Behavioral Factors Influencing Sovereign Bond Yield Spreads: Evidence from Euro Countries.

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Abstract

The models currently used to analyze sovereign bond yield spreads do not appear to function optimally, especially in times of heightened crisis and in the presence of a sudden deterioration in general market conditions, since some significant "non-fundamental" determinants are not considered in traditional models.

The paper investigates the impact of behavioral aspects on the level of spreads, by focusing on the differential of rates of government bonds issued by the main Euro countries. Results show that behavioral variables included in the analysis, proxies of consumer and market sentiment, are strongly statistically significant in the models considered.

Keywords: spread, sentiment, market movers, dynamic heterogeneous panel estimation

EFM classification: 320, 340, 550

JEL classification: G12, G14, C23

1. Introduction

The recent financial crisis has drawn attention in Europe to an indicator of credit risk that only a few years ago had seemed to have almost disappeared, the spread, the difference between the interest rate offered by securities and a benchmark. In the course of this paper, the term spread will be used in reference to the market for bonds issued by sovereign states in the European Monetary Union (EMU). In this case, therefore, the term spread is used to indicate the difference between the yields on long-term (10 years) securities issued by individual countries that are part of the EMU, as compared to those on securities of equal residual maturity issued by the German government (the Bund), which represent the benchmark, and are seen as a safe haven, as they have a low credit risk and high liquidity.

Before the introduction of the Euro, the interest rate differential compared with Germany (on medium and long term securities), touched levels of just under 10 percentage points. The main reasons for the high interest rates offered by government bonds of some states were exchange rate risks and the fear of systematic devaluations which investors had to face. Figure 1 shows how the spreads saw a gradual reduction in the 1990s, before reaching historically low levels around 1999, the year of the introduction of the single currency, despite many countries registering a deterioration in terms of levels of deficits and national debt.

<< INSERT FIGURE 1 HERE >>

Although there is an overwhelming consensus that these reductions primarily reflected the elimination of currency risk, there still remains the enigma of why these differences continued to fall after that date. This has led to the hypothesis that the process of financial integration had finally eliminated the element of credit risk for Euro-zone countries, regardless of their individual national fiscal policies. Yet after the collapse of Lehman Brothers, and the intensification of the financial crisis, spreads began to widen considerably. While the timescales and impacts involved may vary, the interest rate differential against German bonds has affected all members of the EMU, beginning with those characterized by fundamental economic and fiscal weakness. Since then, the containment of the spread of individual national bonds against the German Bund has represented the biggest challenge facing the EMU since its creation, as the interest rate differential also has repercussions in countries with strong fundamentals.

This paper is structured as follows: next section summarizes the results of the principal literature, while Section 3 goes on to describe the methodologies adopted and the data used in the study. Paragraph 4 illustrates the empirical evidence of impacts of behavioral variables on long-term government bond yield spread. In closing, Section 5 contains a summary of the research, and draws some conclusions based on the results achieved.

2. Literature review

The literature contains numerous works focusing on the analysis of the spreads of government bonds. Early studies concentrated their attention on the dynamics of the spread for bonds issued by developing countries. A pioneer of this line of research was Edwards, who in 1984 demonstrated how the spreads of sovereign bonds can be explained by a number of domestic, international, macroeconomic, fiscal, and financial variables, all used by investors in evaluating the solvency of states.

Attention shifted in the following years to the analysis of differentials for OECD countries, with the focus very much still on key variables (among others, Alesina et al., 1992; Bernoth et al., 2006); more recent work (among others, Alexopoulou et al., 2009) has studied the difference in spreads on 10-year government bonds issued in Euro by Central and Eastern European countries against the German Bund. For a detailed review of the literature on this line of research see Maltritz (2012).

The return of the attention of investors, policy-makers and public opinion in general to the dynamics of the spreads of sovereign bonds issued by countries in the Euro area has generated a renewed interest in this issue among academics. A vast empirical literature has analyzed the behavior of spreads on sovereign bonds in the Eurozone since the birth of the EMU in 1999. Scholars broadly agree that there are three main categories of variables that influence the level and volatility of spreads, even if the results achieved by the authors often fail to agree about the relative importance of these factors, given the close relationship between the various components analyzed.

The main groups of variables that can be analyzed to reach an understanding of the dynamics of the spread are: i) risk factors at the international level, ii) “country-specific” risk factors; iii) factors related to liquidity risk.

In the literature there is a general agreement that the differential in interest rates on government bonds is significantly influenced by factors of type (i), deriving mainly from the

U.S. market (see among others, Codogno et al., 2003, Geyer et al., 2004; Arghyrou and Kontonikas, 2010, Favero et al., 2010) and the risk aversion of investors, measurable both as the difference between the long-term rates (7-10 years) offered by corporate bonds and government bonds, and in the volatility of financial markets.

Also "country-specific" factors (ii) relating to credit risk explain a major part of the spreads on the government bonds of countries belonging to the Euro area, even though their role has changed over time (Bernoth et al., 2006).

Liquidity (iii) is another possible factor in explaining differentials (Geyer et al., 2004; Bernoth et al., 2006), especially in difficult market conditions (Beber et al., 2009); that being said, empirical results demonstrate that this factor plays a marginal role in determining the spread (Favero et al., 2010).

The models described above do not help, however, to explain the duration of the phenomenon for the various Euro area countries. A more recent study by De Santis (2012) seeks to bridge this gap by using high frequency data and focusing on the persistence of the event. The author further identifies factors that explain the behavior of the differential in interest rates, in particular the Greek contagion effect, after the downgrade, which caused a chain reaction in countries with weak fundamentals (Ireland, Portugal, Italy and Spain).

Given the imperfect independence between the components linked to credit risk and those related to liquidity risk, subdividing the difference in interest rates on government bonds is not an easy operation, from an empirical perspective, because the importance of the two components tends to vary over time, depending on the economic cycle and structural changes in the economy. In an attempt to include the temporal factor (and thus the dynamics of the relative importance of the individual determinants of the spread), in recent years some authors have tried to introduce different models from those previously employed (Bernoth and Erdogan, 2010).

An even more innovative approach was adopted by Maltritz (2012): given the disagreement in the literature about the key determinants of the spread on sovereign debt interest rates, the author speculates that this lack of homogeneity in the results stems from uncertainty about which empirical model to use. Bayesian models are suitable for the analysis of small samples with a high degree of uncertainty, as they allow, given a large number of explanatory variables, for the identification of those that have the highest probability of being included within the "true" model of estimates. Using these models, the author identifies, among the most significant country-specific variables, fiscal variables, and those related to the balance of payments; on the common level, on the other hand, the variables with the greatest impact on

the spread include the presence or absence of a liquidity crisis in the markets and investor sentiment.

Even though almost all studies conducted to date agree that market spreads broadly reflect the fundamentals of the various national economies, some authors argue that factors thus far regarded as "non-fundamental" play an important role, such as market imperfections and risk aversion among investors. The presence of explanatory variables not included in the models is documented in other studies (Geyer et al., 2004).

Although sentiment is not a variable analyzed in traditional financial theory, the behavioral approach suggests that aspects of the bounded rationality of investors must be taken into consideration, as this may be persistent, and have an impact on asset prices for extended periods of time. While most studies on the topic available in the literature document inefficiencies in equity markets due to a significant relationship between investor sentiment and returns on assets (among the others Baker and Wurgler 2006, 2007, Schmeling, 2009 and Baker et al., 2012), in recent years researchers and practitioners have started to wonder whether extreme movements in European sovereign bond spreads are due to fundamental factors or rather to a negative market sentiment, even if a seminal paper on this topic dated back to 1998 when Eichengreen and Mody find that changes in fundamental variables explain only a fraction of the spread compression in the period leading up to the crisis in emerging markets of late 1990s.

