THE EURO AREA SOVEREIGN DEBT CRISIS

SAFE HAVEN, CREDIT RATING AGENCIES AND THE SPREAD OF THE FEVER FROM GREECE, IRELAND AND PORTUGAL

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In 2012 all ECB publications feature a motif taken from the €50 banknote.

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Abstract

Since the intensification of the crisis in September 2008, all euro area long-term government bond yields relative to the German Bund have been characterised by highly persistent processes with upward trends for countries with weaker fiscal fundamentals. Looking at the daily period 1 September 2008 - 4 August 2011, we find that three factors can explain the recorded developments in sovereign spreads: (i) an aggregate regional risk factor, (ii) the country-specific credit risk and (iii) the spillover effect from Greece. Specifically, higher risk aversion has increased the demand for the Bund and this is behind the pricing of all euro area spreads, including those for Austria, Finland and the Netherlands. Country-specific credit ratings have played a key role in the developments of the spreads for Greece, Ireland, Portugal and Spain. Finally, the rating downgrade in Greece has contributed to developments in spreads of countries with weaker fiscal fundamentals: Ireland, Portugal, Italy, Spain, Belgium and France.

Keywords: Sovereign spreads, credit ratings, spillovers.

JEL classification: G15, F36

Non − Technical Summary

Since the intensification of the financial crisis in September 2008 after the collapse of Lehman, long-term government bond yields relative to the German Bund have been rising after ten years of stability at very low levels. In the first phase, the associated global uncertainty and in the euro area the rescue of the largest Irish banks by the Irish government might have played a key role in the developments of the euro area sovereign spreads. The situation started to improve in the course of the spring and the summer 2009 as global uncertainty receded and after the announcement of stringent fiscal stabilization measures by the Irish government on 22 February 2009. On 16 October 2009, the Greek Prime Minister George Papandreou in his first parliamentary speech disclosed the country's severe fiscal problems and immediately after on 5 November 2009 the Greek government revealed a revised budget deficit of 12.7% of GDP for 2009, which was the double of the previous estimate. Since then, the sovereign spreads rose sharply for most of the euro area countries, causing the biggest challenge for the European monetary union since its creation.

The tension is further illustrated by the reaction in highly rated sovereign papers. Benchmark French, Dutch, Austrian, Finnish and German yields have turned round to fluctuate with a declining trend over the 2008-2011 period. However, the spreads vis-à-vis the German Bund have been rising also on bond issued by countries with solid fiscal fundamentals, such as Austria, Finland and the Netherlands. None of the market participants have suggested that the developments in sovereign bond yields of these countries were the results of the market pricing re-assessment of the government credit risk. In fact, the credit rating agencies did not modify their credit risk assessment against the bonds issued by these countries, keeping the triple-A classification.

Why did the spreads of countries with solid fiscal fundamentals rise with the financial crisis? Why did the spreads of countries with weak fiscal fundamentals skyrocketed with the financial crisis? Is there evidence of spillover effects of sovereign downgrades of bond issued by Greece, Ireland and Portugal on other euro area countries' spreads? These are the three questions investigated in this paper.

The factors affecting the sovereign bond yields are associated to aggregate risk, country-specific risk and contagion risk. The aggregate risk is driven by changes in monetary policy, global uncertainty and risk aversion, while the country-specific risk is related to changes in default probabilities on the sovereign debt, the ability to raise fund in the primary market and liquidity factors in the secondary market.

Separating the liquidity explanation and contagion risk from aggregate risk and sovereign default is very important from a policy making perspective, because an

intervention by the central bank can be successful if financial markets face technical liquidity problems or subject to contagion. If, on the contrary, the rise in spreads is due to aggregate factors and sovereign default then a central bank has only little room for manoeuvre.

Looking at the daily period 1 September 2008 - 4 August 2011, we find that three factors can explain the recorded developments in sovereign spreads: (i) an aggregate regional risk factor, (ii) the country-specific credit risk and (iii) the spillover effect from Greece.

Specifically, higher risk aversion has increased the demand for the Bund and this is behind the pricing of all euro area spreads, including those for Austria, Finland and the Netherlands. During the financial crisis, the German Bund has benefited from the safe haven status, which has historically characterized US Treasuries, the Swiss franc, the Japanese Yen and gold.

Country-specific credit ratings have played a key role in the developments of the spreads for Greece, Ireland, Portugal and Spain. It is useful to point out that institutional investors, such as pension funds and insurers, are obliged by law or their own statutes to purchase and hold bonds with a certain minimum rating. Moreover, credit ratings are used by regulators to establish banks' capital requirements and can impact banks' portfolios because only high rated assets are eligible as collateral to obtain credit from the central bank. Therefore, a downgrade can generate a portfolio shift, which can significantly affect bond yields.

