level of indebtedness of each country's private sector in the analysis. To that end, we make use of a unique dataset on private debt-to-GDP by sector in each EMU country. In particular, we use three variables: banks' debt-to-GDP, non-financial corporations' debt-to-GDP, and households' debt-to-GDP, which have been constructed with data obtained from the European Central Bank Statistics. Since high leverage levels in the private sector have a negative impact on the public sector's sustainability, an increase in these three variables would positively affect sovereign yield spreads.

Finally, according to certain authors [Bolton and Jeanne (2011) and Allen *et al.* (2011), among them], in a scenario of increased international financial activity in the euro area, not only public finance imbalances are key determinants of the probability that the sovereign debt crisis could spill over from one country to another, but the transmission of the crisis through the banking system can also be a major issue. As a result, in our analysis we also include variables that capture the important cross-border banking system linkages in euro area countries. These linkages are measured using the consolidated claims on an immediate borrower basis of Bank for International Settlements (BIS) reporting banks in the public, banking and non-financial private sectors as a proportion of GDP. Moreover, we also explore the role of consolidated claims on an immediate borrower basis, provided by BIS by nationality of reporting banks as a proportion of total foreign claims on each country. We expect that higher banking sector exposure and cross-border banking system linkages will be associated with an increase in sovereign spreads[7].

On the other hand, four variables have been used to gauge the effect of regional, global or local market sentiment in each different country over sovereign spreads: stock returns, stock volatility, an index of economic policy uncertainty, and an index of the fiscal stance.

Monthly stock returns are used in order to reflect portfolio allocation effects between stocks and bonds in each country (see among others, Aizenman *et.al.*, 2013 and Georgoutsos and Migiakis, 2013). Since periods of financial turmoil and negative stock returns may be accompanied by rises in sovereign bond spreads because of an increased propensity to hold safer assets (the German bund in our case), we expect a negative association between them. To this end, differences of logged stock index prices of the last and the first day of the month have been calculated for the benchmark stock index in each country; whilst the Eurostoxx-50 and the Standard and Poor's 500 have been used to calculate, respectively, the evolution of regional and global stock returns. Volatility is a measure of the level of uncertainty prevailing in stock markets. Two different approaches are used to estimate it; while historical volatility involves measuring the standard deviation of closing returns for any particular security over a given period of time, implied volatility is derived from option prices. The latter represents the estimates and assumptions of market participants involved in a trade, on the basis of a given option price, and has been used to gauge both regional and global stock market volatility. In particular, the variables VSTOXX and VIX which measure implied volatility in Eurostoxx-50 and Standard and Poor's 500 index options and have been widely used in the literature by other authors (see, e.g., Afonso, 2012, Aizenman *et al.*, 2013, and Battistini *et al.*, 2013) have been incorporated as measures of uncertainty in the Eurozone and the global financial markets, respectively. However, since the implied volatility

[7] The construction and evolution of sectoral private debt, foreign banks claims by sector and by nationality of reporting banks are explained in Gómez-Puig and Sosvilla-Rivero (2013).

indices were not available for all countries, we opted for the monthly standard deviation of equity returns in each country to capture local stock market volatility. The increased stock market volatility is usually accompanied by an increase in other risk components and, thus, leads to increases in bond yield spreads; as a result, we expect a positive sign for the respective coefficient.

Some authors (see, e.g. Ades and Chua, 1993) find that political instability has strong negative effects on a country's per capita growth rate. Thus, to assess whether policy uncertainty has an influence on the decisions of bond market investors, we have used the index of economic policy uncertainty (EPU), built up by Baker *et. al.* (2013), which draws on the frequency of newspaper references to policy uncertainty and other indicators and which is available for Germany, France, Italy, Spain, Europe and the United States. A positive sign is also expected for the respective coefficient since policy uncertainty may discourage investments in sovereign debt markets. A related question is the analysis of the impact of the fiscal stance of each country on sovereign debt spreads. Therefore, the index of the fiscal stance suggested by Polito and Wickens (2011, 2012) is also included in the analysis. Unlike the standard econometric tests of fiscal sustainability, this index is suitable for assessing fiscal policy in the short and medium term as it can measure the fiscal consolidation needed to achieve a pre-specified debt target at any future time horizon. To capture regional and global risk we have used the European and United States indices of the fiscal stance respectively. Since, by construction, the higher the index, the worse the fiscal stance, we expect a positive sign for its coefficient.

Another variable, the consumer confidence indicator[8], has been used to measure either regional (Eurozone) or local market sentiment in each different country. This index is used to gauge economic agents' perceptions of future economic activity and it seems reasonable to expect a negative relationship between it and spreads, since an increase in consumer confidence may lead to a rise in investor confidence in the economy's potential for growth.

Finally, the analysis of the influence of local, regional and global market sentiment on sovereign yield spreads has been completed by the inclusion of one more variable in the first case, five additional variables in the second, and two supplementary variables in the third.

Credit rating has been included as a proxy of the market perception of default risk in each local market. So, following Blanco (2001), we built up a monthly scale to estimate the effect of investor sentiment based on the rating offered by the three most important agencies (Standard &Poor's, Moody's and Fitch). Since this variable is considered an *ex post*

[8] According to some authors (see, e.g., Rua, 2002), the Economic Sentiment Indicator (ESI) has informative content for the GDP growth rate and can therefore be used to gauge economic agents' perceptions of future economic activity. However, since this indicator was not available for Ireland, and the correlation between the Consumer Confidence Indicator and the ESI is very high, we decided to include the former in the analysis.

measure of fiscal sustainability it should have a positive impact on sovereign spreads (by construction, the higher the scale, the worse the rating categories).

Five variables have been added to explore the impact of regional market sentiment on sovereign spreads. First, we have accounted for the effects of the prevailing credit risk conditions in the European corporate bond market. Following Georgoutsos and Migiakis (2013), the indices (iBoxx) of European corporate bonds with a rating of BBB have been used in order to obtain the spread between their yields, since they are commonly used as a proxy of the effects that changes in credit risk conditions in the European corporate bond market exercise on European sovereign bond spreads. Furthermore, to capture the full spectrum of credit quality in the euro area corporate market, we have also included the evolution of two indices: the $ITRAXX_{FIN}$ and the $ITRAXX_{NF}$. These are European 5-year CDS indices in the financial and the non-financial sector respectively (the corresponding indices for the United States have been widely used in the literature: see, for instance, Gilchrist *et. al.*, 2013). Considering the "safe haven" status of the German bund, we expect these two variables, which measure credit risk in the corporate bond market, to be positively related to the spreads.