In a working paper, Spyrou (2011) concludes that a key factor that influences both the level of, and variation in, the spread, together with factors that are regarded as "country-specific", is the sentiment of investors, especially during times of crisis. Even more recent studies seem to agree with the conclusion above: Giordano et al. (2012) show that for the majority of high-debt European countries fiscal variables have been underpriced prior to the financial crisis and overpriced during the crisis: a positive market sentiment helps in reducing the government bond spreads and in favoring high-debt countries, while a negative market sentiment favors the dispersion of the spreads, damaging more those countries perceived risker. In other word, investors require a risk premium which is too low in good times (before the financial crisis) and too high after 2010 (in bad times), because they under/oversestimate the risk of default. De Grauwe and Ji (2012) come to the same conclusion; in particular the authors find that during the period 2010-11 a significant portion of the rise of spreads for four high-debt European countries (Greece, Ireland, Portugal and Spain) is not related to fiscal variables, but to a negative market sentiment. To the authors' opinion, this phenomenon is mainly due to the fact that those countries issue debt in a currency they cannot control. An even more recent working paper seems to confirm this assumption; in particular Schoder (2013) support the view that

countries within a monetary union are more prone to investors' sentiments than stand-alone countries, in line with De Grauwe (2011). Also Favero and Missale (2012) suggest that yield spreads are significantly driven by market sentiment and contagion; relying only on the disciplinary effects of financial markets to halt a crisis may not be hence enough.

The empirical evidence outlined illustrates that, with the onset of the financial crisis, investors began to rethink credit risk (and therefore also developments regarding the spread) as the main factor for the allocation of investments, and punish those governments with high debt and deficit levels, calling for higher interest rates on bonds.

An understanding of the forces underlying the variations of the spread is therefore essential for both economists and policymakers. However, the models currently used do not appear to function optimally, especially in times of heightened crisis, such as the current situation, and in the presence of a sudden deterioration in general market conditions.

The growing number of publications on the subject is further evidence of the interest the academic community has in this argument; in some cases, authors arrive at a criticism of the work of the organs of monetary policy. Spyrou (2011), for instance, states that financial crises can essentially arise from two causes: from a crisis of liquidity in the system, or from a crisis of confidence among investors. The monetary policy authorities can intervene and help resolve a crisis caused by situations of illiquidity of the markets; when financial crises arise, on the other hand, from an increase in risk aversion among investors, monetary policy maneuvers are completely ineffective in resolving the problem. As a result other ways and means of intervention are necessary.

The present paper is part of the strand of literature analyzing the impact of behavioral aspects on the level of spreads, by focusing on the differential of rates of government bonds issued by states that have adhered to the EMU.

The objectives of this study can be grouped into two main categories:

1. To bridge the gap in the literature concerning the lack of studies that analyze the impact of behavioral aspects on the level and volatility of spreads on government bonds issued by states that are members of the EMU;
2. To illustrate the extent to which changes in market spreads can be explained by changes in fundamentals, and the extent to which they are due to behavioral issues;

This paper is original in several respects, and can be classified as part of the behavioral research field, in attempting to explain the variability in results that previous empirical models

currently used in the literature, and based almost exclusively on fundamental variables, are unable to demonstrate. The most original aspects can be summarized as follows.

Firstly, the object of the research, namely the impact that behavioral factors have on the level and volatility of the spreads of government bonds issued by Eurozone countries, has not been previously developed in depth by researchers.

Then, almost all the works present in the literature, in fact, only consider fundamental variables. Only a few authors have also considered behavioral factors in their models, as these had not been taken into account before.

Finally, the sample of countries under investigation. Unlike other studies that limit their analysis to the main OECD countries, or certain Euro area countries, the present study considers the main states that have taken part in the EMU, to determine if behavioral aspects have an impact of a different nature in the various nations.

3. Methodology and data

3.1 Methodology

As said above, we define the term spread as the difference between the yields on 10-year securities issued by individual EMU countries, as compared to those on securities of equal residual maturity issued by the German government (the Bund), which represent the benchmark. In formula (1):

$$SPREAD_{i,t} = s_{it} = yield_{i,t} - yield_{Germany,t} \quad (1)$$

where $SPREAD_{i,t}$ represents the spread of country i at time t, $yield_{i,t}$ is the government benchmark 10-year bond yield of country i at time t, and $yield_{Germany,t}$ is the German government benchmark 10-year bond yield at time t.

Several empirical studies have adopted a general long-run model to analyze the determinants of sovereign spread for country *i* at time *t*:

$$s_{it} = \alpha_i + \beta_i' X_{it} + \varepsilon_{it} \quad (2)$$

where $i = 1,2,...,N$ and $t = 1,2,...,T$, α_i is a country-specific intercept term, β_i is a $k \times 1$ vector of coefficients (which are allowed to be heterogeneous and vary across countries) and X_{it} is a $k \times 1$ vector of explanatory variable. X_{it} can be partitioned into two sub-sets of regressors, Z_{it} and F_t, which respectively include country specific factors (like fiscal fundamentals, economic activity variables and liquidity factors) and common factors (mainly related to global market risk aversion).

Extending model (2) to a dynamic panel specification by including lags of the dependent variable, as well as lagged independent variables, the resulting autoregressive distributed lags (ARDL(p,q)) specification can be obtained:

$$s_{it} = \alpha_i + \sum_{j=1}^{p} \lambda_{ij} s_{i,t-j} + \sum_{j=0}^{q} \beta_{ij}' X_{i,t-j} + \varepsilon_{it} \tag{3}$$

which can be rearranged into the following error correction (ECM) equation:

$$\Delta s_{it} = \phi_i \left[s_{i,t-1} - \theta_i' X_{it} \right] + \sum_{j=1}^{p-1} \lambda_{ij}^{*} \Delta s_{i,t-j} + \sum_{j=0}^{q-1} \beta_{ij}'^{*} X_{i,t-j} + \alpha_i + \varepsilon_{it} \tag{4}$$

where $\phi_i = -(1 - \sum_{j=1}^{p} \lambda_{ij})$, $\theta_i = \sum_{j=0}^{q} \beta_{ij} / (1 - \sum_k \lambda_{ik})$, $\lambda_{ij}^{*} = -\sum_{m=j+1}^{p} \lambda_{im}$ (with $j = 1,2,...,p-1$) and $\beta_{ij}^{*} = -\sum_{m=j+1}^{q} \beta_{im}$ (with $j = 1,2,...,q-1$). The term in brackets is the long-run relationship between the spreads and the explanatory variables and θ_i is the vector of long-run elasticities. The parameter ϕ_i is the speed of adjustment term and is significantly different from zero when a long-run relationship between the dependent and in exists. ϕ_i is expected to be significantly negative under the assumption that the variables converge a long-run equilibrium (i.e.: the system is stable and returns to the long-run equilibrium after a deviation is occurred). As pointed out by Pesaran and Shin (1995), representation (4) applies to both stationary and I(1) series.

The estimation of the dynamic heterogeneous panel model (4), when both N and T dimensions are large, can be carried out by means of alternative approaches. Assuming that only the intercepts α_i differ across groups, a dynamic fixed-effects (DFE) estimator can be used. However, this approach leads to inconsistent estimates when the homogeneity of slope coefficients is not appropriate. On the other hand, the model can be estimated separately on each group and a simple average of the coefficients could be calculated, obtaining the mean group (MG) estimator of Pesaran and Shin (1995) in which intercepts, (long- and short-run) slopes and error variances are heterogeneous across groups.

Here, following Ferrucci (2003) and Bellas et al. (2010) we use the pooled mean group (PMG) estimator proposed by Pesaran, Shin and Smith (1999), which combines pooling and averaging, and can be considered as an intermediate case between DFE and MG estimators. The PMG estimator allows intercepts, short-run coefficients and error variances to be unrestricted and vary across groups, but imposes a homogeneity restriction on the long-run coefficients of (4) (i.e.: $\theta_i = \theta$, $\forall i$). The estimating model thus becomes

$$\Delta s_{it} = \phi_i \left[s_{i,t-1} - \theta' X_{it} \right] + \sum_{j=1}^{p-1} \lambda_{ij}^{*} \Delta s_{i,t-j} + \sum_{j=0}^{q-1} \beta_{ij}'^{*} X_{i,t-j} + \alpha_i + \varepsilon_{it} \quad (5)$$

which in non-linear in the parameters and can be estimated by maximum likelihood methods.