Finally, the rating downgrade in Greece has contributed to developments in spreads of countries with weaker fiscal fundamentals: Ireland, Portugal, Italy, Spain, Belgium and France. Credit rating agencies have brought the contagion risk to the fore. For example, when Moody's downgraded the Portugal's long-term government bond ratings by four notches on 5 July 2011 from Baa1 to Ba2 and assigned a negative outlook, it argued that a voluntary rollover of Greek debt would imply a rising risk that private sector participation could become a precondition for additional rounds of official lending to Portugal as well. The debate about the voluntary debt rollover for Greece has contributed to a major re-assessment of the Portuguese outlook and triggered a significant increase in yield spreads for Portugal. In other words, Portugal was not primarily judged on the basis of its own fundamentals.

From a policy-making point of view, to safeguard the stability of the euro area financial system, the highest priority is to reduce the sovereign solvency risk and tackle contagion. Will policy-makers close the large gap between spending and revenues? Will they cut spending and/or raise taxes enough to make the debt sustainable? The challenge that the policy-makers face is to reduce inefficient spending and avoid a deflationary spell, through structural reforms. In the long run, a key challenge is to enhance the political union in Europe possibly with an institution that guarantees long-term fiscal discipline to individual euro area countries.

1 Introduction

Since the intensification of the financial crisis in September 2008 after the collapse of Lehman, long-term government bond yields relative to the German Bund have been rising after ten years of stability at very low levels (see Panel A in Figure 1). In the first phase, the associated global uncertainty and in the euro area the rescue of the largest Irish banks by the Irish government might have played a key role in the developments of the euro area sovereign spreads. The situation started to improve in the course of the spring and the summer 2009 as global uncertainty receded and after the announcement of stringent fiscal stabilization measures by the Irish government on 22 February 2009. On 16 October 2009, the Greek Prime Minister George Papandreou in his first parliamentary speech disclosed the country's severe fiscal problems and immediately after on 5 November 2009 the Greek government revealed a revised budget deficit of 12.7% of GDP for 2009, which was the double of the previous estimate. Since then, the sovereign spreads rose sharply for most of the euro area countries, causing the biggest challenge for the European monetary union since its creation.

The tension is further illustrated by the reaction in more highly rated sovereign papers. Benchmark French, Dutch, Austrian, Finnish and German yields have turned round to fluctuate with a declining trend over the 2008-2011 period (see Panel B in Figure 1). However, the spreads vis-à-vis the German Bund have been rising also on bond issued by countries with solid fiscal fundamentals, such as Austria, Finland and the Netherlands.[1] None of the market participants have suggested that the developments in sovereign bond yields of these countries were the results of the market pricing re-assessment of the government credit risk. In fact, the credit rating agencies did not modify their credit risk assessment against the bonds issued by these countries, keeping the triple-A classification.

Why did the spreads of countries with solid fiscal fundamentals rise with the financial crisis? Why did the spreads of countries with weak fiscal fundamentals skyrocketed with the financial crisis? Is there evidence of spillover effects of sovereign downgrades of bond issued by Greece, Ireland and Portugal on other euro area countries' spreads? These are the three questions investigated in this paper.

The factors affecting the sovereign bond yields are associated to aggregate risk, country-specific risk and contagion risk (see Figure 2). The aggregate risk is driven by changes in monetary policy, global uncertainty and risk aversion, while the country-specific risk is related to changes in default probabilities on the sovereign debt, the

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[1]According to Eurostat, the government deficit (-) and debt to GDP ratio in 2009 amounted respectively to -4.1 and 69.6% in Austria, -2.6% and 43.8% in Finland, and -5.5% and 60.8% in the Netherlands. The same statistics amounted to -7.5% and 78.3% in France, -5.9% and 96.2% in Belgium, -11.1% and 53.3% in Spain, -5.4% and 116.1% in Italy, -10.1% and 83% in Portugal, -14.3% and 65.6% in Ireland, -15.4% and 127.1% in Greece.

ability to raise fund in the primary market and liquidity factors in the secondary market. An important issue of any paper studying the determinants of bond yields is the identification of the variables to be used as a proxy.

Many of the relationships studied in this paper have already been investigated in the literature, but the use of high-frequency data, the focus on the crisis period and the modelling of the high persistency make the contribution of the paper novel. The existing empirical models, some of which are reviewed in Section 2 (i.e. Favero, *et al.*, 2010; Gerlach, *et al.,* 2010; Arghyrou and Kontonikas, 2010), cannot help explaining the extent of the sovereign spreads of individual euro area countries, because they do not address the strong persistent effect in the sovereign yield spreads and do not control for the higher demand for German sovereign bonds and the sovereign default risk.