Moreover, one- and ten-year interest rate volatility indices for the Eurozone (EIRVIXs) based on the implied volatility quotes of caps (floors) – one of the most liquid interest rate derivatives, constructed by López and Navarro (2013) – have also been incorporated in the analysis. A positive sign is also expected for these variables, since increased interest rate volatility is usually accompanied by an increase in yield spread volatility. To account for the concerns for the stability of the euro we have used the indicator built up by Klose (2012) which reflects the market expectation of the probability that at least one euro area country will have left the currency union by the end of 2013. Finally, to measure the joint default risk in the euro area, we include the time-varying probability of two or more credit events (out of ten) over a one-year horizon calculated by Lucas *et al.* (2013). A positive relationship is also expected between the last two variables (which measure uncertainty and default risk in the euro area) and sovereign yield spreads.

As mentioned, two supplementary variables have also been introduced in the model in order to assess global market risk aversion. Firstly, following the empirical literature on sovereign bond spreads in emerging markets, which shows that yields on US government bonds are the main determinants of sovereign spreads, the spread between 10-year fixed interest rates on US swaps and the yield on 10-year Moody's Seasoned AAA US corporate bonds is also introduced as a proxy of international risk factors (see Codogno *et al.*, 2003 and Gómez-Puig, 2008). Secondly, we have included the Kansas City Financial Stress Index built by Hakkio and Keeton (2009), which is a monthly measure of stress in the U.S. financial system based on 11 financial market variables (a positive value indicates that financial stress is above the

long-run average, while a negative value signifies that financial stress is below the long-run average). Therefore, a positive relationship is also expected between these two variables and sovereign spreads.

5. Empirical Results

5.1. All sample analysis

As mentioned before, our empirical analysis starts with a general unrestricted statistical model including all explanatory variables to capture the essential characteristics of the underlying dataset, using standard testing procedures to reduce its complexity by eliminating statistically-insignificant variables, and checking the validity of the reductions at every stage in order to ensure congruence of the finally selected model.

Tables 1 to 3 show the final results for three groups of countries: all EMU countries, EMU central countries, and EMU peripheral countries, respectively, during the whole sample period: 1999:01-2012:12. In each case, we report the results obtained using the three panel regression methods described above. Based on the specification tests, the FE model is the relevant one in all cases[9]. Therefore, we only comment the results based on the FE regressions.

[Insert Tables 1 to 3 here]

The results in these tables do not take into account the dynamic properties of sovereign spreads drivers over time; they show the results for the whole period (pre and crisis) in order to select the best model to be used in the rest of the analysis after having eliminated statistically-insignificant variables. Nevertheless, some conclusions regarding the different drivers in central and peripheral EMU countries are worth to be noted. Concretely, whilst local macrofundamentals are more relevant in explaining peripheral yields spreads rather than those of central countries, variables gauging regional macrofundamentals are more significant in central countries than in peripheral ones. This result, along with the fact that in both cases some variables measuring market sentiment are significant, might explain the observed increase in central countries yield spreads during the crisis period. Indeed, 10-year yields spreads over Germany of Austrian, Finish, French and Dutch government's bonds achieved a maximum level of 183, 83, 189 and 84 basis points (in November 2011 in the first three countries and in April 2012 in the case of the Netherlands, see Figure 1) while the credit rating provided by the three most important agencies (Moody's, Standard & Poor's and Fitch) at the same date was, like in Germany, the highest one.

The reason behind sovereign risk rise in central countries, triggered by the behaviour of peripheral countries can only partially be explained by the evolution of local macroeconomic variables in those countries (the two domestic

[9] The Hausman test rejects the RE model in favour of the FE estimation. The joint significance of the fixed error component model is strongly confirmed, suggesting that FE is needed. The Breusch and Pagan LM test fails to reject the null that variances across entities are zero, concluding that RE is not appropriate.

components of sovereign risk included in its standard definition, market liquidity and credit risk, are the only that turn out to be significant). Conversely, it can be more related, not only to regional macroeconomic fundamentals behaviour, but also to local as much as regional and global market sentiment variables which reflect investors' risk aversion, since in times of uncertainty, they become more risk averse and the "flight-to-safety" motive favors bonds of countries that are generally regarded to have a low default risk (e.g. during the crisis Germany experienced one of its lowest yields' levels in history).

Besides, it is also important to remark than whilst foreign bank's claims on the private (non-financial) sector are significant in the two groups of countries, foreign claims on the banking and on the public sector are only significant in one group of countries: central and peripheral, respectively.

5.2. Pre- and post-crisis analysis

Since one of the objectives of this paper is to examine whether investors may have ignored cross country differences or changes in country-specific fundamentals during the stability period and may have reacted much more strongly during the crisis one, we analyze the differences of coefficients' significance over time (i.e., during the pre-crisis and the crisis period).

To that end, the breakpoint date has been fixed at the end of November 2009, since Gómez-Puig and Sosvilla-Rivero (2014b), applying both the Quandt-Andrews and the Bai and Perron (1998, 2003) tests and letting the data select when regime shifts occurred, showed that around two thirds of the breakpoints they examine[10] (i.e., 63%) occur after November 2009 when Papandreou's government disclosed that its finances were far worse than previously announced[11], which market the beginning of the euro area sovereign debt crisis.

In addition to the independent variables that have be explained in Section 4, following Gómez-Puig (2006 and 2008), in order to estimate potential changes in the marginal effects after the crisis, a dummy (DPRE), that takes the value 1 in the pre-crisis period (and 0, otherwise), is also introduced in equation (1) and the coefficients of the interactions between this dummy and the rest of variables are calculated. Therefore, the marginal effects of each variable are:

$$\beta = \beta_1 + \beta_2 \text{DPRE}$$

[10]In this paper, the authors explore changes in the existence and direction of causality by means of a Granger-causality approach before and after endogenously (data-based) identified crises during the period January 1999-December 2012.