In the context of our analysis, the PMG estimator is preferable to alternative estimation procedures. Firstly, the PMG provides a dynamic error correction framework, which allows to better capture the dynamics of the spreads and to control for cointegration with variables with different order of integrations irrespective of whether they are I(0) or I(1). Secondly, by assuming long-run commonalities, PMG leads to more stable and economically plausible estimates than the heterogeneous MG estimator. As pointed out by Baltagi and Griffin (1997) heterogeneous estimators, though allowing for differences among groups, tend to be unstable and may provide unreliable results, especially when the cross-sectional dimension N is not large. Thirdly, contrary to the DFE estimator, PMG allows to account for heterogeneous short-term dynamics and speed of adjustments coefficients. Haque, Pesaran and Sharma (2000) show that neglecting cross-country heterogeneity in short-run responses may lead to inconsistent results.

The appropriateness of the PMG estimation method can be empirically assessed by means of LR or Hausman-type tests of the hypotheses of homogeneity of error variances and/or short and long-run slope coefficients, as the PMG and DFE estimators are restricted versions of the individual group estimations in the mean group estimator.

3.2 Data

The sample includes data referring to ten euro-area countries (Austria, Belgium, Finland, France, Greece, Ireland, Italy, Netherlands, Portugal, and Spain), since their entrance in the monetary union. Other euro-area counties have been excluded due to lack of data: Luxembourg is excluded as it basically has no public debt, while the remaining countries are recent entrants and the estimation period would be too short to provide reliable estimates. Germany is also not considered since its 10-year government bond yield is used to calculate the bond spread for investigated countries and, following the dominant approach in the empirical literature of sovereign spreads determinants (see among others Favero and Missale (2012) and Maltritz (2012)), all country-specific independent variables are expressed in terms of difference between the national levels and the German ones.

Observations cover a period of 13 years on a monthly basis (from January 2000 to December 2012). Following Giordano et al. (2012), fiscal and macroeconomic quarterly

seasonally adjusted series are converted to a monthly frequency by keeping the value constant in each month of the quarter (i.e.: they are kept constant to the values assumed in the month of publication for the two following months). This corresponds to assuming that spreads react with a 3-month lag to fiscal and macroeconomic fundamentals and helps to reduce concerns on endogeneity and reverse causation.

Moreover, all the variables selected are grouped into four main categories: default variables (DEF), indicating factors previous studies correlate to country default risk; liquidity variables (LIQ), which influence the liquidity of the countries' government bonds market; general variables (GEN), which are proxies of the general economy; and finally sentiment variables (SEN), which describe the feeling of national and international investors.

In particular, in line with the literature, we identified four different variables as proxies of the default risk of a country: (i) the government debt and (ii) the country deficit, both expressed as percentages of the country GDP, (iii) the country GDP growth and the (iv) country industrial production. We consider the country government debt as percentage of the EU17 total debt and the 3-month Euribor as expression of the liquidity risk, while the country inflation and the external balance, which is the difference between exports and imports over GDP, are proxies of the general economy.

Since fundamental and macroeconomic factors seem not to be able to fully explain the movements of govern bond spreads, we also identify behavioral variables that investors consider to be market movers. We used six different proxies of investors sentiment, where three of them are specific for each country analyzed, while the others are common factors that can be assumed as proxies of the European and the international market sentiment.

The country-specific variables are the following: (i) the Economic Sentiment Indicator (ESI) is a composite indicator made up of five sectorial (industrial, services, consumer, construction and retail trade) confidence indicators weighted differently released by the European Union and calculated using the answers to questions closely related to the general economic activity of the Union and its members, while the OECD (ii) Business and (iii) Consumer confidence indicators, as the name says provided by the Organization for Economic Cooperation and Development, focus on determining turning points in production, the former, and on a different aspect of the economic cycle, the latter, since it captures cyclical patterns in household consumption behavior.

Common factors used in our analysis are (i) the Chicago Board Options Exchange (CBOE) Volatility Index, better known as the VIX© index, representing the implied volatility of S&P 500 index options and measures the market's expectation of the volatility over the next month.

Since its introduction in 1993, it is considered by investors as one of the best barometer of the market sentiment, (ii) the University of Michigan Consumer Sentiment Index, the oldest consumer attitude survey, based on interviews to five hundred American consumers about their opinion on national economic conditions, and finally (iii) the German IFO Business Climate Index, published by the German Institute for Economic Research, as a result of a monthly survey conducted on more than seven thousand business leaders and managers, all are asked to judge the current Germany's business situation as well as their expectations over the next six months. Historically movements in the index tend to lead changes also in the other European countries' industrial production by a couple of months.

Table 1 shows a description of the variables considered in the paper and data sources.

<< INSERT TABLE 1 HERE >>

Table 2 provides a summary of main descriptive statistics. It is worth remarking that the panel is unbalanced, since the date of entrance in the EMU differs for Greece (January 2001) and also due to missing values in some explanatory variables. The number of observation is on average 153 months for each country considered, for a total of more than 1500 data for each independent variable. In Table 2 country-specific variables are expressed in terms of national levels and not as differences with respect to the corresponding German values. At the bottom of the Table we report country-invariant variables (common factors), as 3-month Euribor, VIX, IFO Bus_t and $Michigan_t$ which assume the same values for all cross-sectional unit at a given time t, but vary through time. As regards country-specific sentiment variables, it should be pointed out that for Ireland the Economic Sentiment Indicator is not available for all the period considered while the OECD Business and Consumer Confidence indicators are available only until May 2008. For this reason, to avoid dropping Ireland from the estimation sample, we have chosen to replace the Economic Sentiment Indicator with the Consumer Confidence Indicator, which is one of the four components of the aggregate ESI. At the same time we have used the monthly growth rate of the Consumer Sentiment Index, published by the Economic and Research Institute (ESRI), to complete the series of OECD Business and Consumer Confidence indexes. However, since hypothesizing that the Business Confidence indicator follows the same pattern of the Consumer Sentiment Index for the period June 2008–December 2012 may be a too strong assumption, we have also decided to leave the series unchanged for Ireland (indicated in what follows as OECD BUS CONF2) and estimate the model of spreads determinants on a reduced and more unbalanced panel. Comparing results from these two

specifications provide indications on the robustness of our results and their sensibility to data unbalancing.

<< INSERT TABLE 2 HERE >>

4. Empirical results and discussion

In this Section we present and discuss the estimates of the heterogeneous dynamic panel data model of sovereign spreads determinant discussed in Section 3.1

As a preliminary step, we analyze the stationarity behavior of the series considered. Despite the general ARDL model (4) is valid irrespective of whether the regressors are I(0) or I(1), this analysis is crucial to assure that none of the series considered exceeds the I(1) order of integration, since the presence of some I(2) variables would result in inconsistent estimates (Asteriou and Monastiriotis, 2004).

We consider different tests for country-specific variables and common factors, expressed in levels and first differences, and we employ both unit root and stationarity tests. In particular, we consider the panel unit root tests proposed by Im, Pesaran and Smith (2003), Maddala and Wu (1999) and Breitung (Breitung, 2000; Breitung and Das, 2005) and the panel stationarity test developed by Hadri (2000), while the stationarity properties of the common factors have been analyzed by means of the Augmented Dickey-Fuller and Phillips-Perron unit root tests and the KPSS stationarity test. Table 3 summarizes the results of these tests and, as we expected, we find that all the variables do not exceed the I(1) order of integration. In particular, with respect to country-specific variables, the sovereign bond spreads series emerges as integrated of order 1, as well as *GOV DEBT*, *DEFICIT*, *EXT BALANCE*, GOV DEBT EU17 and *ESI*. On the other hand, *GDP GROWTH*, *INDUSTRIAL PROD* and *INFLATION* are, as expected, stationary in levels. All the OECD confidence indicators (*OECD BUS CONF*, *OECD BUS CONF2* and *OECD CONS CONF*) also emerges as I(0) series. Turning to the analysis of the stationarity properties of the common factors, *UNIMICHIGAN CONS CONF* and *EURIBOR3M* are integrated of order 1, while *VIX* and *IFO BUS CLI* are stationary in levels.