In this paper, first, we identify a euro area common risk factor. The sovereign spreads of the countries with solid fiscal fundamentals move in tandem with the ten-year spread between the German government-guaranteed KfW ('Kreditanstalt fur Wiederaufbau') bond and the German sovereign bond (see Figure 3), both guaranteed by the German government and, therefore, carrying the same default risk. Since the credit risk component of agency yields is assumed to be the same as that of bonds issued directly by the guaranteeing government (Longstaff, 2004; Schwarz 2010), any differences between agency and government bond yields should reflect both flight-to-liquidity (investors' preference for assets with the lowest liquidity risk) and flight-to-safety (investors' preference for safe German assets, such as the Bund).

During the financial crisis, the German Bund seems to have benefited from the safe haven status (Schuknecht, *et al.*, 2009), which has historically characterized US Treasuries, the Swiss franc, the Japanese Yen and gold. As shown in Figure 4, the 10-year spread between the German KfW and the Bund increased steadily from 10-15 basis points before the financial crisis started, attributed to the liquidity premium,[2] to 90 basis points in the first quarter of 2009, which is most likely the result of investors' demanding more German bund for safety reasons.

The US corporate bond spread and the US implied stock market volatility (VIX) are generally used to measure global uncertainty and aggregate risk aversion. The two series comove with the KfW-Bund until end 2009, declined sharply in the course of 2009, but then they decoupled (see Figure 4). The KfW-Bund rose again as the euro area's sovereign debt crisis unfolded in 2010 and 2011 with risk aversion benefiting liquid, safe haven assets, such as the Bund. We show that the higher demand for the German Bund is the key reason for the developments in spreads for Austria, Finland and the Netherlands during the crisis and can partly explain all euro area sovereign spreads.[3] We also show that this regional risk factor dominates the international risk

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[2] Also at its launch in spring 1998, a jumbo KfW bond offered a 10-15 basis points in addition to the benchmark German government bond (McCauley, 1999).

[3] Manganelli and Wolswijk (2009) identified in the main refinancing operations (MRO) minimum

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factor for all euro area sovereign spreads with the exception of Greece and Spain, where both factors seem to play a role.

Separating the liquidity explanation from the safe haven motive is very important from a policy-making perspective, because an intervention by the central bank can be successful if financial markets face technical liquidity problems. If, on the contrary, the rise in spreads is due to the safe haven premium then a central bank has only little room for manoeuvre. Several studies have used the KfW-Bund spread for liquidity pricing effects (McCauley, 1999; Schwarz 2010; Monfort and Renne, 2011). However, separating flight-to-liquidity and flight-to-safety is difficult because liquidity premia and safe haven premia are positively correlated (Ericsson and Renault, 2006). We control for bond maturity-specific bid-ask spreads, bond-specific transaction volumes as well as for the new issuance of long-term government debt, which are often used to price liquidity in the secondary and primary markets. The results suggest that liquidity and funding risk factors have played only a marginal role during the crisis period.

Before the outbreak of the Greek sovereign debt crisis at the end of 2009, also the spreads for Spain, Belgium, France and, to a certain extent for Italy, could be explained by the safe haven flows to Germany (see Figure 3). However, the developments in 2010 and 2011 were remarkable with the Greek, Irish and Portuguese spreads hitting in July 2011 respectively 1600, 1200 and 1100 basis points. Similarly, Spanish and Italian spreads reached 400 basis points, Belgium hit 200 basis points and France hit 90 basis points.

The market players have singled out the debt sustainability issue and have argued that the solvency risk for these countries deteriorated in the course of 2010 and 2011. From an asset-pricing perspective, of course, changes in default probabilities have an impact on the equilibrium required premium for bearing credit risk. Therefore, the econometric analysis is carried out controlling for the government deficit (a first proxy for sovereign solvency risk), as reported by Eurostat in its press releases of April and October of each year (see Figure 5). We find that the deterioration in public finances plays a role in the crisis, as also found by Barrios, *et al.* (2009), Haugh, *et al.* (2009), Attinasi, *et al.* (2010), Borgy, *et al.* (2011), Ejsing, *et al.* (2011) and Amisano and Tristani (2011)[4], only if we do not control for credit ratings.

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bid rate of the euro area the regional aggregate risk factor driving euro area spreads over the January 1999 to April 2008 period. However, during the sovereign debt crisis in 2010 and 2011, the MRO rate was constant for most of the sample period.

