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Pricing sovereign bond risk in the EMU area: An empirical investigation *

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Abstract

We use a panel of ten euro area countries to assess the determinants of long-term sovereign bond yield spreads over the period 1999.01-2010.11. We find that government bond yield spreads are well-explained by fiscal fundamentals over the crisis period. We also find that the menu of risk factors priced by markets has been significantly enriched since March 2009, including international risk, liquidity risk and the risk of the crisis' transmission among EMU member states. Finally, we find that transmission risk has increased considerably since spring 2009 due to rapidly increasing risk of investing in periphery bonds relative to core ones.

JEL: C23, E62, H50.
Keywords: sovereign yields, government debt, panel analysis

1. Introduction

Following the 2008-2009 international financial crisis, fiscal imbalances increased in the euro area, reflecting the high fiscal cost of the measures taken to contain the fallout from the credit crisis. These developments have been followed by a sovereign debt crisis, which started from Greece in autumn 2009 and gradually engulfed the whole of the European Monetary Union (EMU), particularly the so-called periphery EMU economies. With their government bond yields soaring, and following a series of credit rating downgrades, Greece Ireland and Portugal were forced in 2010-11 to resort to financial rescue schemes organised by the European Union (EU), the European Central Bank (ECB) and the International Monetary Fund (IMF). These, however, failed to put a halt to the crisis. Not only all three countries remain, effectively, cut-off from international bond markets, but since the second half of 2011 Spanish and Italian government bonds have been under significant market pressure.

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A number of recent studies have attempted to identify the factors affecting EMU government bonds yields spreads against Germany, the variable typically used to measure the crisis' severity and extent. These studies share two common findings. First, the widening in spreads is largely driven by the increased international risk factor. In this process, the role of the banking sector has been crucial (see Attinasi et al., 2009; Barrios et al., 2009; Gerlach et al., 2010; Schuknecht et al., 2010; and Acharya et al., 2011). Second, markets now penalise fiscal and macro-imbalances much more heavily than before the crisis (see Barrios et al., 2009; Manganelli and Wolswijk, 2009; Schuknecht et al., 2010; Favero and Missale, 2011; Arghyrou and Tsoukalas, 2011; Arghyrou and Kontonikas, 2012). Moreover, there exist important cross-country contagion/spill-over effects (see Arghyrou and Kontonikas, 2012; De Santis, 2012; Favero and Missale, 2011). Finally, liquidity risk has been playing a limited role in the current crisis (see e.g. Barrios et al., 2009; Arghyrou and Kontonikas, 2012; De Santis, 2012; Favero and Missale, 2011).

In this paper we investigate the determinants of European government bond yield spreads against Germany adding to the existing literature three new dimensions. First, our analysis focuses onto the extent to which the determination of spreads has changed before and after the onset of the crisis, as well as during different stages of the crisis. Specifically, we distinguish not only between the period preceding and following the global credit crunch in the summer of 2007, as the majority of existing studies do, but also the period during which the global credit crunch had not yet mutated into a sovereign debt crisis; and the period during which it did so, following the revelation in spring 2009 of the fiscal costs caused by the global credit crunch. Second, we allow government bond yields to be determined by a quantitative measure of the risk of crisis transmission across EMU countries derived using principal components analysis. This reveals increasing divergence between core and periphery EMU and provides information on the market's perception regarding each country's classification across the two groups, as well as the firmness of this perception. Finally, we use a widened set of fundamentals in the empirical analysis of EMU sovereign spreads allowing us to test whether spreads' variability is explained by factors additional to those considered by the existing literature.

The remainder of the paper is structured as follows. Section 2 discusses our methodology. Section 3 presents our empirical findings. Finally, section 4 concludes.