<< INSERT TABLE 3 HERE >>

Table 4 summarizes the main results of pooled mean-group regressions. As it is possible to note, we run eight different models, in order to verify whether behavioral variables were

significant or not, and if so, which determinants were most important compared to others. For all the models including behavioral indicator (for a total of 10 independent variables), we consider an ARDL(3; 1, 1, 1, 1, 2, 1, 1, 1, 1, 1) specification. The two additional lags of the dependent variable, as the additional lag for the inflation rate, have been included to accommodate for serial correlation in the error terms. All the specifications include dummies for each two-year period (namely, 2000-2002, 2003-2005 and 2006-2008) to account for differences in the level of the spreads during the financial crisis period and to control for errors cross-sectional dependence.

Before analyzing the estimates of the long- and short-run coefficients, we assess the appropriateness of the PMG against the heterogeneous MG approach and the dynamic fixed-effects estimator by means of the Hausman test. Results are reported in Panel B of Table 4. Comparing the MG and the PMG estimates, the validity of the homogeneity of long-run effects cannot be rejected in all the alternative specifications considered and, despite both approaches yield consistent estimates, the PMG is preferable as it is more efficient. Conversely, the DFE is strongly rejected in favor of the PMG estimator for all the models, providing support to the necessity of allowing for cross-country heterogeneity in short-term dynamics and in the adjustment to the long-run equilibrium to obtain consistent estimates of the determinants of sovereign spreads.

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Panel A shows long run coefficients and error correction coefficients. Model 1 regresses only fundamental variables, and consistently with the previous literature, results show that significant determinants of the spreads are the government debt, both in terms of percentage of the country GDP and of the EU17 total debt, the GDP growth and the industrial production, directly related to the country default risk, and the rate of inflation.

If we include also a financial variable proxy of the liquidity risk, such as the 3-month Euribor (see model 2), this determinant appears also to be significant in explaining spread behavior; but once we consider any sentiment variables (models from 3 to 8), the 3-month Euribor ceases to be so, in favor of these news factors. This means that behavioral factors play a major role in explaining sovereign debt spreads compared to variables related to liquidity risk, or in other word that liquidity risk is already taken into consideration by investors while deciding how to behave, while fundamental variables continues to be important in any models.

The first behavioral variable we decided to include in the regression (model 3) is the VIX index, which is assumed by investors a proxy of international market sentiment. The VIX not only appears to be significant in model 3, but it is remain so also in following models, where other behavioral variables are tested. This means that the VIX is one of the major determinants of the sovereign debt spread behavior.

Last models (from 4 to 8) test separately other behavioral variables, in order to verify whether different determinants generate different results. Evidences are consistent to what we expected: sentiment proxies are significant in every model tested, but for model 8 the sentiment variable, in particular the University of Michigan Consumer Sentiment Index, does not seem as critical in determining the behavior of the government spreads as in influencing stock markets movements.

It is worth remarking the difference between models 5a and 5b. Although the behavioral determinant tested is the same (the OECD Business confidence), the variable has been built using two different methodologies, as discussed in Section 3, in order to deal with the issue of a lack of data in the official OECD database for Ireland from June 2008 onwards. In specification 5a we leave the original series unchanged, thus reducing the estimation sample for Ireland and unbalancing the structure of our panel, while in model 5b we replace missing data assuming that the OECD Business Confidence Indicator follows the same dynamics of the Consumer Confidence Indicator. As it can be noticed results obtained from the two specifications are very similar, not only in the estimated effects of the behavioral variable, but also in the effects of the other determinants. This also provides supports to the stability and robustness of our empirical results to the dimension and structure of the estimation sample considered.

Turning to the analysis of the error correction coefficients, the average speed of adjustment to long-run equilibrium ($\frac{1}{N}\sum_{i=1}^{N}\phi_i$) is negative and significantly different from zero in all the eight models considered. This result provides support to the existence of a significant long-run cointegrating relationship between the sovereign spreads and the explanatory variables and implies that the spread level cannot be explained by short-run variations only. Concerning the short-run coefficients, it is possible to point out that the changes in industrial production and inflation significantly affects changes in the spreads in the short-run. However, it clearly emerges that changes in market volatility, as measured by the VIX index, play a positive and significant effects on the short-run dynamics of bond spreads. This result, which remains stable irrespective of the specification considered, is in line with the findings of Bellas et al. (2010)

and points out the necessity of accounting for market volatility factors, since traditional determinants are not relevant for explaining deviations in the short□run, especially when sovereign spreads are more volatile.

Table 5 shows country-specific estimates of the speed of adjustment to equilibrium values for each country included in the sample.

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Evidence resulting from the table seems to be quite interesting since generally all error corrections appears to be significant for all countries, but Greece. This result indicates that the cointegrating system does not converge to the long-run equilibrium and it is mainly related to the effects of the financial crisis, which severely affected the country after the second half of 2009 and consequently the dynamics of the sovereign spread.

For all the other countries, the error correction coefficients are negative and significantly different from zero. It is worth remarking that the error correction adjustment is usually stronger in those ones with weak fundamentals, such as Ireland, Italy, Portugal and Spain, indicating a faster adjustment process after deviations form the long-run equilibrium.

Finally, Table 6 illustrates empirical results obtained by including short-run interactions between each regressor and a "financial crisis" dummy variable, equal to one for the period following the failure of Lehman Brothers (i.e.: form October 2008 to December 2012). By doing this we extend the baseline specification allowing for differentiated short-run dynamics during the financial crisis period.

<< INSERT TABLE 6 HERE >>

Evidence is consistent with results obtained in the baseline specifications presented in Table 4. In particular, all factors considered in our models seem to be significant in the long term, but the University of Michigan Consumer Sentiment Index, which continues to be not significant due to a non direct relationship with the government spreads. Also in these models, error correction coefficients appear strongly significant in all regressions tested, indicating that the cointegrated system is stable and adjusts towards the long-run equilibrium.

5. Conclusions

In this paper we explore whether sentiment variables influence European government bond yield spreads, since in literature there is a lack on this field.

Using an unbalanced monthly dataset covering a 13-year period (from January 2000 to December 2012) and focusing on ten European countries, we tested different pooled mean-group regressions using several behavioral variables and comparing these results with fixed panel models and mean-group regressions.

Our results show that behavioral proxies included in the models are strongly statistically significant. In particular in the case of regressing variables just related to default and liquidity risks or to the general economy, we note that fundamental factors assume a primary role in explaining the government bond spread. But once we add sentiment proxies, these new variables seem to better capture the spread behavior, especially in disfavor of liquidity risk determinants. Results are consistent independently to the behavioral variable tested.

The containment of the spread of individual national bonds against the German Bund represents hence one of the biggest challenge facing the EMU since its creation, as the interest rate differential also has repercussions in countries with strong fundamentals, as recent facts confirm. An understanding of the forces underlying the variations of the spread is therefore essential for both economists and policymakers; however, the models currently used do not appear to function optimally, especially in times of heightened crisis, such as the current situation, and in the presence of a sudden deterioration in general market conditions, since some significant determinants are not considered in traditional models, such as behavioral variables, as we suggest.

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FIGURE 1

Ten-year sovereign bond yield spreads of Euro area countries

(monthly data; in % points; M1 2000 – M12 2012) (Source: Eurostat)