[11] This announcement served to worsen the severe crisis in the Greek economy, and the country's debt rating was lowered to BBB+ (the lowest in the euro zone) on December 8th.

We honestly think that a formal coefficient test H_0: $\beta_1 = \beta_1 + \beta_2$, , in order to assess whether the impact of independent variables on the bond yield spreads changed significantly with the start of the sovereign debt crisis, is not necessary as long as β_2 turns out to be significant. So, the marginal coefficients of a variable are:

$\beta = \beta_1$ (in the crisis period)
$\beta = \beta_1 + \beta_2$ (in the pre-crisis period)

[Insert Tables 4 to 6 here]

The first column of Tables 4 to 6 reports the original FE estimation results (Tables 1 to 3) while the second column shows the FE re-estimation results with the DPRE dummy. As can be seen, in all cases the marginal effects increase in the crisis period (β_1) compared to the pre-crisis one ($\beta_1 + \beta_2$).

Therefore, these results are in line with previous studies that point out the dynamic properties of sovereign spreads drivers over time, after the start of the crisis [see, e.g., Pozzi and Wolswijk (2008), Gerlach et *al.* (2010), Aβmann and Boysen-Hogrefe (2012) and Bernoth and Erdogan (2012)] or which show an increase in the sensitivity of the price of risk to fundamentals during the euro area debt crisis than in the pre-crisis period (see Beirne and Fratzscher, 2013, among them). It is worth noting that, not only all the variables that capture both local and regional fundamentals or market sentiment increase their significance, in the two groups of countries, in the crisis period compared to the pre-crisis one, but also that the variable that gauges global market sentiment also raises its significance after the start of the crisis in both central and peripheral EMU countries, confirming the increased importance of investors' risk aversion suggested by the literature (see Codogno *et al.* (2003), Sgherri and Zoli (2009) or Bernoth and Erdogan (2012) among them) in sovereign risk pricing, in times of uncertainty when risk is also related to herding behaviour of investors (see Lux, 1995; or Akerlof and Shiller, 2009).

6. Concluding remarks

The sovereign debt crisis in Europe that began in late 2009 has reignited the literature on euro area sovereign spreads drivers and given an increased importance to uncertainty and variables reflecting investment confidence conditions and perceptions for the upcoming economic activity. In this framework, some important questions to be addressed for economists have been raised. What explains the disparities and shift in the pricing of sovereign debt risk during the crisis period? Have the drivers of yield spreads and their relevance changed after the crisis? Are there important differences among peripheral and central countries?

The main contribution of this paper to the existing literature is methodological and refers to the adoption of an eclectic approach to empirically assess, using a general-to specific modelling strategy with panel data techniques, the

relevance of the highest number of variables that have been proposed in the recent theoretical and empirical literature as potential drivers of EMU sovereign bond yield spreads.

To our knowledge, this paper presents one of the most exhaustive compilations of the variables used in the literature to examine sovereign yield spreads behaviour and, in particular, to gauge the effect of changes in market sentiment and risk aversion on yield spreads, whose importance has specially been stressed by the literature after the outburst of the recent debt crisis. However, following the broad literature that re-emerged with the euro area sovereign debt crisis, the paper also examines whether there are differences among peripheral and central countries and analyzes the time-varying pricing of the same spread drivers by market participants after the crisis outbreak. Therefore, this paper represents an updated analysis of sovereign yield spreads drivers in times of crisis.

All in all, looking across the columns in Tables 4 to 6, the following conclusions can be drawn: (1) Sovereign risk rise in central countries in the crisis period can only partially be explained by the evolution of local macroeconomic variables in those countries. Conversely, it can be more related, not only to regional macroeconomic fundamentals behaviour, but also to local, regional and global market sentiment. (2) Besides, the variables that measure global market sentiment and investors' risk aversion, which are significant in both periods, register a rise in their marginal effects after the start of the sovereign crisis. These results confirm the increased importance of investors' risk aversion suggested by the literature, in times of uncertainty, when "flight-to-safety" motive favors bonds of countries that are generally regarded to have a low default risk and consequently implies a risk premium increase in the rest of the countries. (3) In all the cases, the marginal effects of sovereign spreads drivers increase in the crisis period compared to the pre-crisis one. Therefore, these results are in line with previous studies that point out the dynamic properties of sovereign spreads determinants, after the start of the crisis, showing an increase in the sensitivity of the price of risk to fundamentals during the euro area debt crisis than in the pre-crisis period.

We consider that our results will have some practical meaning for investors and policymakers, as well as some theoretical insights for academic scholars interested in the behaviour of euro area sovereign debt markets. Our methodology could be used as a tool to provide information regarding the different market price that investors give to a wide set of factors that drive EMU sovereign bond yield spreads (particularly those that measure market sentiment) both in a stable and in a crisis period, as well as to examine whether there are important differences among central and peripheral countries.

Appendix A: Definition of the explanatory variables in the panel regressions and data sources

A.1. Variables that measure local market sentiment.

Variable	Description	Source

Stock Returns (STOCKR)	Differences of logged stock indices prices of the last and the first day of the month for each country.	Datastream
Stock Volatility (STOCKV)	Monthly standard deviation of the daily returns of each country's stock market general index	Datastream
Index of Economic Policy Uncertainty (Germany, France, Italy, and Spain)/(EPU)	This index draws on the frequency of newspaper references to policy uncertainty and has been built up by Baker *et al.*, 2013.	www.policyuncertainty.com
Index of the Fiscal stance (IFS)	This indicator compares a target level of the debt-GDP ratio at a given point in the future with a forecast based on the government budget constraint. It has been built up by Polito and Wickens (2011, 2012). Monthly data have been linearly interpolated from yearly observations for the available data: 1999-2011	Provided by the authors.
Consumer Confidence Indicator (CCI)	This index is built up by the European Commission which conducts regular harmonised surveys to consumers in each country.	European Commission (DG ECFIN)
Rating (RAT)	Credit rating scale built up from Fitch, Moody's, S&P ratings for each country.	Bloomberg

A.2. Variables that measure regional market sentiment.