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2. Methodology

Existing studies typically model European government bond yields on three main variables namely an international risk factor; credit risk and liquidity risk (see e.g. Manganelli and Wolswijk, 2009). Based on the above, we use a unified framework of analysis capturing simultaneously and extending the insights of the studies by Arghyrou and Kontonikas (2012) and Afonso et al. (2012). In its simplest version our econometric model can be written as:

$$spr_{it} = a + \beta_1 spr_{it-1} + \beta_2 vix_t + \beta_3 ba_{it} + \beta_4 balance_{it} + \beta_5 debt_{it} + \beta_6 q_{it} + \beta_7 gind_{it} + \beta_8 pc2_t + \gamma_i + \varepsilon_{it.} \quad (1)$$

Equation (1) models the 10-year government bond yield spread versus Germany, spr_{it}, on the international risk factor, bond market liquidity conditions, macroeconomic and fiscal fundamentals, and contagion effects, also incorporating country-specific fixed effects (γ_i). We employ a panel of ten euro area countries (Austria, Belgium, Finland, France, Greece, Ireland, Italy, the Netherlands, Portugal and Spain), using monthly data over the period 1999:01-2010:12. The data sources and definitions are in the Appendix. To account for endogeneity across the right hand side variables[1] we estimate equation (1) using Two-Stage Least Squares (2SLS) with cross-section weights accounting for cross-sectional heteroskedasticity.[2]

Following standard practice in the literature Equation (1) includes lagged spreads to account for spreads' persistence (see also Gerlach et al., 2010).[3] vix_t is the logarithm of the S&P 500 implied stock market volatility index (VIX), a widely-used proxy for the international risk factor (see e.g. Beber et al., 2009; and Gerlach et al., 2010). ba_{it} denotes the 10-year government bond bid-ask spread used to capture liquidity effects (see e.g. Barrios et al., 2009; Favero et al., 2010; and Gerlach et al., 2010). $balance_{it}$ and $debt_{it}$ respectively denote the expected (one-year ahead) government budget balance-to-GDP ratio and the expected government debt-to-GDP ratio, both measured as differentials versus Germany (see

[1] For each sample country we have applied the Darbin-Wu-Hausman endogeinity test. The results (available upon request) suggest that the null hypothesis of exogeneity for the vector of the right-hand side variables of equation (1) is rejected.

[2] An alternative panel estimation approach, the Arrelano and Bond Genarlised Method of Moments, is more appropriate when the panel includes a large number of cross-sections and a small number of time-series observations, that is the opposite case of the panel we work with. We have also estimated our models using the Feasible Generalised Least Squares method with cross-section weights accounting for cross-sectional heteroskedasticity. The results (available upon request) are similar to the 2SLS ones.

[3] While the persistent nature of spreads implies that the exclusion of the lagged spread will generate omitted variable bias (see Hallerberg and Wolff, 2008) its inclusion generates a different bias since the lagged spread is correlated with the fixed effects (see Nickell, 1981). Nevertheless, the latter bias declines as the time-series dimension of the panel (T) increases and becomes quite small once T reaches 20 (see Hallerberg and Wolff, 2008). In our sample T = 144, hence any bias due the inclusion of the lagged spread is very small and in all likelihood smaller than the omitted variables bias arising by its exclusion. For robustness we have also estimated our base line model excluding the lagged spread term. The results, available upon request, remain very similar.

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e.g. Gerlach et al., 2010; and Favero and Missale, 2011).[4] q_{it} is the log of the trade-weighted real effective exchange rate. This captures credit risk originating from general macroeconomic disequilibrium although, given the inclusion in equation (1) of variables specifically capturing fiscal fundamentals and growth conditions, in our specifications it may be mainly capturing external competitiveness.[5] $gind_{it}$ is the annual growth rate of industrial production (differential versus Germany), used as a proxy for the effects of economic growth on spreads (see Bernoth et al., 2004). Finally, $pc2_t$ is our proxy for the risk of transmission of the sovereign debt crisis among EMU members. This is derived using principal components analysis (see Longstaff et al., 2011) explained in section 3.1 below.