[4]Focusing on the papers, which study the financial crisis period, Borgy, *et al.* (2011) and Ejsing at al. (2011) find respectively that expected changes in debt/GDP ratios and fiscal deficits have a significant impact on bond spreads since autumn 2008. Using a regime switching model, Amisano and Tristani (2011) find that yield spreads for France, Greece, Ireland, Italy, Portugal and Spain move from one regime to the other with probabilities that are affected by: markets' perceptions of the sustainability of a country's fiscal situation (proxied by the deficit-to-GDP ratio); changing attitudes

Given that credit rating agencies are meant to provide an assessment of the likelihood of default,[5] we use ratings as a second proxy of sovereign credit risk, by transforming the sovereign credit rating reviews (explicit credit ratings as well as credit outlook and credit watch) reported by Standard and Poor (S&P), Moody's Investors Service (Moody's) and Fitch into a discrete variable, which codifies the rating agency's decisions according to the values reported in Appendix (see Table A1).[6] It is useful to point out that institutional investors, such as pension funds and insurers, are obliged by law or their own statutes to purchase and hold bonds with a certain minimum rating. Moreover, credit ratings are used by regulators to establish banks' capital requirements (Bongaerts, et al., 2009) and can impact banks' portfolios because only high rated assets are eligible as collateral to obtain credit from the central bank. Therefore, a downgrade can generate a portfolio shift, which can significantly affect bond yields. The results are plotted against the spreads in Figure 6. There is a clear relationship between these variables for Greece, Ireland and Portugal suggesting that sovereign solvency risk, which according to the three credit agencies deteriorated over time, might have played a key role in the crisis, a result corroborated by the econometric evidence in this paper.

Moreover, credit rating agencies have brought the contagion risk to the fore. For example, when Moody's downgraded the Portugal's long-term government bond ratings by four notches on 5 July 2011 from Baa1 to Ba2 and assigned a negative outlook, it argued that a voluntary rollover of Greek debt would imply a rising risk that private sector participation could become a precondition for additional rounds of official lending to Portugal as well.[7] The debate about the voluntary debt rollover for Greece has contributed to a major re-assessment of the Portuguese outlook and triggered a significant increase in yield spreads for Portugal. In other words, Portugal was not

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with respect to risk (proxied by the US BAA-AAA corporate spread); and cross country spillovers, captured by allowing for explicit interactions between each country's probabilities of jumping to the "crisis" state.

[5] Agency ratings should measure the default risk over long investment horizons and should not be affected by the economic cycle (Cantor, 2001), a view that has been empirically confirmed by Altman and Rijken (2004) for the corporate sector.

[6] While there is an extensive literature studying the impact of rating announcements on corporate yields, little work exists on the response of sovereign yields spreads and CDS. There is evidence that sovereign rating changes and credit outlooks have a relevant effect on the size and volatility of lending (Kräussl, 2005), bond yield spreads (Reisen and von Maltzan, 1999) and CDS (Ismailescu and Hossein, 2010) in emerging markets; and bond yield spreads and CDS pooling the major euro area countries (Manganelli and Wolswijk, 2009; Afonso, et al. 2011). There are also studies that find existence of spillover effects across sovereign ratings by pooling 34 developed and developing economies (Gande and Parsley, 2005) and euro area countries (Arezki, Candelon and Sy, 2011; Afonso, et al., 2011).

[7] The Moody's press release on 5 July 2011, which downgrades Portugal to Ba2 with a negative outlook from Baa1 can be found here: http://www.moodys.com/research/Moodys-downgrades-Portugal-to-Ba2-with-a-negative-outlook-from?lang=en&cy=global&docid=PR_222043

primarily judged on the basis of its own fundamentals.

We find clear evidence of spillover effects; that is, as suggested by Gande and Parsley (2005), a ratings change in one country has a significant effect on sovereign credit spreads of other countries.

Regardless of whether using S&P, Moody's or Fitch credit ratings, the regression analysis indicates that rating events concerning Greek sovereign bonds lead to strong increases of sovereign yields in Ireland and Portugal and less noticeable, but strongly statistically significant, impacts on Italy, Spain, Belgium and France. The spillover effect from Ireland is also estimated to be sizeable vis-à-vis countries with weak fiscal fundamentals, although the effect from Greece is larger and predominant.

The econometric strategy involves four main steps. First, we run standard preliminary regressions, which show that over the September 2008 - August 2011 period the sovereign spreads are highly persistent and cannot be explained by traditional variables used in the literature. Second, we show that unit root tests on sovereign spreads and their potential determinants cannot be rejected during the crisis period. Third, we estimate the model using cointegration methodologies to identify the plausible specification (e.g. cointegration tests and dynamic OLS). Fourth, we construct a Structural Vector Error Correction Model (SVECM) based on the dynamic OLS estimates in order to assess the causality between sovereign spreads and credit ratings as well as the contagion risk.