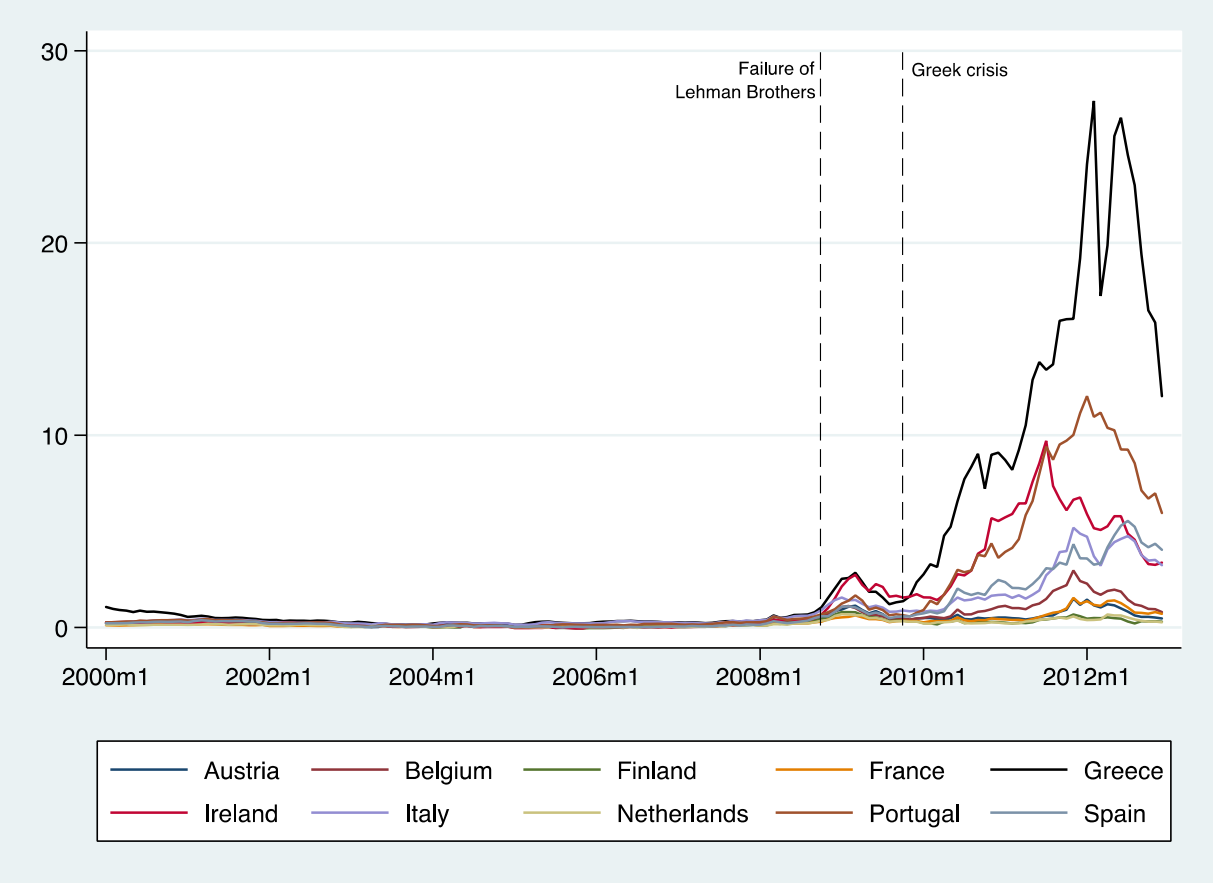

TABLE 1

Description of variables

N.	GROUP	ID	NAME	DEFINITION	SOURCE
0	Independent variable	$SPREAD_{i,t}$	Bond yield spread	Difference between the 10-year maturity redemption yields on sovereign bonds of country i and Germany	Eurostat
1	DEF	$GOV\ DEBT_{I,t}$	Government debt	Government debt as percentage of the country GDP	Eurostat
2	DEF	$DEFICIT_{i,t}$	Country deficit/surplus	Country deficit/surplus as percentage of the GDP	Eurostat
3	DEF	$GDP\ GROWTH_{i,t}$	GDP growth	Country GDP growth	Eurostat
4	DEF	$INDUSTRIAL\ PROD_{i,t}$	Industrial production	Country industrial production	Eurostat
5	GEN	$INFLATION_{i,t}$	Inflation	Country inflation YoY	Eurostat
6	GEN	$EXTBAL_{i,t}$	External balance	Difference between exports and imports over GDP	Eurostat
7	LIQ	$GOV\ DEBT\ EU17_{i,t}$	Government debt EU17	Country government debt as percentage of the EU17 total debt	Eurostat
8	LIQ	EURIBOR 3M	3-month Euribor	3-month Euribor	European Central Bank
9	SEN	VIX_t	VIX© index	CBOE Volatility Index	www.cboe.com
10	SEN	$ESI_{i,t}$	Economic Sentiment Indicator	Economic Sentiment Indicator	Eurostat
11	SEN	$OECD\ BUS\ CONF_{i,t}$	OECD Business confidence	OECD Business confidence	www.oecd.org
12	SEN	$OECD\ CONS\ CONF_{i,t}$	OECD Consumer confidence	OECD Consumer confidence	www.oecd.org
13	SEN	$IFO\ BUS_t$	IFO Business Climate Index	German IFO Business Climate Index	www.ifo.de
14	SEN	$MICHIGAN_t$	Consumer Sentiment Index	University of Michigan Consumer Sentiment Index	www.sca.isr.unimc.edu

***Notes**: Subscripts i and t refer to country and time respectively*

TABLE 2

Descriptive statistics

		Countries:										
Variables	**Statistics**	Austria	Belgium	Finland	France	Greece	Ireland	Italy	Netherlands	Portugal	Spain	All countries
Spread	Mean	0.33	0.48	0.21	0.27	3.78	1.39	0.92	0.18	1.73	0.84	0.99
	Min	0.00	0.03	-0.05	0.02	0.13	-0.05	0.14	-0.02	0.00	0.00	-0.05
	Max	1.49	2.97	0.80	1.54	27.39	9.71	5.19	0.69	12.03	5.55	27.39
Gov Debt	Mean	63.97	91.90	41.64	57.52	127.00	48.35	106.29	49.98	69.72	43.91	69.59
	Min	56.20	78.90	27.30	48.40	106.50	24.20	97.00	40.70	48.20	29.50	24.20
	Max	69.40	107.40	58.50	74.70	181.20	117.00	120.20	64.60	123.50	72.40	181.20
Deficit	Mean	-2.23	-1.74	2.35	-3.84	-8.17	-4.66	-3.34	-1.78	-5.27	-2.98	-3.13
	Min	-10.61	-18.39	-10.38	-10.90	-17.21	-42.01	-9.58	-9.09	-13.10	-16.77	-42.01
	Max	3.12	9.11	11.74	4.28	-0.82	13.08	2.23	4.07	2.94	6.23	13.08
GDP Growth	Mean	1.80	1.57	2.03	1.36	0.78	3.18	0.52	1.43	0.59	2.00	1.53
	Min	-6.30	-4.40	-10.00	-4.30	-9.00	-7.40	-7.30	-5.00	-5.40	-4.40	-10.00
	Max	5.50	5.60	6.40	4.80	7.80	15.60	4.40	5.80	4.50	6.70	15.60
Industrial Prod	Mean	0.25	0.30	0.09	-0.08	-0.22	0.46	-0.13	0.12	-0.13	-0.14	0.05
	Min	-5.00	-9.40	-13.00	-4.90	-9.30	-19.90	-4.30	-9.40	-12.00	-5.60	-19.90
	Max	4.30	3.80	11.80	4.40	7.20	14.30	3.40	11.20	8.70	5.60	14.30
Inflation	Mean	0.17	0.19	0.17	0.16	0.25	0.18	0.20	0.19	0.21	0.24	0.20
	Min	-0.60	-1.90	-0.80	-0.60	-2.10	-1.00	-1.80	-1.60	-0.90	-1.70	-2.10
	Max	1.20	2.50	1.20	0.90	3.40	1.20	2.50	1.50	1.60	2.40	3.40
Ext Balance	Mean	3.95	3.30	4.77	-0.69	-11.19	15.04	-0.02	7.34	-7.90	-3.34	1.38
	Min	1.46	0.32	-2.47	-3.62	-14.97	7.22	-2.54	3.59	-12.35	-7.54	-14.97
	Max	6.43	6.21	10.79	1.90	-7.17	26.64	2.02	9.51	0.01	2.23	26.64
Gov Debt EU17	Mean	3.16	5.57	1.31	19.45	4.73	1.34	29.82	5.06	2.07	7.51	8.03
	Min	2.84	4.64	0.97	17.01	3.77	0.89	25.55	4.65	1.50	6.16	0.89
	Max	3.55	6.51	1.82	21.04	5.53	2.64	32.23	5.95	2.77	10.33	32.23
ESI	Mean	101.13	89.75	97.61	99.82	101.04	100.32	98.94	100.66	96.65	101.65	98.74
	Min	71.00	46.00	74.40	73.60	75.00	74.50	68.30	70.30	74.50	78.10	46.00
	Max	116.20	153.00	118.70	115.50	116.50	120.50	116.80	116.50	115.80	114.40	153.00
OECD Bus Conf	Mean	99.89	100.20	99.58	100.12	99.30	100.09	100.14	99.99	100.30	99.66	99.96
	Min	95.32	97.35	96.00	96.87	95.14	95.67	97.25	96.43	96.96	95.43	95.14
	Max	102.05	101.80	101.66	101.62	102.90	102.90	101.97	101.95	102.39	102.13	102.90
OECD Cons Conf	Mean	100.30	100.51	101.05	99.81	99.28	98.84	99.96	100.16	99.10	99.81	99.89
	Min	97.83	98.24	96.67	97.96	96.02	83.32	96.64	98.11	96.74	96.34	83.32
	Max	102.02	102.87	103.61	101.70	101.23	108.60	103.02	102.72	101.30	102.17	108.60
3-month EURIBOR	Mean											2.65
	Min											0.19
	Max											5.28
VIX	Mean											21.88
	Min											10.42
	Max											59.89
IFO Bus	Mean											102.02
	Min											84.50
	Max											115.00
Michigan	Mean											82.80
	Min											55.30
	Max											112.00