We extend Equation (1) by adding variables capturing further insights relating to the movements of spreads within the EMU. First, we add the share of long-term general government debt, $ltsdebt_{it}$, defined as debt maturing at least after one year, in total general government debt. Second, we add the interaction between past spreads and illiquidity conditions (see Llorente et al., 2002). Given that sovereign bond yield spreads and bid-ask spreads are highly positively correlated,[6] the product of these two variables typically increases (declines) because both terms increase (decline). Therefore, $(spr_{it-1}*ba_{it-1})$ can be interpreted as a stress indicator for bond markets, since a rise is associated with falling bond prices and higher illiquidity. Assuming an increase in spreads and illiquidity, a positive coefficient for $(spr_{it-1}*ba_{it-1})$ would indicate the existence of market forces pushing bond prices below their equilibrium value, as this is determined by the remaining spreads' determinants. This would be consistent with (though not definitely proving) speculation trading pushing bond prices below their fair value. On the other hand, a negative coefficient for $(spr_{it-1}*ba_{it-1})$ would indicate market forces pushing bond prices above their equilibrium value. This could be consistent with (a) purchases by private agents, speculating that the market has underpriced bonds, which they proceed to buy in anticipation of a future price increases; (b) purchases by institutional investors in an effort to prevent a collapse of the bonds' market. Overall in its most general form our empirical model of spreads is given by:

$$\begin{aligned} spr_{it} = a &+ \beta_1 spr_{it-1} + \beta_2 vix_t + \beta_3 ba_{it} + \beta_4 balance_{it} + \beta_5 debt_{it} + \beta_6 q_{it} + \beta_7 gind_{it} \\ &+ \beta_8 pc2_t + \beta_9 ltsdebt_{it} + \beta_{10} debt_{it}^2 + \beta_{11} spr_{it-1} ba_{it-1} + \gamma_i + \varepsilon_{it} . \end{aligned} \quad (2)$$

[4] These forecasts are produced by the European Comission's DG ECFIN twice a year (spring and autumn).

[5] The inclusion of real exchange rates in a model for spreads is theoretically justified in the analysis of Arghyrou and Tsoukalas (2011). The empirical significance of real exchange rates in explaining spreads in the EMU area has been confirmed by Arghyrou and Kontonikas (2012).

[6] In our panel the correlation coefficient between sovereign bond yields spreads and bid-ask spreads is 0.77.

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After estimating Equations (1) and (2) we account for two possible structural breaks in the relationship between spreads and their determinants using two slope dummy variables. The first ($D2007.08_t$) aims to capture the effects of the global financial crisis, widely accepted to begin in August 2007 (see e.g. Arghyrou and Kontonikas, 2012; Attinasi et al., 2009). The second ($D2009.03_t$) captures the point in time when the global credit crisis started being transformed into the European sovereign debt crisis. We date this development back to March 2009 for two reasons. First, the most intense period of the credit crisis was over by the spring 2009 with major stock market indices experiencing their lowest levels in early March 2009 and since then recording significant gains. Second, March 2009 was the month when the European Commission revised upwards the projected public debt to GDP ratio by an average of 19% across euro area members, making the fiscal fallout of the banking crisis public news.

3. Empirical findings

3.1. Measuring transmission effects

Following the spike in all countries' spreads at the height of the global credit crunch, the spreads of core EMU countries have been relatively stable, albeit at levels higher compared to those of the pre-crisis period, while those of periphery EMU countries have been on an ascending path. This core-periphery divergence raises the possibility of transmission of the sovereign debt crisis within the euro area. We define transmission as the increase in the spread of any given EMU country due to the markets discounting worsened future fiscal and/or macro fundamentals for that country after having observed an increased probability of default in another EMU country, reflected in higher spreads for that second country. Transmission can take place both from periphery to core countries, as well as within periphery countries and is linked to periphery-core divergence through two channels.

First, core-periphery divergence, denoting increased probability of default and/or euro exit in one or more periphery countries, signals an increased probability of future sovereign rescues. Given the superior state of their fiscal fundamentals, the latter are more likely to be financed by core countries. Therefore, core-periphery divergence signals an increased probability of increased future borrowing requirements from core countries to cover the potential support efforts. Through this channel, core-periphery divergence may cause transmission of the crisis from the periphery to the core.