The remainder of the paper is structured as follows: Section 2 shows that the existing model specifications in the literature cannot explain the developments during the crisis; Section 3 describes the data; Section 4 presents the results from the unit root tests, the Phillips-Ouliaris cointegration tests, the dynamic OLS estimates and the impact of credit rating shocks on yield spreads based on country-specific SVECM; Section 5 concludes.

2   The break down of recent explanations

Recent empirical analysis, conducted before the financial crisis erupted in 2010 and 2011, pointed out that an international risk factor is the main driver of the euro area sovereign spreads with liquidity risk playing a smaller role when aggregate risk rises (Favero, *et al.,* 2010).[8] Gerlach, *et al.* (2010) confirm the role of the international risk factor - the difference in yields between US corporate bonds and treasury securities of similar maturity - as an important driver of European bond spreads. At the same time, they find that the size of the banking sector is an important explanatory variable of the sovereign spreads when aggregate risk increases, suggesting that a large banking sector is a source of financial risk to government when the perception of aggregate risk increases. Finally, Arghyrou and Kontonikas (2010) argue that an

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[8] See also Monfort and Renne (2011).

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international risk factor - proxied by the US stock market implied volatility (VIX) - and a country-specific macro factor represented by international competitiveness are behind the developments in spreads during the financial crisis.

We can replicate their findings when the model specifications are applied before the financial crisis; but they cannot assist us in interpreting the developments during the 2008-2011 period.[9] This suggests that there is evidence of a striking shift in market pricing behavior. This can result from two kinds of changes: (i) a change in the market assessment of the underlying risk (the debtors are riskier than previously thought) or (ii) a change in the price of risk (for a given unchanged amount of risk, the compensation demanded by investor to carry this risk is higher because of higher risk aversion).

Panel A of Table 1 shows the results of the baseline model specification suggested by Favero, *et al.* (2010) estimated by the seemingly unrelated regression (SUR) method on a sample of daily observations from September 1, 2008 to August 4, 2011. The model takes the specification in their Table 4 (Favero, *et al.* (2010), pg. 126):

$$Y_{i,t}^j - Y_{b,t}^j = \beta_{1,i} + \beta_{2,i}\left(Y_{i,t-1}^j - Y_{b,t-1}^j\right) + \beta_{3,i}\left(M_{i,t}^j - M_{b,t}^j\right) + \beta_{4,i}R_{US,t}^j \quad (1)$$
$$+ \beta_{5,i}\left(c_{i,t}^j - c_{b,t}^j\right) + \beta_{6,i}\left(c_{i,t}^j - c_{b,t}^j\right)R_{US,t}^j + u_{i,t}^j,$$

where $\left(Y_{i,t}^j - Y_{b,t}^j\right)$ denotes the spread between the benchmark bond yield in country i and the benchmark country, $\left(M_{i,t}^j - M_{b,t}^j\right)$ is the differential in the residual maturity of the benchmark bonds in country i and the benchmark country,[10] $R_{US,t}^j$ is the spread between the j-year corporate bond yield and U.S. government bond yield,[11] $\left(c_{i,t}^j - c_{b,t}^j\right)$ is the differential between the bid-ask spread of bonds in country i and the benchmark country. The index i varies across countries and the index j is in this case the 10-year maturity.

The comparison between the results reported in Table 1 based on the 2008-2011 period and those reported by Favero *et al.* (2010) in their Table 4 based on the 2002-2003 period suggests that: (i) the spreads for all countries have become much more persistent; (ii) the maturity correction is no longer statistically significant; (iii)

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[9] Data are going to be detailed in the next section.

[10] Favero, *et al.* (2010) and Gerlach, *et al.* (2010) control for the differences in the maturity between the bond of country i and the German bond by including this difference in the regression equation, in order to filter out of the data the effect introduced by the different maturity of benchmark bonds and the effect of changes in benchmarks occurring at different dates for different countries in the sample period.

[11] Favero, *et al.* (2010) use the US swap spread to measure the internatioal risk factor. However, as pointed out by Gerlach, *et al.* (2010), the swap spread plunged with the financial crisis in the fall of 2008, while all other risk indicators displayed record levels. Following Codogno *et al.* (2003) and Gerlach, *et al.* (2010), we use the seven-to-ten year US corporate bond spread for the rating category BBB from Merrill Lynch, given that it is the most liquid corporate bond market.

the coefficient of the aggregate international risk factor is statistically significant only in three cases (Austria, Finland and the Netherlands); (iv) the bid-ask spreads are positive and statistically significant in seven out of nine cases (while Favero *et al.* (2010) find it significant in four out of eight cases) with small coefficients that resemble the coefficients estimated by Favero *et al.* (2010); (v) finally, in line with Favero *et al.* (2010)'s hypothesis that the equilibrium value of liquidity tends to be lower in worse aggregate states, the interaction between liquidity and the aggregate risk factor always has a negative impact on the yield differentials, although the coefficient is statistically significant and small in five out of nine cases.