TABLE 3

Stationarity tests

Panel A: Country-specific variables in levels

Test	H0	Variable	Spread	Gov Debt	Deficit	GDP Growth	Industrial Prod	Inflation	Ext Balance	Gov Debt EU17	ESI	OECD Bus Conf	OECD Bus Conf2	OECD Cons Conf
IPS	Unit Root	Statistic	0.9524	2.6916	3.0025	-1.9537	-41.6046	-34.4801	-0.3975	-1.3548	0.4503	-2.1379	-2.7321	-1.7761
		p-Value	*(0.8296)*	*(0.9964)*	*(0.9987)*	*(0.0254)*	*(0.0000)*	*(0.0000)*	*(0.3455)*	*(0.0877)*	*(0.6737)*	*(0.0163)*	*(0.0031)*	*(0.0379)*
Maddala-Wu	Unit Root	Statistic	14.0308	18.4043	7.8272	30.0397	373.7446	562.0924	18.6469	34.7073	8.7886	29.3909	38.8438	23.7225
		p-Value	*(0.8289)*	*(0.5608)*	*(0.9930)*	*(0.0692)*	*(0.0000)*	*(0.0000)*	*(0.5449)*	*(0.0217)*	*(0.9852)*	*(0.0803)*	*(0.0070)*	*(0.2547)*
Breitung	Unit Root	Statistic	-0.5502	1.5351	-0.9705	-1.6569	-22.4879	-10.3396	-0.5595	-0.3986	-1.9146	0.1756	-1.9322	-2.4007
		p-Value	*(0.2911)*	*(0.9376)*	*(0.1659)*	*(0.0488)*	*(0.0000)*	*(0.0000)*	*(0.2879)*	*(0.3451)*	*(0.0278)*	*(0.5697)*	*(0.0267)*	*(0.0082)*
Hadry	Stationarity	Statistic	163.8895	183.3412	199.4269	137.4958	-2.4267	0.8457	113.6324	119.9741	197.2462	109.9725	164.0656	118.7266
		p-Value	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.9924)*	*(0.1989)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*

Panel A.2: Country-specific variables in first differences

Test	H0	Variable	Spread	Gov Debt	Deficit	GDP Growth	Industrial Prod	Inflation	Ext Balance	Gov Debt EU17	ESI	OECD Bus Conf	OECD Bus Conf2	OECD Cons Conf
IPS	Unit Root	Statistic	-16.5052	-26.8947	-38.8042	-34.0520	-32.0771	-62.0835	-34.5021	-39.8428	-39.0644	-15.4243	-13.0310	-13.3850
		p-Value	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*
Maddala-Wu	Unit Root	Statistic	206.3673	262.6088	327.3769	318.2602	813.8784	661.8569	333.1400	258.8950	307.8907	121.5705	154.8702	175.6989
		p-Value	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*
Breitung	Unit Root	Statistic	-12.8141	-22.7490	-24.4754	-22.2943	-30.2348	-12.1700	-17.4188	-14.1441	-15.6851	-3.2063	-9.0400	-9.3372
		p-Value	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0007)*	*(0.0000)*	*(0.0000)*
Hadry	Stationarity	Statistic	-0.1396	-0.7742	-0.8212	-2.4834	-3.4749	-3.3789	-1.3409	-1.5215	-2.1206	-2.7658	-1.1673	-0.9335
		p-Value	*(0.5555)*	*(0.7806)*	*(0.7942)*	*(0.9935)*	*(0.9997)*	*(0.9996)*	*(0.9100)*	*(0.9359)*	*(0.9830)*	*(0.9972)*	*(0.8785)*	*(0.8247)*

Panel B: Country-specific variables

1. Levels

Test	H0	Variable	VIX	IFO Bus Cli	UniMichigan Cons Conf	Euribor3m
ADF	Unit Root	Statistic	-16.5052	-26.8947	-38.8042	-34.0520
		p-Value	*(0.0026)*	*(0.0411)*	*(0.1772)*	*(0.4202)*
Phillips-Perron	Unit Root	Statistic	-3.496	-1.906	-2.462	-0.879
		p-Value	*(0.0081)*	*(0.3295)*	*(0.1249)*	*(0.7948)*
KPSS	Stationarity	Statistic	0.303	0.695	2.72***	1.6***

2. First differences

Test	H0	Variable	VIX	IFO Bus Cli	UniMichigan Cons Conf	Euribor3m
ADF	Unit Root	Statistic	-32.0771	-62.0835	-34.5021	-39.8428
		p-Value	*(0.0000)*	*(0.0022)*	*(0.0000)*	*(0.0005)*
Phillips-Perron	Unit Root	Statistic	-11.709	-8.396	-12.548	-6.191
		p-Value	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*
KPSS	Stationarity	Statistic	0.0274	0.0832	0.0696	0.14

Notes: For each test optimal lag length has been selected. As Breitung and Hadri tests require strongly balanced data, they have been carried out on a subsample of the estimation dataset.
*** indicates rejection of the null hypothesis of stationarity in the KPSS tests at the 1% level.

TABLE 4

Pooled Mean Group estimates of sovereign spreads determinants

Panel A: Long-run coefficients and error correction

	pmg00 (1)	pmg00 (2)	pmg0_vix (3)	pmg_esi (4)	pmg_oecd_b (4a)	pmg_oecd_b2 (5b)	pmg_oecd_c (6)	pmg_ifo_bc (7)	pmg_unimich (8)
Long Run Coefficients									
Gov Debt	0.0693***	0.0633***	0.0528***	0.0323**	0.0399**	0.0465***	0.0411***	0.0565***	0.0546***
	(0.0226)	(0.0174)	(0.0149)	(0.0141)	(0.0158)	(0.0138)	(0.0156)	(0.0185)	(0.0145)
Deficit	0.0140	0.0374**	0.0348***	0.0339***	0.0332***	0.0278***	0.0319***	0.0421***	0.0315***
	(0.0243)	(0.0154)	(0.0118)	(0.0105)	(0.0118)	(0.0105)	(0.0117)	(0.0158)	(0.0112)
GDP Growth	-0.2924***	-0.1789***	-0.1262***	-0.0889***	-0.0990***	-0.0758**	-0.1029***	-0.1401***	-0.1151***
	(0.0763)	(0.0444)	(0.0314)	(0.0271)	(0.0328)	(0.0302)	(0.0323)	(0.0437)	(0.0296)
Industrial Prod	-0.1370**	-0.0959**	-0.0736**	-0.0515**	-0.0630**	-0.0569**	-0.0675**	-0.0824**	-0.0712***
	(0.0603)	(0.0376)	(0.0287)	(0.0245)	(0.0293)	(0.0259)	(0.0283)	(0.0380)	(0.0274)
Inflation	1.6875***	0.9983***	0.7428***	0.6277***	0.6897***	0.6082***	0.7098***	1.0483***	0.6816***
	(0.3979)	(0.2114)	(0.1566)	(0.1354)	(0.1543)	(0.1343)	(0.1526)	(0.2295)	(0.1482)
Ext Balance	-0.1000	-0.0848**	-0.0700**	-0.0516**	-0.0512	-0.0569**	-0.0395	-0.0571	-0.0636**
	(0.0663)	(0.0392)	(0.0292)	(0.0255)	(0.0314)	(0.0269)	(0.0311)	(0.0401)	(0.0284)
Gov Debt EU17	-0.5583***	-0.4673***	-0.5681***	-0.4399***	-0.4810***	-0.4882***	-0.4609***	-0.4453***	-0.5756***
	(0.1309)	(0.0848)	(0.0802)	(0.0761)	(0.0889)	(0.0767)	(0.0902)	(0.1098)	(0.0785)
3-month EURIBOR		0.4157***	0.1101	0.0440	0.0912	0.0696	0.0678	0.0843	0.0902
		(0.1063)	(0.0710)	(0.0626)	(0.0728)	(0.0630)	(0.0708)	(0.1004)	(0.0686)
VIX			0.0355***	0.0321***	0.0422***	0.0346***	0.0360***	0.0620***	0.0313***
			(0.0075)	(0.0064)	(0.0087)	(0.0070)	(0.0077)	(0.0146)	(0.0079)
ESI				-0.0280***					
				(0.0089)					
OECD Bus Conf					-0.2609***				
					(0.0749)				
OECD Bus Conf2						-0.1849***			
						(0.0495)			
OECD Cons Conf							-0.0965**		
							(0.0403)		
IFO Bus								0.0525***	
								(0.0167)	
Michigan									-0.0054
									(0.0056)
Error Correction Coefficient	-0.0477***	-0.0656***	-0.0746***	-0.0799***	-0.0710***	-0.0782***	-0.0757***	-0.0637***	-0.0775***
	(0.0098)	(0.0098)	(0.0115)	(0.0129)	(0.0120)	(0.0139)	(0.0117)	(0.0094)	(0.0122)