Second, increased probability of default and/or euro exit in one periphery country may operate as a trigger for fears of subsequent default and/or euro exit in another periphery country (the so-called domino effect). Hence, increasing core-periphery divergence caused by

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increased spreads in a specific periphery country may cause precautionary capital flight in other periphery countries, leading to a tighter credit environment and deteriorating growth expectations. These, in turn, can cause deteriorating expectations about future fiscal performance, increasing credit risk through the channels linking banking risk with sovereign risk. Through this channel, increasing core-periphery divergence may cause crisis transmission from one periphery country to another.

To test the transmission hypothesis we need a quantitative measure of transmission risk which we pursue through a principal components analysis (see Longstaff et al., 2011). The results are presented in Table 1. The reported eigenvalues and the cumulative proportion figures suggest that the variance of the spreads is essentially captured by the first two principal components which explain around 97% of the variation of the full variable set. This also implies that we only take into account the components whose associated eigenvalues are above 0.7, a rule suggested by Jollife (1972).

[Table 1]

The first principal component can be interpreted as an EMU-wide indicator of sovereign risk (roughly a general index of spreads) with all countries entering with approximately equal weights. The second component differentiates between two groups of countries, distinguished by the sign of the reported weights. Table 1 suggests that the first group (denoted by a positive sign) includes Finland, the Netherlands, Austria, France and Belgium. The second group (denoted by a negative sign) includes Greece, Portugal, Spain, Ireland and Italy. The country composition of the two groups identified by the second principal component coincides with the core- and periphery-groups widely assumed to exist within the euro area. The absolute size of the reported weights is indicative of the markets' perception regarding the definitiveness of a country's position within its group. These suggest a firm periphery classification for Greece, Portugal and, to a slightly lesser extent, Spain and Ireland. Italy falls within the periphery group by a small margin. On the other hand, we obtain a firm core classification for Finland, Netherlands, and Austria and, to a lesser extent, France. Belgium falls within the core group by a small margin.

The second principal component provides a measure of divergence between the core and periphery groups, roughly a kind of spread between the core and periphery countries (see Longstaff et al. 2011, p.81) As such, it can be interpreted as the risk involved in investing in core bonds relative to the risk of investing in periphery bonds. As explained earlier, increasing divergence between the core and periphery groups indicates an increasing probability of a sovereign default and/or euro exit within the periphery group. This is directly linked to the

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concept of crisis' transmission through the two channels (periphery-to-core and periphery-to-periphery transmission) described above.

Figure 1 plots the first two estimated principal components for the period 1999-2010. Focusing on the second principal component, starting from early 2009 the two groups are decoupled, with the risk of the periphery relative to the core increasing rapidly. Furthermore, the first principal component has been rising since early 2010 indicating the possibility of transmission from the developing periphery crisis. Overall, the movements of the second principal component provide clear evidence for core-periphery divergence since early 2009, which in association with the recent increase in the first principal component, and on the basis of our arguments above, renders the former variable an appropriate proxy for transmission effects. In our empirical models variable $pc2_t$, defined as minus the second principal component, is used to capture transmission effects.[7] If the latter are present $pc2_t$ is expected to enter the empirical models of spread determination with a significantly positive sign.

[Figure 1]

3.2. Panel estimation results

We start our econometric investigation by estimating Equations (1) and (2) for the full sample period without allowing for possible structural breaks. The results from our 2SLS estimations are reported in Table 2. Spreads appear to be highly persistent. In Column (2), that reports estimates from the fully specified model, we obtain statistically significant coefficients with the theoretically expected signs for the international risk factor, the fiscal balance and growth conditions. Liquidity conditions are significant with the appropriate sign only in the estimates of Column (1). The role of fiscal fundamentals appears limited, since public debt and the ratio of long-term debt to total debt are not statistically significant while the fiscal balance is significant only at the 10% level. Finally, real exchange rates, the principal component capturing transmission effects and the multiplicative term involving past spreads and illiquidity are not significant. Overall, some of the findings reported in Table 2 are consistent with our a priori expectations while others are not.