The coefficients on the international aggregate risk factor is very small suggesting that it cannot help interpreting the sharp developments in euro area sovereign spreads.

Panel B of Table 1 shows the results of the baseline model specification suggested by Gerlach, *et al.* (2010) estimated by the SUR method. The model takes the specification reported in their Table A-2 (Gerlach, *et al.* (2010), pg. 40):

$$Y_{i,t}^j - Y_{b,t}^j = \beta_{1,i} + \beta_{2,i} \left(Y_{i,t-1}^j - Y_{b,t-1}^j \right) + \beta_{3,i} \left(M_{i,t}^j - M_{b,t}^j \right) + \beta_{4,i} R_{US,t}^j \qquad (2)$$
$$+ \beta_{5,i} \left(c_{i,t}^j - c_{b,t}^j \right) + \beta_{6,i} \left(B_{i,t}^j - B_{b,t}^j \right) + \beta_{7,i} \left(B_{i,t}^j - B_{b,t}^j \right) R_{US,t}^j + u_{i,t}^j,$$

where $\left(B_{i,t}^j - B_{b,t}^j \right)$ denotes the differential between the total assets held by the banking sector relative to GDP in country i and the benchmark country. According to Gerlach, *et al.* (2010), this differential measures the country-specific default risk. The interaction term allows the default risk to vary with aggregate risk, under the hypothesis that the greater the aggregate risk the higher the likelihood of banks to require public support, which would then deteriorate a government's fiscal position.[12]

The series employed are recorded at different frequencies with financial data being continuously available, while macroeconomic information can be obtained at a monthly (banks' assets) or quarterly (GDP) frequency. When estimating the models, as suggested by Gerlach, *et al.* (2010), we keep the lower frequency data constant until a new observation occurs. We employ this approach also for all other macrovariables used in the paper.

The results on the aggregate risk and the liquidity risk are very similar to those reported in Panel A with the bid-ask spreads now positive and statistically significant in eight out of nine cases. The results also suggest that during the sovereign debt crisis bank assets to GDP ratio is not a good proxy for sovereign default risk.

The overall results would suggest that liquidity variables are economically important over the crisis period supporting the view of Beber *et al.* (2009), who find that liquidity is a factor playing a role is euro area sovereign spreads in times of market stress. We show in the next Sections that this is not the case once the strong persistent effect of the sovereign yield spreads is taken into consideration.[13]

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[12] See also Ejsing and Lemke (2011).

[13] Beber *et al.* (2009) find also that differences in credit quality among countries play a major role

Arghyrou and Kontonikas (2010) argue that the international risk factor (the log of VIX) and the country 's competitiveness (the log of the real effective exchange rate deflated by the consumer price index) can explain the developments in sovereign spreads of all euro area countries over the monthly period August 2007-April 2010. Panel C of Table 1 shows the results of the baseline model specification suggested by Arghyrou and Kontonikas (2010) estimated by the SUR method. The model takes the specification reported in their Table 5 (Arghyrou and Kontonikas (2010), pg. 42), but without the contemporaneous Greek spread used as a regressor to measure contagion, given that within a monetary union sovereign spreads tend to comove and, therefore, there is a great risk of simultaneity bias, which would bias OLS estimated coefficients and standard errors. Moreover, rather than using the country's log real exchange rate, we look at the relationship between sovereign spreads and relative competitiveness, namely the difference between the country's log real effective exchange rate and the German log real effective exchange rate, $(Q_{i,t} - Q_{b,t})$:

$$Y_{i,t}^j - Y_{b,t}^j = \beta_{1,i} + \beta_{2,i}\left(Y_{i,t-1}^j - Y_{b,t-1}^j\right) + \beta_{3,i}R_{U\,\mathrm{Si}\,t}^j + \beta_{4,i}\left(Q_{i,t} - Q_{b,t}\right) + u_{i,t}^j. \quad (3)$$

The use of relative competitiveness rather than absolute competitiveness is justified on theoretical as well as empirical grounds. The literature on the determinants of sovereign spreads employs as explanatory regressors country's variables relative to the benchmark country, as reported in (1) and (2). From the empirical point of view, the sovereign spreads during the crisis moved with a trend and this is the case for the real effective exchange rate. Therefore, the positive relationship found by Arghyrou and Kontonikas (2010) might be spurious (see Granger (2001) and Granger, *et al.* (2001)).

The results reported in Panel C indicate that the VIX is statistically significant with the correct sign only in three cases (Austria, Finland and the Netherlands) as found in Panel A and that the relative degree of competitiveness is an explanatory variable for the Greek spread, but it is not a general macro factor, which has affected overall pricing behavior during the crisis.