Panel B: Short-run coefficients and Hausman tests

	pmg00 (1)	pmg00 (2)	pmg0_vix (3)	pmg_esi (4)	pmg_oecd_b (4a)	pmg_oecd_b2 (5b)	pmg_oecd_c (6)	pmg_ifo_bc (7)	pmg_unimich (8)
Short Run Coefficients									
D Spread (t-1)	0.1002***	0.0806**	0.0608	0.0576	0.0163	0.0458	0.0576	0.0429	0.0677*
	(0.0260)	(0.0320)	(0.0378)	(0.0368)	(0.0410)	(0.0371)	(0.0384)	(0.0388)	(0.0383)
D Spread (t-2)	0.1399***	0.1178***	0.1077***	0.1047***	0.1036***	0.0909***	0.1034***	0.0929***	0.1085***
	(0.0373)	(0.0362)	(0.0349)	(0.0346)	(0.0227)	(0.0349)	(0.0351)	(0.0334)	(0.0341)
D Gov Debt (% GDP) (t)	0.0172	0.0206	0.0224	0.0226	0.0059	0.0222	0.0223	0.0230	0.0228
	(0.0176)	(0.0173)	(0.0175)	(0.0178)	(0.0040)	(0.0175)	(0.0176)	(0.0173)	(0.0178)
D Deficit (t)	0.0045**	0.0035*	0.0029	0.0029	0.0011	0.0029	0.0028	0.0027	0.0034
	(0.0021)	(0.0020)	(0.0018)	(0.0022)	(0.0010)	(0.0018)	(0.0018)	(0.0018)	(0.0023)
D GDP Growth (t)	0.0035	0.0007	-0.0001	-0.0003	0.0047	0.0006	-0.0007	0.0012	-0.0002
	(0.0072)	(0.0071)	(0.0075)	(0.0072)	(0.0037)	(0.0058)	(0.0074)	(0.0075)	(0.0062)
D Industrial Prod (t)	0.0063***	0.0062***	0.0047***	0.0038***	0.0034***	0.0039***	0.0045***	0.0043***	0.0045***
	(0.0011)	(0.0011)	(0.0009)	(0.0008)	(0.0009)	(0.0009)	(0.0009)	(0.0009)	(0.0009)
D Inflation (t)	-0.0760***	-0.0673***	-0.0634***	-0.0600***	-0.0469***	-0.0586***	-0.0620***	-0.0706***	-0.0611***
	(0.0195)	(0.0145)	(0.0133)	(0.0126)	(0.0113)	(0.0124)	(0.0132)	(0.0150)	(0.0135)
D Inflation (t-1)	-0.0295***	-0.0234***	-0.0229***	-0.0221***	-0.0179***	-0.0217***	-0.0227***	-0.0276***	-0.0217***
	(0.0100)	(0.0070)	(0.0054)	(0.0054)	(0.0056)	(0.0054)	(0.0055)	(0.0072)	(0.0054)
D Ext Balance (t)	0.0172*	0.0175**	0.0142*	0.0113	0.0082	0.0147*	0.0131	0.0138	0.0153*
	(0.0090)	(0.0088)	(0.0085)	(0.0080)	(0.0063)	(0.0089)	(0.0085)	(0.0084)	(0.0091)
D Gov Debt EU17 (t)	0.0270	0.0169	0.0219	0.0199	0.0294	0.0257	0.0244	0.0167	0.0177
	(0.0206)	(0.0206)	(0.0209)	(0.0221)	(0.0209)	(0.0266)	(0.0221)	(0.0218)	(0.0216)
D 3-month EURIBOR (t)		-0.0948***	-0.0392	-0.0474	-0.0074	-0.0447	-0.0354	-0.0543*	-0.0400
		(0.0257)	(0.0291)	(0.0352)	(0.0208)	(0.0430)	(0.0324)	(0.0282)	(0.0286)
D VIX (t)			0.0054***	0.0053**	0.0032***	0.0054**	0.0053**	0.0045**	0.0064**
			(0.0021)	(0.0022)	(0.0010)	(0.0024)	(0.0021)	(0.0020)	(0.0026)
D ESI (t)				-0.0080					
				(0.0054)					
D OECD Bus Conf (t)					0.0222				
					(0.0296)				
D OECD Bus Conf2 (t)						-0.0874			
						(0.1012)			
D OECD Cons Conf (t)							-0.0053		
							(0.0065)		
D IFO Bus (t)								-0.0045	
								(0.0039)	
D Michigan (t)									0.0047
									(0.0029)
Dummy 2000-2002	-0.0852**	-0.2046***	-0.1662***	-0.1244***	-0.1054**	-0.1248***	-0.1574***	-0.1497***	-0.1519***
	(0.0421)	(0.0435)	(0.0439)	(0.0403)	(0.0419)	(0.0360)	(0.0417)	(0.0458)	(0.0423)
Dummy 2003-2005	-0.0850*	-0.1529***	-0.1248***	-0.1015**	-0.0737*	-0.1034***	-0.1146***	-0.0988**	-0.1174***
	(0.0440)	(0.0438)	(0.0432)	(0.0410)	(0.0379)	(0.0348)	(0.0419)	(0.0461)	(0.0422)
Dummy 2006-2008	-0.1040**	-0.2031***	-0.1549***	-0.1292***	-0.1142***	-0.1244***	-0.1454***	-0.1526***	-0.1431***
	(0.0454)	(0.0472)	(0.0423)	(0.0428)	(0.0425)	(0.0386)	(0.0416)	(0.0485)	(0.0395)
Intercept	-0.2430***	-0.2957***	-0.4317***	-0.3239**	-0.3707***	-0.3893***	-0.3317***	-0.6713***	-0.4246***
	(0.0757)	(0.0826)	(0.1473)	(0.1321)	(0.1258)	(0.1460)	(0.1253)	(0.1125)	(0.1566)
Hausman tests									
MG vs. PMG	3.69	5.13	4.73	3.09	5.51	6.87	0.36	9.41	6.67
	0.815	0.744	0.857	0.979	0.855	0.738	1.000	0.494	0.756
PMG vs. DFE	25.89	21.96	23.41	40.56	80.6	25.33	24.37	44.68	77.8
	0.001	0.005	0.005	0.000	0.000	0.005	0.007	0.000	0.000
N x T	1521	1521	1521	1521	1465	1521	1521	1521	1521
N. of countries	10	10	10	10	10	10	10	10	10
Min T	144	144	144	144	88	144	144	144	144
Avg T	152.10	152.10	152.10	152.10	146.50	152.10	152.10	152.10	152.10
Max T	153	153	153	153	153	153	153	153	153
Log. Likelihood	765.25	789.18	820.51	834.88	1217.88	835.63	824.62	831.43	825.13

Notes: Standard errors are reported in parenthesis below the estimates.
***, ** and * denote significance at the 1, 5 and 10 per cent level, respectively.