Variable	Description	Source
Stock Returns (EuroSTOCKR)	Differences of logged stock indices (Eurostoxx-50) prices of the last and the first day of the month for each country.	Yahoo-finance
Stock Volatility (VSTOXX) (EuroSTOCKV)	Eurostoxx-50 implied stock market volatility index. Monthly average of daily data.	www.stoxx.com
Index of Economic Policy Uncertainty (Europe)/ (EuroEPU)	Baker *et al.*, 2013.	www.policyuncertainty.com
Index of the Fiscal stance (Europe)/(EuroIFS)	Polito and Wickens (2011, 2012). Monthly data have been linearly interpolated from yearly observations for the available data: 1999-2011.	Provided by the authors.
Consumer Confidence Indicator (Eurozone)/(EuroCCI)	European Commission	European Commission (DG ECFIN)
Credit Spread (EuroCSPREAD)	Difference between the yields of the iBoxx indices containing BBB-rated European corporate bonds against the yields of the respective iBoxx index of AAA-rated European corporate bonds. Monthly average of daily data.	Datastream
$ITRAXX_{FIN}$ / $ITRAXX_{NF}$ ($EuroITRAXX_{FIN}$) ($EuroITRAXX_{NF}$)	European 5-year CDS index in the financial and non-financial sectors: 2010:9-2012:12. Monthly average of daily data.	Bloomberg
EIRVIX-1Y/EIRVIX-10Y (EuroEIRVIX-1Y) (EuroEIRVIX-10Y)	1-year and 10-year interest rate volatility index for the Eurozone based on the implied volatility quotes of caps (floors). This index has been built up by López and Navarro (2013) for the period 2004:1-2012:4.	Provided by the authors.
Euro Instability (EuroINSTAB)	Market expectation of the probability that at least one Euro area country will have left the currency union at the end of 2013, built up by Klose (2012) for the period 2010:8-2012:8. Monthly average of daily data.	Provided by the authors.
Euro area default risk (EuroDEFAULT)	Probability of two or more credit events, calculated by Lucas *et. al.* (2013): 2008:1-2012:12	Provided by the authors.

A.3. Variables that measure global market sentiment.

Variable	Description	Source
Stock Returns (GlobalSTOCKR)	Differences of logged stock indices (S&P 500) prices of the last and the first day of the month.	Datastream
Stock Volatility (VIX) (GlobalSTOCKV)	Chicago Board Options Exchange Market Volatility Index. (Implied volatility of S&P 500 index options), Monthly average of daily data.	Yahoo-Finance
Index of Economic Policy Uncertainty (United States)/(GlobalEPU)	Baker *et al.*, 2013.	www.policyuncertainty.com
Index of the Fiscal stance (United States)/(GlobalIFS)	Polito and Wickens (2011, 2012). Monthly data have been linearly interpolated from yearly observations for the available data: 1999-2011	Provided by the authors.
Global Risk Aversion (GlobalRISK)	The spread between 10-year fixed interest rates on US swaps and the yield on 10-year Moody's Seasoned AAA US corporate bonds. Monthly average of daily data.	Datastream
Kansas City Financial Stress Index (GlobalKCFSI)	Based on 11 financial market variables, each of which captures one or more key features of financial stress. It has been built up by Hakkio and Keeton (2009)	http://www.kansascityfed.org

A.4. Variables that measure local macrofundamentals.

Variable	Description	Source
Net position towards the rest of the world (CAC)	Current-account-balance-to-GDP Monthly data are linearly interpolated from quarterly observations.	OECD

Growth potential (U)	Unemployment rate	Eurostat
Competitiveness (INF)	Inflation rate. HICP monthly interannual rate of growth	Eurostat
Fiscal Position (DEF) (GOVDEBT)	Government deficit-to-GDP and Government debt-to-GDP. Monthly data are linearly interpolated from quarterly observations.	Eurostat
Market liquidity (LIQ)	Domestic Debt Securities. Public Sector Amounts Outstanding (billions of US dollars) Monthly data are linearly interpolated from quarterly observations.	BIS Debt securities statistics. Table 18
Bank's debt (BANDEBT)	Banks' debt-to-GDP. Monthly data are linearly interpolated from quarterly observations for the GDP.	ECB's Monetary Financial Institutions balance sheets and own estimates. GDP has been obtained from Eurostat
Non-financial corporation's debt (NFCDEBT)	Non-financial corporations' debt-to-GDP. Monthly data are linearly interpolated from quarterly observations for the GDP.	ECB's Monetary Financial Institutions balance sheets and own estimates. GDP has been obtained from Eurostat
Household's debt (HOUDEBT)	Households' debt-to-GDP of country. Monthly data are linearly interpolated from quarterly observations for the GDP.	ECB's Monetary Financial Institutions balance sheets and own estimates. GDP has been obtained from Eurostat

A.5. Variables that measure regional macrofundamentals.

Variable	Description	Source
Net position towards The rest of the world. (EuroCAC)	Current-account-balance-to-GDP Monthly data are linearly interpolated from quarterly observations.	OECD
Growth potential (EuroU)	Unemployment rate	Eurostat
Competitiveness (EuroINF)	Inflation rate. HICP monthly interannual rate of growth	Eurostat
Fiscal Position (EuroDEF) (EuroGOVDEBT)	Government deficit-to-GDP and Government debt-to-GDP. Monthly data are linearly interpolated from quarterly observations.	Eurostat
Market liquidity (EuroLIQ)	Domestic Debt Securities. Public Sector Amounts Outstanding (billions of US dollars) Monthly data are linearly interpolated from quarterly observations.	BIS Debt securities statistics. Table 18

A.6. Variables that measure financial linkages.