[Table 2]

We now turn our attention to the examination of structural change in the links between the risk factors and sovereign spreads. Specifically, we repeat our estimation of the fully specified model accounting for slope dummies differentiating between three periods, namely the period preceding the global financial crisis (1999.01 – 2007.07), the early crisis period

[7] Increases in $pc2_t$ indicate higher periphery risk. The negative sign of the second pricipal component in the definition of $pc2_t$ is an adjustment for the fact that periphery countries load negatively in the former.

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(2007.08 – 2009.02) and the latter crisis period (2009.03 – 2010.12). Column (3) in Table 2 reports the 2SLS estimation results. Our results suggest that markets started pricing the international risk factor since the onset of the global credit crunch in summer 2007 and liquidity risk only during the latter part of the European debt crisis. Importantly, we find that there was stronger impact from international risk on sovereign spreads during the escalation of the debt crisis. Furthermore, transmission risk becomes a significant determinant of spreads since March 2009, with the variable displaying the theoretically expected positive sign. The role of fiscal fundamentals, debt in particular, increases in significance during the crisis period: Markets have been penalising increases in expected debt throughout our sample period but started attaching increasingly higher penalties since the onset of the financial crisis in August 2007 and especially during the debt crisis period. Furthermore, since March 2009 a decrease in the long-term component of total public debt is associated with higher spreads.[8]

All in all, our results suggest that since the onset of the global financial crisis in summer 2007 markets have gradually moved to a pricing model that is much more compatible with theoretical expectations. [9]Furthermore, the menu of fundamentals affecting sovereign risk has been becoming richer as the crisis evolves. Therefore, compared to the no-breaks models, accounting for structural change offers superior information regarding the determinants of sovereign bond spreads in the euro area and the timing of activation of these links, especially for the crisis period.

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[8] The positive sign of the first slope dummy on *ltsdebt* indicates that between summer 2007 and spring 2009 the decrease in the share of long-term debt to total debt was not penalised by markets. This is consistent with the prediction by Favero et al. (2010) according to which in crisis periods investors choose from a reduced set of alternative investment opportunities, limiting their willingness to move away from government debt securities. In the process of fleeing the stock market at the early phase of the global credit crisis, and given an environment of high uncertainty not favouring long-term commitment of funds, investors increased their demand for liquid short term Treasury bills. At the same time, sovereign bond issuers had an incentive to increase short term debt issuance in order to avoid locking themselves into (the prevailing at the time) high long-term borrowing costs.

[9] Our finding that international risk, liquidity risk and the majority of fiscal and macro variables were not priced prior to the global credit crunch of 2007 is supportive of the 'convergence trade' hypothesis, according to which investors "…bought the bonds of peripheral European governments in the hope that their yields would convergence with those of Germany" (The Economist, 12/06/2010). The resulting high demand for the bonds of periphery countries exerted a downward pressure on their spreads and the expectation of convergence became self-fulfilling, leading to profits for bond market investors and lower borrowing costs for the governments, even in the presence of deteriorating fundamentals. This hypothesis, and the findings reported in Table 2, are consistent with the theoretical model by Arghyrou and Tsoukalas (2011), according to which prior to 2007 the investment risk caused by macro and fiscal imbalances were not priced by markets due to full credibility of each country's EMU participation and a perceived guarantee of the fiscal liabilities of each EMU member by the rest of the EMU countries. Arghyrou and Tsoukalas argue that following the global credit crunch and developments in Greece in 2009 a double shift in expectations took place, transferring Greece and other periphery EMU countries from a regime of full credibility of future EMU participation under fiscal guarantees, implying no pricing of any risk factors, to a regime of non-fully credible EMU participation without fiscal guarantees, where markets attach positive risk premia to all sources of investment risk in line with theoretical expectations.