3   Data

The models are estimated using country-specific data for Greece, Ireland, Portugal, Belgium, Italy, Spain, Austria, Finland, France and the Netherlands. Given that the market pricing behavior has changed with the crisis, we cover the financial crisis period from 1 September 2008 to 4 August 2011. The frequency of data is daily business.

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is euro area sovereign spreads. They proxy credit quality with sovereign credit default swaps (CDS). We instead employ directly the underlying factors, such as government balances and credit rating reviews and show in the Appendix that during the 2008-2011 period CDS are driven by the same factors that drive sovereign yield spreads.

3.1 Bond yields and CDS

We use 5-year and 10-year government bond yields as well as CDS on 5-year senior debt, which come from Thomson Reuters Datastream. The rates are secondary market yields of government bonds with a remaining maturity close to five and ten years. The bond spreads are computed as the difference between the sovereign bond yield and the German government bond with the same residual maturity. The spreads are measured in basis points. The data are collected at the end of the day (see Figures 1-2). The 5-year yield and CDS are used in the robustness check section.

3.2 Aggregate risk

We use the 5-year and 10-year KfW-Bund spreads, which come from Bloomberg, computed as a the difference between the KfW bond yield and the corresponding German government bond yield, to measure the regional aggregate risk factor. This spread can be used to measure flight-to-liquidity and flight-to safety, both phenomena generally associated with higher risk aversion.

Sovereign bond spreads might also be affected by global uncertainty, which is often proxied by the US corporate bond spreads (Codogno, et al., 2003; Gerlach, 2010) or the US VIX (stock market volatility index). The former performs better. Hence, we use the difference between the US triple-B corporate bond provided by Merrill Lynch and US Treasury of the same maturity in the main regressions and the VIX as a robustness check.

The data are available in Thomson DataStream and the spreads are measured in basis points. The data are collected at the end of the day (see Figure 4).

3.3 Country-specific risk

3.3.1 Sovereign default risk

Government budget deficit. Eurostat publishes twice a year a news release with the budget balance-GDP ratio of all European countries for the previous year. We use this data in real time to assess the impact of government deficit on spreads and CDS. The data are discrete time processes and are calendared on the day of the press release (see Figure 5). Given the credibility of the creditworthiness of the German government, it could be argued that investors decide their portfolio strategies based on the aggregate budget deficit situation in the country and not relatively to developments of the German budget deficit. We consider both cases and the results do not change except for Italy, where the spreads are correctly negatively related to the Italian budget balance, but positively related to the differential between the Italian and the German budget balances. The overall results on all other variables are not modified; therefore to save space we show only the findings under the first

hypothesis.[14]

Sovereign ratings. Credit ratings provide an assessment of the likelihood of default, with the criteria for a rating assessment for any sovereign based on a large set of indicators, which include the assessment of the public finance situation (past dynamics through debt levels, current dynamics through budget deficit and future dynamics through e.g. the pension liabilities), interest rate levels, growth prospect, and the government's commitment to repay.

They can affect financial markets, as they pool the information on the creditworthiness of the country. Moreover, institutional investors, such as pension funds and insurers, are obliged by law or their own statutes to purchase and hold bonds with a certain minimum rating. Similarly, banks' portfolios depend upon the credit ratings on the assets they hold due to regulatory requirements. Therefore, their decisions can generate a significant portfolio shift, which can trigger a reaction on spreads.

The three main rating agencies, S&P, Moody's and Fitch, use similar rating scales with the best quality issuers receiving a triple-A notation. As often carried out in the literature (see for example Gande and Parsley, 2005; and Afonso *et al.*, 2011), we transform the sovereign credit rating information into a discrete variable that codifies the decision of the rating agencies using a linear scale as depicted in Table A1 in the Appendix. The ratings are grouped into 22 categories from 1 (triple-A) to 22 (default). We also take into consideration the changes in the credit outlook and credit watch. Rating agencies sometimes lower the credit outlook and then put a country under credit watch, sometime do the opposite. The second move has generally lower impact relative to the first move. Therefore, the first negative news (either outlook or watch) is set equal to +0.5, while the second bad news is set equal to +0.25; similarly, the first positive news (either outlook or watch) is set equal to -0.5, while second good news is set equal to -0.25. The data are discrete time processes.

As depicted in Figure 6, the credit rating information for Greece worsened dramatically over the estimation period (2008-2011) followed by Ireland and Portugal. Spain also suffered from several downgrades on its debt, while Italy and Belgium received only one negative credit outlook over the sample period.