Variable	Description	Source
Foreign claims on bank's debt (EXTDEBTBAN)	Foreign bank claims on banks debt-to-GDP. Monthly data are linearly interpolated from quarterly observations.	BIS Consolidated banking statistics. Table 9C. GDP has been obtained from the OECD.
Foreign claims on public's debt (EXTDEBTPUB)	Foreign bank claims on government debt-to-GDP. Monthly data are linearly interpolated from quarterly observations.	BIS Consolidated banking statistics. Table 9C. GDP has been obtained from the OECD
Foreign claims on non-financial private's debt. (EXTDEBTPRI)	Foreign bank claims on non-financial private debt-to-GDP. Monthly data are linearly interpolated from quarterly observations.	BIS Consolidated banking statistics. Table 9C. GDP has been obtained from the OECD.
Cross-border banking linkages (XXYYBAN)	Percentage of the total foreign claims on country XX held by country YY's banks	BIS Consolidated banking statistics. Table 9D and own estimates.

References

Abad, P., Chulià H., Goméz-Puig, M., 2010. EMU and European government bond market integration. Journal of Banking and Finance. 34, 2851–2860.

Aβmann, C., Boysen-Hogrefe, J., 2012. Determinants of government bond spreads in the euro area in good times as in bad. Empirica. 39, 341–356.

Ades, A., Chua, H.B. (1993): Regional instability and economic growth: Thy neigbor's curse. Discussion Paper 704, Economic Growth Center, Yale University.

Afonso, A., Arghyrou, M.G., Kontonikas, A., 2012. The determinants of sovereign bond yield spreads in the EMU. Working Paper 36, Department of Economics, Technical University of Lisbon.

Aizenman, J., Binici, M., Hutchison, M. M., 2013. Credit ratings and the pricing of sovereign debt during the euro crisis. Working Paper 19125, National Bureau of Economic Research.

Allen, F.; Beck; T., Carletti; E., Lane; P. L., Schoenmaker, D., Wagner, W., 2011. Cross-border Banking in Europe: Implications for Financial Stability and Macroeconomic Policies, Centre for Economic Policy Research, London.

Andrews, D. W. K., 1993. Tests for parameter instability and structural change with unknown change point. Econometrica. 61, 821-856.

Andrews, D., Ploberger, W., 1994. Optimal tests when a nuisance parameter is present only under the alternative. Econometrica. 62, 1383–1414.

Akerlof, G. A., Shiller, R. J., 2009. Animal Spirits, Princeton University Press, Princeton:.

Baele, L., Ferrando, A., Hördahl, P., Krylova, E., Monnet, C., 2004. Measuring European financial integration. Oxford Review of Economic Policy. 20, 509–530.

Bai, J., Perron, P., 1998. Estimating and testing linear models with multiple structural changes. Econometrica. 66, 47–78.

Bai, J., Perron, P., 2003. Computation and analysis of multiple structural change models. Journal of Applied Econometrics. 6, 72–78.

Baker, S.R., Bloom, N., Davis, S. J., 2013. Measuring economic policy uncertainty. Working Paper 13-02, Booth School of Business, The University of Chicago.

Baltagi, B. D., 2008. Econometric Analysis of Panel Data, fourth ed. John Wiley & Sons, Chichester.

Barrios, S.; Iversen; P., Lewandowska M., Setze, R., 2009. Determinants of intra-euro area government bond spreads during the financial crisis. Economic Paper 388, European Commission.

Basse, T., 2013. Searching for the EMU core member countries. European Journal of Political Economy. 32, 412–431

Battistini, N., Pagano, M. Simonelli, S., 2013. Systemic risk, sovereign risk and bank exposures in the euro crisis. Working Paper 345, Centre for Studies in Economics and Finance.

Bayoumi, T., Goldstein, M., Woglom, G., 1995.: Do credit markets discipline sovereign borrowers? Evidence from the US States. Journal of Money, Credit and Banking. 27, 1046-1059.

Beirne, J., Fratzscher, M., 2013. The pricing of sovereign risk and contagion during the European sovereign debt crisis. Journal of International Money and Finance. 34, 60-82.

Bernoth, K.; Erdogan, B., 2012. Sovereign bond yield spreads: A time-varying coefficient approach. Journal of International Money and Finance. 31, 975-995.

Breusch, T. S., Pagan, A R., 1980. The lagrange multiplier test and its applications to model specification in econometrics. Review of Economic Studies. 47, 239-253.

Blanco, R., 2001. The Euro-area government securities markets. Recent developments and implications for market functioning. Working Paper 0120, Banco de España.

Bolton, P., Jeanne, O., 2011.: Sovereign default risk and bank fragility in financially integrated economies. Discussion Paper 8368, Centre for Economic Policy Research.

Büchel, K., 2013. Do words matter? The impact of communication on the PIIGS' CDS and bond yield spreads during Europe's sovereign debt crisis. European Journal of Political Economy. 32, 412–431.

Caceres, C., Vicenzo, G., Segoviano Basurto, M. A., 2010. Sovereign spreads: Global risk aversion, contagion or fundamentals. Working paper 10/120, International Monetary Fund.

Codogno, L., Favero, C., Missale, A., 2003. Yield spreads on EMU government bonds. Economic Policy. 18, 503-532.

Dornbusch, R., Park, Y. C., Claessens, S. 2000. Contagion: Understanding how it spreads. The World Bank Research Observer. 15, 177-198.

Dötz, N., Fischer, C., 2010. What can EMU countries' sovereign bond spreads tell us about market perceptions of default probabilities during the recent financial crisis? Economic Studies, 2010–11, Deutsche Bundesbank.

Favero, C., Missale, A., 2012.: Sovereign spreads in the Euro area: which prospects for a Eurobond? Economic Policy. 27, 231–270.

Gerlach, S., Schulz, A., Wolff, G. B., 2010. Banking and sovereign risk in the euro area. Economic Studies, 2010–09, Deutsche Bundesbank.

Geyer, A., Kossmeier, S., Pichler, S., 2004. Measuring systematic risk in EMU government yield spreads. Review of Finance. 8, 171–197.

Georgoutsos, D. A., Migiakis, P. M., 2013. Heterogeneity of the determinants of euro-area sovereign bond spreads: What does it tell us about financial stability? Journal of Banking and Finance. 37, 4650-4664.

Gilchrist, S., Zakrajsek, E., 2013. The impact of the Federal Reserve's large-scale asset purchase programs on corporate credit risk. Working Paper 19337, National Bureau of Economic Research.

Gómez-Puig, M., 2006. Size matters for liquidity: Evidence from EMU sovereign yield spreads. Economics Letters. 90, 156-162.