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4. Conclusions

In this paper we studied the determinants of long-term government bond yield spreads against Germany in ten euro area countries using an extended set of potential spreads' determinants and monthly data over the period 1999:01-2010:11. In the process we derived a quantitative measure of the crisis' perceived transmission risk using principal components analysis. This provides information on the risk of investing in periphery relative to core bonds, the composition of each group and the firmness of market perceptions regarding each country's classification within the groups. Our main findings can be summarised as follows: First, starting from early 2009 periphery and core countries are clearly decoupled, with the perceived risk of the periphery relative to the core increasing rapidly. Second, European government bond yield spreads are well-explained by fiscal fundamentals over the crisis period. Third, the menu of risk factors priced by markets has been significantly enriched since March 2009, including the risk of the crisis' transmission, international risk and liquidity risk.

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Figures and Tables

Figure 1: Principal components of 10-year government bond yield spreads

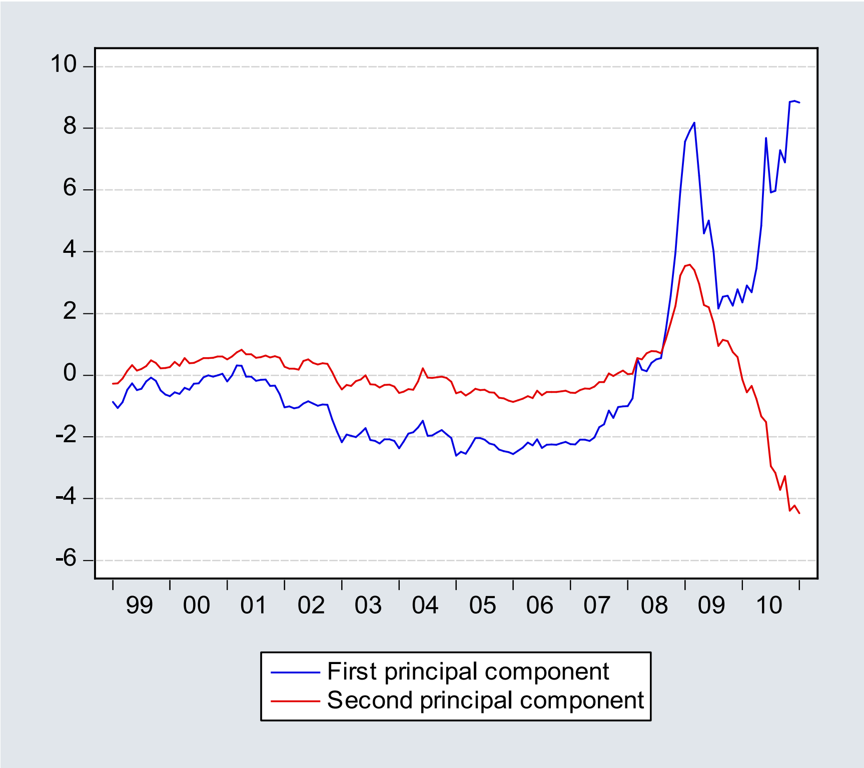

Table 1: Principal component analysis of bond yield spreads

Number	Eigenvalues	Cumulative proportion	Eigenvectors (Loadings)	*First principal component*	*Second principal component*
1	8.193	0.819	Austria	0.315	0.330
2	1.477	0.967	Belgium	0.343	0.070
3	0.121	0.979	Finland	0.278	0.458
4	0.058	0.985	France	0.336	0.160
5	0.049	0.990	Greece	0.290	-0.424
6	0.034	0.993	Ireland	0.323	-0.265
7	0.022	0.995	Italy	0.340	-0.058
8	0.019	0.997	Netherlands	0.295	0.422
9	0.016	0.999	Portugal	0.307	-0.380
10	0.011	1.000	Spain	0.327	-0.273

Note: Principal component analysis is carried out over the time period 1999.01-2011.01 (T=143).