TABLE 5

Country-specific estimates of the speed of adjustment coefficients

	pmg00 (1)	pmg00 (2)	pmg0_vix (3)	pmg_esi (4)	pmg_oecd_b (4a)	pmg_oecd_b2 (5b)	pmg_oecd_c (6)	pmg_ifo_bc (7)	pmg_unimich (8)
Austria	-0.0223	-0.0590***	-0.1033***	-0.1255***	-0.1032***	-0.1156***	-0.1082***	-0.0607***	-0.1083***
	(0.0141)	(0.0191)	(0.0232)	(0.0250)	(0.0223)	(0.0232)	(0.0237)	(0.0167)	(0.0239)
Belgium	-0.0331**	-0.0862***	-0.1209***	-0.1280***	-0.1235***	-0.1405***	-0.1226***	-0.0774***	-0.1300***
	(0.0146)	(0.0232)	(0.0266)	(0.0295)	(0.0279)	(0.0303)	(0.0273)	(0.0205)	(0.0277)
Finland	-0.0184**	-0.0349***	-0.0492***	-0.0582***	-0.0476***	-0.0497***	-0.0475***	-0.0362***	-0.0528***
	(0.0075)	(0.0103)	(0.0127)	(0.0138)	(0.0118)	(0.0133)	(0.0126)	(0.0096)	(0.0134)
France	-0.0332***	-0.0566***	-0.0723***	-0.0854***	-0.0631***	-0.0873***	-0.0753***	-0.0539***	-0.0750***
	(0.0120)	(0.0155)	(0.0167)	(0.0193)	(0.0149)	(0.0182)	(0.0172)	(0.0139)	(0.0171)
Greece	-0.0363*	-0.0342	-0.0297	-0.0198	-0.0072	-0.0054	-0.0294	-0.0348	-0.0295
	(0.0213)	(0.0210)	(0.0209)	(0.0216)	(0.0057)	(0.0251)	(0.0224)	(0.0218)	(0.0208)
Ireland	-0.1056***	-0.1120***	-0.1018***	-0.1023***	-0.0899***	-0.0962***	-0.1007***	-0.1193***	-0.1057***
	(0.0263)	(0.0286)	(0.0286)	(0.0288)	(0.0275)	(0.0285)	(0.0290)	(0.0305)	(0.0299)
Italy	-0.0851***	-0.1173***	-0.1290***	-0.1347***	-0.1208***	-0.1345***	-0.1298***	-0.1022***	-0.1331***
	(0.0207)	(0.0230)	(0.0230)	(0.0239)	(0.0219)	(0.0233)	(0.0233)	(0.0202)	(0.0235)
Netherlands	-0.0136***	-0.0303***	-0.0360***	-0.0409***	-0.0347***	-0.0439***	-0.0358***	-0.0247***	-0.0381***
	(0.0048)	(0.0078)	(0.0090)	(0.0100)	(0.0086)	(0.0107)	(0.0090)	(0.0067)	(0.0096)
Portugal	-0.0687***	-0.0614***	-0.0522***	-0.0529***	-0.0572***	-0.0480***	-0.0521***	-0.0649***	-0.0517***
	(0.0171)	(0.0162)	(0.0148)	(0.0149)	(0.0164)	(0.0158)	(0.0155)	(0.0162)	(0.0148)
Spain	-0.0604***	-0.0642***	-0.0516***	-0.0514***	-0.0631***	-0.0613***	-0.0560***	-0.0633***	-0.0511***
	-0.016	(0.0166)	(0.0159)	(0.0162)	(0.0176)	(0.0170)	(0.0167)	(0.0154)	(0.0162)

Notes: Standard errors are reported in parenthesis below the estimates.
***, ** and * denote significance at the 1, 5 and 10 per cent level, respectively.

TABLE 6

Robustness analysis: estimated long-run coefficients including short-run interactions

	pmg00 (1)	pmg00 (2)	pmg0_vix (3)	pmg_esi (4)	pmg_oecd_b (4a)	pmg_oecd_b2 (5b)	pmg_oecd_c (6)	pmg_ifo_bc (7)	pmg_unimich (8)
Long Run Coefficients									
Gov Debt	0.0741***	0.0522***	0.0588***	0.0323**	0.0356**	0.0289**	0.0500***	0.0456**	0.0643***
	(0.0174)	(0.0158)	(0.0180)	(0.0164)	(0.0178)	(0.0135)	(0.0177)	(0.0226)	(0.0179)
Deficit	0.0016	0.0304**	0.0378**	0.0382***	0.0354**	0.0231**	0.0314**	0.0424*	0.0389**
	(0.0189)	(0.0135)	(0.0166)	(0.0132)	(0.0139)	(0.0099)	(0.0153)	(0.0220)	(0.0170)
GDP Growth	-0.2117***	-0.1540***	-0.1914***	-0.1030***	-0.1122***	-0.0699**	-0.1381***	-0.2014***	-0.1943***
	(0.0565)	(0.0389)	(0.0478)	(0.0349)	(0.0389)	(0.0272)	(0.0445)	(0.0637)	(0.0488)
Industrial Prod	-0.1329***	-0.1072***	-0.1297***	-0.0798**	-0.0907***	-0.0701***	-0.1001***	-0.1351***	-0.1273***
	(0.0478)	(0.0343)	(0.0419)	(0.0313)	(0.0341)	(0.0243)	(0.0373)	(0.0522)	(0.0427)
Inflation	1.4203***	0.9498***	1.3777***	1.0228***	1.0398***	0.6951***	1.2537***	1.8179***	1.3855***
	(0.3052)	(0.1946)	(0.2764)	(0.2003)	(0.2097)	(0.1368)	(0.2511)	(0.4011)	(0.2920)
Ext Balance	-0.1257**	-0.1027***	-0.1119***	-0.0810**	-0.0798**	-0.0626**	-0.0796*	-0.1090*	-0.1106**
	(0.0528)	(0.0357)	(0.0433)	(0.0320)	(0.0380)	(0.0259)	(0.0418)	(0.0586)	(0.0457)
Gov Debt EU17	-0.5761***	-0.4053***	-0.5693***	-0.4327***	-0.4243***	-0.3605***	-0.5248***	-0.2362	-0.5881***
	(0.1086)	(0.0792)	(0.1035)	(0.0885)	(0.1019)	(0.0748)	(0.1152)	(0.1639)	(0.1046)
3-month EURIBOR		0.4174***	0.3530***	0.1742**	0.1974**	0.1329**	0.2440**	0.4552**	0.3520***
		(0.0996)	(0.1234)	(0.0866)	(0.0926)	(0.0629)	(0.1092)	(0.1803)	(0.1295)
VIX			0.0342***	0.0303***	0.0391***	0.0236***	0.0360***	0.0706***	0.0319**
			(0.0114)	(0.0084)	(0.0104)	(0.0065)	(0.0107)	(0.0213)	(0.0132)
ESI				-0.0349***					
				(0.0105)					
OECD Bus Conf					-0.3790***				
					(0.1013)				
OECD Bus Conf2						-0.2034***			
						(0.0480)			
OECD Cons Conf							-0.0945**		
							(0.0434)		
IFO Bus								0.0941***	
								(0.0273)	
Michigan									-0.0036
									(0.0084)
Error Correction Coefficient	-0.0558***	-0.0695***	-0.0604***	-0.0665***	-0.0668***	-0.0746***	-0.0630***	-0.0494***	-0.0605***
	(0.0117)	(0.0107)	(0.0099)	(0.0124)	(0.0114)	(0.0175)	(0.0111)	(0.0100)	(0.0097)

Notes: Short-run coefficients are not reported; complete results are available from the authors. Standard errors are reported in parenthesis below the estimates.

***, ** and * denote significance at the 1, 5 and 10 per cent level, respectively.