Gómez-Puig, M., 2008. Monetary integration and the cost of borrowing. Journal of International Money and Finance. 27, 455-479.

Goméz-Puig, M., 2009. Systemic and idiosyncratic risk in EU-15 sovereign yield spreads after seven years of monetary union. European Financial Management. 15, 971–1000.

Gómez-Puig, M,. Sosvilla-Rivero, S. 2013. Granger-causality in peripheral EMU public debt markets: A dynamic Approach. Journal of Banking and Finance. 37, 4627-4649.

Gómez-Puig, M., Sosvilla-Rivero, S., 2014. EMU sovereign debt markets crisis: Fundamental-based or pure contagion? Working Paper 2014/02, Institut de Recerca en Economia Aplicada Regional i Pública, Universitat de Barcelona.

Gómez-Puig, M,. Sosvilla-Rivero, S., 2014b. Causality and contagion in EMU sovereign debt markets. Working Paper 2014/03, Institut de Recerca en Economia Aplicada Regional i Pública, Universitat de Barcelona.

Gruppe, M., Lange, C., 2013. Spain and the European sovereign debt crisis. European Journal of Political Economy, forthcoming.

Hakkio, C.S., Keeton, W. R., 2009. Financial stress: What is it, how can it be measured, and why does it matter? Federal Reserve Bank of Kansas City Economic Review, second quarter, 5-50.

Hsiao, C., 2007. Panel Data Analysis: Advantages and Challenges. Test. 16, 1-22.

International Monetary Fund, 2010. Global Financial Stability Report, April, International Monetary Fund, Washington, D. C.

Katsimi, M., Moutos, T., 2010. EMU and the Greek crisis: The political-economy perspective. European Journal of Political Economy. 26, 568–576.

Klose, J., 2012. Determinants of sovereign yield spreads during the Euro-crisis–Fundamental factors versus systemic risk. Working Paper 07/2012, German Council of Economic Experts.

Korajczyk, R., Sadka, R., 2008. Pricing the commonality across alternative measures of liquidity. Journal of Financial Economics. 87, 45–72.

López, R., Navarro, E., 2013. Interest rate and stock return volatility indices for the Eurozone. Investors' gauges of fear during the recent financial crisis. Applied Financial Economics. 23, 1419-1432.

Lucas, A., Schwaab, B., Zhang, X., 2013. Conditional euro area sovereign default risk. Working Paper 269, Sveriges Riksbank.

Lux, T., 1995. Herd behaviour, bubbles and crashes. The Economic Journal. 105, 881-896.

Masson, P., 1999. Contagion: Macroeconomic models with multiple equilibria. Journal of International Money and Finance. 18, 587–602.

Mody, A., 2009. From bear sterns to Anglo Irish: How Eurozone sovereign spreads related to financial sector vulnerability. Working Paper 09/108, International Monetary Fund.

Mondria, J., Quintana-Domeque, C., 2013. Financial contagion and attention allocation. The Economic Journal. 123, 429-454.

Pagano, M., von Thadden, L., 2004. The European bond markets under EMU. Oxford Review of Economic Policy. 20, 531–554.

Palladini, G., Portes, R., 2011. Sovereign CDS and bond pricing in the Euro Area. Working Paper 17586, National Bureau of Economic Research.

Polito, V., Wickens, M., 2012. A model-based indicator of the fiscal stance. European Economic Review. 56, 526-551.

Pozzi, L., Wolswijk, G., 2008. Have Euro Area government bond risk premia converged to their common state? Discussion Paper 08–042/2, Tinbergen Institute.

Quandt, R. E., 1960. Tests of the hypothesis that a linear regression system obeys two separate regimes. Journal of the American Statistical Association. 55, 324-330.

Rua, A., 2002. Composite indicators for the Euro area economic activity. Economic Bulletin, Banco de Portugal, September, pp. 87–100.

Sgherri, S., Zoli, E., 2009. Euro area sovereign risk during the crisis. Working Paper 09/222, International Monetary Fund.

Schuknecht, L., Von Hagen, J., Wolswijk, G., 2009. Government risk premiums in the bond market: EMU and Canada. European Journal of Political Economy. 25, 371–384.

Von Hagen, J., Schuknecht, L., Wolswijk, G., 2011. Government bond risk premiums in the EU revisited: The impact of the financial crisis. European Journal of Political Economy. 27, 36–43.

White, H., 1980. A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity. Econometrica. 48, 817–838.