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Table 2: Modelling bond yield spreads

	(1)	(2)	(3)
spr_{it-1}	0.841 ***	0.810 ***	0.476 ***
vix_t	0.062 ***	0.066 ***	-0.013
vix_t*$D2007.08_t$			0.175 *
vix_t*$D2009.03_t$			0.446 **
$pc2_t$	0.001	-0.001	-0.076
$pc2_t$ *$D2007.08_t$			-0.016
$pc2_t$ *$D2009.03_t$			0.146 ***
ba_{it}	0.004 **	0.004	-0.001
ba_{it}*$D2007.08_t$			-0.002
ba_{it} *$D2009.03_t$			0.014 ***
q_{it}	0.053	0.118	0.167
q_{it}*$D2007.08_t$			0.212
q_{it} *$D2009.03_t$			3.189
$balance_{it}$	-0.007 *	-0.009 *	-0.011
$balance_{it}$ *$D2007.08_t$			0.004
$balance_{it}$ *$D2009.03_t$			-0.018
$debt_{it}$	0.000	0.001	0.002 **
$debt_{it}$ *$D2007.08_t$			0.001 *
$debt_{it}$ *$D2009.03_t$			0.004 ***
$gind_{it}$	-0.004 ***	-0.003 *	0.001
$gind_{it}$ *$D2007.08_t$			0.001
$gind_{it}$ *$D2009.03_t$			-0.005
$ltsdebt_{it}$		0.144	0.093
$ltsdebt_{it}$ *$D2007.08_t$			0.702 ***
$ltsdebt_{it}$ *$D2009.03_t$			-0.528 *
spr_{it-1}* ba_{it-1}		0.000	0.004
spr_{it-1}* ba_{it-1}*$D2007.08_t$			0.000
spr_{it-1}* ba_{it-1}*$D2009.03_t$			-0.004
*N*T*	1420	1420	1420
Adj-R^2	0.96	0.96	0.95
J-statistic	5.630	6.138	12.679

Note: The regression models are estimated over the time period 1999.02-2010.11 (T=142). The panel members include Austria, Belgium, Finland, France, Greece, Ireland, Italy, Netherlands, Portugal and Spain (N=10). Two Stage Least Squares (2SLS) fixed effects panel estimates, which account for endogeneity, are reported. The dummy variables *D2007.08* and *D2009.03* which are equal to one from August 2007 and March 2009 onwards, respectively, and zero otherwise were also included as intercept dummies. Colum (1) reports the estimates from the no-breaks baseline model, while Column (2) reports the estimates from the no-breaks fully specified model. Column (3) reports the estimates of the fully specified model that accounts for structural change. The instruments used in the 2SLS estimation of Column 1 are the first lag of *vix*, *pc2* and *ba*, and the first to third lag of *q*, *balance*, *debt* and *gind*. In the estimates of Column 2 the first lag of *ltsdebt* is added in the set of instruments, while in Column 3 the interactive terms are treated as predetermined, as they are entering in their first lag.. The *J*-statistic considers the null hypothesis of valid over-identifying restrictions. The asterisks ***, **, * indicate significance at the 1, 5, 10% level respectively.

.

Appendix

Table A1: Data definition and sources

Variable	Sample	Description	Source
spr	1999.01-2011.01	10 year government bond yield (differential vs. Germany)	ECB/Reuters
vix	1999.01-2011.01	(Log of) S&P 500 implied stock market volatility index (VIX)	Bloomberg
pc2	1999.01-2011.01	(Minus) Second principal component of *spread*	Own calculations
ba	1999.01-2011.01	10 year government bond bid-ask spread	ECB
q	1999.01-2010.12	(Log of) CPI based real effective exchange rate	IMF
balance	1999.01-2011.01	Expected budget balance/GDP (differential vs. Germany)	European Comission
debt	1999.01-2011.01	Expected debt/GDP (differential vs. Germany)	European Comission
gind	1999.01-2010.11	Industrial production annual growth (differential vs. Germany)	IMF
ltsdebt	1999.01-2011.01	Long-term/Total general government debt	ECB
D2007.08	1999.01-2011.01	Dummy variable: 1 from 2007.08 onwards, zero otherwise	Own calculations
D2009.03	1999.01-2011.01	Dummy variable: 1 from 2009.03 onwards, zero otherwise	Own calculations