Figure 1. Daily 10-year sovereign yield spreads over Germany: 1999-2012

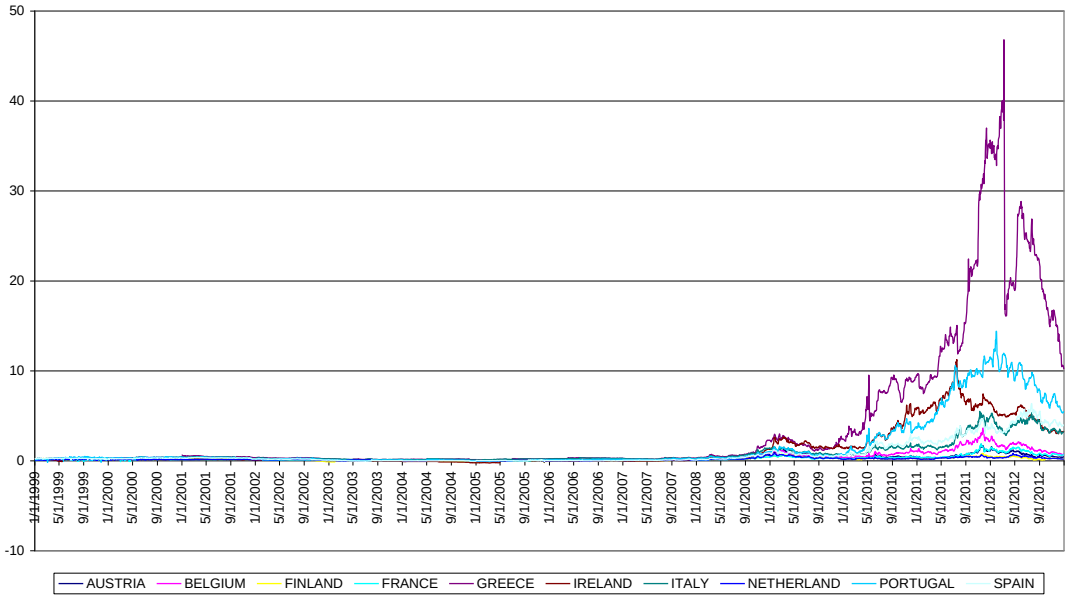

Table 1. Panel regression: All countries

	Pooled OLS	Fixed effects	Random effects
Constant	1.8782*** (1.6615)	2.9474* (3.3173)	2.2693* (2.5749)
Local market sentiment			
RAT	0.3254* (11.7282)	0.3371* (27.9692)	0.3411* (38.7211)
Regional market sentiment			
EuroIRVIX-1Y	0. 0214* (4.8296)	0. 0147* (3.4001)	0.0197* (4.5623)
EuroIRVIX-10Y	0.0659* (3.0248)	0.0776* (3.8115)	0.0626* (3.0776)
Local macrofundamentals			
CAC	-0. 0727* (-5.8166)	-0. 0642* (-2.6463)	-0.0609* (-3.8864)
DEF	0. .0130* (2.8551)	0 .0306* (3.1158)	0.0187** (1.9723)
LIQ	-0.0005* (-9.1285)	-0.0011* (-3.3517)	-0.0007* (-4.1234)
BANDEBT	0.0002** (1.8842)	0 0067* (5.1629)	0.0017** (2.2876)
Regional macrofundamentals			
EuroGOVDEBT	0.0556* (2.7655)	0. 0799* (5.1716)	0.0646* (4.3067)
Financial linkages			
EXTDEBPUB	0.1164* (8.7785)	0.1194* (14.1451)	0.1213* (15.1628)
R^2	0.8301	0.8246	0.8202
Haussman test (FE vs RE)		32.62 [0.0002]	
Breusch and Pagan test (POLS vs RE)		284.68 [0.0000]	
F test for fixed effects (POLS vs FE)		16.80 [0.0000]	
Observations		880	

Table 2. Panel regression: Central countries

	Pooled OLS	Fixed effects	Random effects
Constant	-1.9876*	-2.4938*	-1.9876*
	(-10.6111)	(-13.0438)	(-11.4363)
Local market sentiment			
RAT	0.0338**	0.0270**	0.0338*
	(2.1518)	(2.1263)	(3.4711)
Regional market sentiment			
EuroEPU	0.0032*	0.0036*	0.0032*
	(3.6627)	(6.7169)	(5.4116)
EuroCSPRED	0.0483*	0.0555*	0.0483*
	(10.2216)	(13.2188)	(11.3948)
Global market sentiment			
GlobalRISK	0.1463*	0 .1758*	0 .1462*
	(2.4854)	(5.4374)	(4.3547)
Local macrofundamentals			
GOVDEBT	0.0110*	0.0209*	0.0110*
	(6.0679)	(5.5755)	(9.2212)
LIQ	-0.0001*	-0.0007*	-0.0001*
	(-3.7796)	(-6.9412)	(-5.1367)
Regional macrofundamentals			
EuroGOVDEBT	0.0108*	0.0176*	0.0108*
	(4.4904)	(6.6267)	(4.0455)
EuroLIQ	-0.0001*	-0.0002*	-0.0001*
	(7.63689)	(-10.7158)	(-8.2635)
Financial linkages			
EXTDEBTPRI	0.0046*	0.0051*	0.0046*
	(6.5521)	(10.5303)	(11.6328)
EXTDEBTBAN	0.0135*	0.0127*	0.0135*
	(7.3905)	(10.5328)	(11.4316)
R^2	0.7926	0.8071	0.7670
Haussman test		121.86	
(FE vs RE)		[0.0000]	
Breusch and Pagan test		0.000	
(POOL vs RE)		[1.0000]	
F test for fixed effects		27.91	
(POOL vs FE)		[0.0000]	
Observations		470	

Table 3. Panel regression: Peripheral countries

	Pooled OLS	Fixed effects	Random effects
Constant	3.3352*	4.1544*	3.3352*
	(4.0714)	(8.5911)	(6.1424)
Local market sentiment			
STOCKV	25.4132**	26.4743**	25.4131**
	(1.9416)	(2.3136)	(2.1622)
IFS	3.9413*	2.8091*	3.9413*
	(6.4476)	(5.6425)	(7.1676)
Regional market sentiment			
EuroCSPREAD	0.3310*	0.2434*	0.3310*
	(3.9222)	(6.7736)	(6.4722)
Global market sentiment			
GlobalIFS	0.6178*	0.3252*	0.6178*
	(3.6027)	(3.5509)	(5.0827)
Local macrofundamentals			
U	0.5278*	0.3325*	0.5277*
	(7.2325)	(8.8743)	(15.0125)
GOVDEBT	0.0952*	0.2261*	0.0952*
	(9.8739)	(22.2359)	(20.6739)
BANDEBT	0.0067*	0.0216*	0.0067*
	(3.1729)	(6.1008)	(2.9329)
NFCDEBT	0.0276*	0.0469*	0.0273*
	(4.2036)	(3.0716)	(3.2636)
Regional macrofundamentals			
EuroGOVDEBT	0.1960*	0.1883*	0.1960*
	(3.5405)	(4.8521)	(3.5105)
Financial linkages			
EXTDEBTPUB	0.1158*	0.1966*	0.1158*
	(3.9486)	(15.8665)	(7.0486)
EXTDEBTPRI	0.0133*	0.0299*	0.0133*
	(3.9774)	(4.5906)	(3.9756)
R^2	0.7708	0.8798	0.7969
Haussman test		97.72	
(FE vs RE)		[0.0000]	
Breusch and Pagan test		0.0000	
(POOL vs RE)		[1.0000]	
F test for fixed effects		108.56	
(POOL vs FE)		[0.0000]	
Observations		410	

Table 4. Panel regression: All countries, pre and crisis analysis with dummies

	Without dummies	With dummies
Constant	2.9474* (3.3173)	2.9316* (2.9636)
DPRE		-0.1083* (-3.3306)
Local market sentiment		
RAT	0.3371* (27.9692)	0.4903* (25.2733)
DPRE*RAT		-0.1968* (-4.5171)
Regional market sentiment		
EuroIRVIX-1Y	0. 0147* (3.4001)	0. 0157 (0.5928)
DPRE*EuroIRVIX-1Y		-0.0012 (-1.2913)
EuroIRVIX-10Y	0.0776* (3.8115)	0.0836* (4.1129)
DPRE*EuroIRVIX-10Y		-0.0135* (-2.1201)
Local macrofundamentals		
CAC	-0. 0642* (-2.6463)	-0. 0733* (-4.1197)
DPRE*CAC		0.0106* (5.4637)
DEF	0 .0306* (3.1158)	0 .0451 (1.3906)
DPRE*DEF		-0.0183 (-0.8721)
LIQ	-0..0011* (-3.3517)	-0.0017* (-3.1538)
DPRE*LIQ		0.0004** (2.3328)
BANDEBT	0 0067* (5.1629)	0 0073* (5.3906)
DPRE*BANDEBT		-0.0024* (-2.7501)
Regional macrofundamentals		
EuroGOVDEBT	0. 0799* (5.1716)	0.0836* (3.1201)
DPRE*EuroGOVDEBT		-0.0124* (-2.6278)
Financial linkages		
EXTDEBTPUB	0.1194* (14.1451)	0.1279* (5.9066)
DPRE*EXTDEBTPUB		-0.0211 (-0.8983)
R^2	0.8246	0.8446

Table 5. Panel regression: Central countries, pre and crisis analysis with dummies

	Without dummies	With dummies
Constant	-2.4938*	-2.5632*
	(-13.0438)	(-12.0696)
DPRE		0.0139*
		(2.8252)
Local market sentiment		
RAT	0.0270**	0.0447*
	(2.1263)	(4.4323)
DPRE* RAT		-0.0158**
		(-2.5171)
Regional market sentiment		
EuroEPU	0.0036*	0.0048*
	(6.7169)	(5.0857)
DPRE*EuroEPU		-0.0011*
		(-3.3398)
EuroCSPREAD	0.0555*	0.0618*
	(13.2188)	(6.5218)
DPRE* EuroCSPREAD		-0.0115***
		(-1.8293)
Global market sentiment		
GlobalRISK	0 .1758*	0.1928**
	(5.4374)	(2.8385)
DPRE*GlobalRISK		-0.0650*
		(-2.6443)
Local macrofundamentals		
GOVDEBT	0.0209*	0.0234*
	(5.5755)	(5.4094)
DPRE*GOVDEBT		-0.0011*
		(-3.9705)
LIQ	-0.0007*	-0.0008*
	(-6.9412)	(-6.2514)
DPRE*LIQ		0.0003**
		(1.9612)
Regional macrofundamentals		
EuroGOVDEBT	0.0176*	0.0284*
	(6.6267)	(3.1095)
DPRE* EuroGOVDEBT		-0.0091*
		(-5.2763)
EuroLIQ	-0.0002*	-0.0005*
	(-10.7158)	(-7.4087)
DPRE* EuroLIQ		0.0002*
		(6.0555)
Financial linkages		
EXTDEBTPRI	0.0051*	0.0064*
	(10.5303)	(4.1345)
DPRE*EXTDEBTPRI		-0.0008*
		(-3.8016)
EXTDEBTBAN	0.0127*	0.0143*
	(10.5328)	(9.3655)
DPRE*EXTDEBTBAN		-0.0033*
		(-7.1758)
R^2	0.8071	0.8609

Table 6. Panel regression: Peripheral countries, pre and crisis analysis with dummies

	Without dummies	With dummies
Constant	4.1544*	4.2998*
	(8.5911)	(8.1812)
DPRE		-0.1023*
		(-5.5415)
Local market sentiment		
STOCKV	26.4743**	35.9449*
	(2.3136)	(5.6338)
DPRE*STOCKV		-12.5844*
		(-5.8913)
IFS	2.8091*	2.9795*
	(5.6425)	(5.2706)
DPRE*IFS		-0.2585*
		(-5.1423)
Regional market sentiment		
EuroCSPREAD	0.2434*	0.2786*
	(6.7736)	(4.9798)
DPRE* EuroCSPREAD		-0.0342*
		(-3.3927)
Global market sentiment		
GlobalIFS	0.3252*	0.3705**
	(3.5509)	(2.4017)
DPRE*GlobalIFS		-0.0741*
		(-2.4567)
Local macrofundamentals		
U	0.3325*	0.3534*
	(8.8743)	(4.4835)
DPRE*U		-0.0399***
		(-1.7316)
GOVDEBT	0.2261*	0.2815*
	(22.2359)	(17.4315)
DPRE*GOVDEBT		-0.0613*
		(-10.1341)
BANDEBT	0.0216*	0.0298***
	(6.1008)	(1.7781)
DPRE*BANDEBT		-0.0087
		(-0.5462)
NFCDEBT	0.0469*	0.0549*
	(3.0716)	(7.6372)
DPRE*NFCDEBT		-0.0087*
		(-8.4457)
Regional macrofundamentals		
EuroGOVDEBT	0.1883*	0.2033*
	(4.8521	(4.7515)
DPRE*EuroGOVDEBT		-0.0216*
		(-4.3156)
Financial linkages		
EXTDEBTPUB	0.1966*	0.2343***
	(15.8665)	(1.7765)
DPRE*EXTDEBTPUB		-0.0601*
		(-1.9863)
EXTDEBTPRI	0.0299*	0.0354*
	(4.5906)	(2.9834)
DPRE*EXTDEBTPRI		-0.0096
		(-0.5314)
R^2	0.8798	0.9145

Notes: In all Tables, in the ordinary brackets below the parameter estimates are the corresponding z-statistics, computed using White (1980)'s heteroskedasticity-robust standard errors. In the square brackets below the specification tests are the associated p-values. *, ** and ** indicate significance at 1%, 5% and 10%, respectively. In Tables 4 to 6, we show FE regression results.