3.3.2 Liquidity and funding risks

To assess the role of liquidity risk factors, we use as a proxy of liquidity risk the bond-specific bid-ask spreads of the corresponding maturity (Favero, *et al.*, 2010; Gerlach, *et al.*, 2010). The data are collected at the end of the day using Thomsom Reuters Datastream (see Figure A1 in the Appendix).

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[14] All the results with budget balance differentials and robustness checks discussed and reported in the next Section are available upon request.

As an alternative measure of liquidity risk, we also use the actual trading volume on the electronic platform MTS, which covers about 15-20% of the euro area sovereign bond market, provided by EuroMTS.[15]

To assess the role of funding risk, we use the new issuance of government long-term bond provided on a monthly basis by the European Central Bank (see Figure A2 in the Appendix).

The bid-ask spread differentials are computed as the difference between the bid-ask spread of country i and Germany. As regard the volumes, given that they are flow measures, we use the ratio between the trading volume of sovereign i and Germany.

3.4 Contagion risk

Contagion is a situation whereby instability in a specific market is transmitted to one or several other markets. Following Gande and Parsley (2005), we assess whether a rating change in Greece, Ireland and Portugal has a significant effect on sovereign credit spreads of other countries.

3.5 Additional data for robustness

Bond yields could be driven by expected inflation and real GDP growth (Laubach, 2009). Given the limited data availability at country level for long-horizon, we employ the one-year-ahead consensus forecast of inflation and real GDP growth to control for the effects of the business cycle.

Eurostat publishes twice a year a news release with the government debt of all European countries for the previous year. We use this data in real time to assess the impact of government debt. The data are discrete time processes and are calendared on the day of the press release.

We also consider the European Commission figures, which publishes forecasts about fiscal deficit for all European countries twice a year in spring and in autumn. From the spring release, we use the average prediction for the current year and the following year; from the autumn release, we use average prediction for the current year and the next two following years.

The real effective exchange rates deflated by the consumer price index and the bank assets to GDP ratio used in the previous section are provided by the European Central Bank.

4 Studying the level of sovereign yield spreads

Euro area long-term government bond yields relative to the German Bund are characterized by highly persistent processes during the financial crisis (see the estimated

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[15]Data cannot be shown in agreement with EuroMTS.

coefficients on the own lag reported in Table 1) with a clear upward trend for most of sovereign spreads (see Panel A of Figure 1).

If we employed the standard approach of the literature reported in the previous section, which consists of estimating an autoregressive process with factors that should capture aggregate risk, credit risk and liquidity risk, we would run the risk of estimating spurious relationships. Granger (2001) and Granger, *et al.* (2001) have emphasized that spurious estimated relationships can occur also between stationary, but highly autocorrelated variables.

Efficient inference in time-series econometrics requires taking into account of the specific phenomenon illustrated in Panel A of Figure 1. This allows for the possibility that the level of sovereign yield spreads may be linked to the risk factors, implying that linear combinations of them are cointegrated. In other words, we aim at finding the equilibrium relationship between yield spreads and risk factors, such that actual observations deviate from this equilibrium in a zero-mean stationary process.

Cheung and Lai (1993) point to several finite sample shortcomings on the likelihood ratio tests for cointegration suggested by Johansen (1988). They found that Johansen's tests are biased towards finding cointegration more often than what asymptotic theory suggest. Therefore, we test whether the variables have a common trend running Phillips-Ouliaris (1990) cointegration tests on the regression errors, using daily observations over the financial crisis period starting from 1 September 2008 up to 4 August 2011.

Moreover, the finite sample performance of dynamic ordinary least squares (DOLS), as suggested by Stock and Watson (1993), is found to be systematically better than other estimators (Montalvo, 1995). Therefore, we employ the DOLS method to estimate the coefficients and standard errors.

This section contains four subsections. We begin by displaying the unit root tests. Then, we describe the cointegration tests. In the third subsection we estimate the parameters with their robust standard errors using DOLS. In the fourth subsection, we study causality between rating and yield spreads by means of impulse response functions.

4.1 Unit root tests

Table 2 reports values for the intercept and slope coefficients from an ordinary least squares (OLS) regression of each variable on a constant and its own lagged value, together with the Phillips-Perron (1998) test statistics, which corrects the conventional t-statistics for testing the null hypothesis of a unit root for serial correlation in the regression error using Newey-West's (1987) estimator of the error variance. Table 2 also reports the MZ_α^{GLS} statistic from Ng and Perron (2001), which is designed to have better size and power properties than the former.

The standard unit root tests, such as Phillips-Perron and NG-Perron tests (but

also the augmented Dickey-Fuller test), applied to each of the variables taken into consideration, indicate that the null hypothesis of a unit root applied over the September 2008 - August 2011 period cannot be rejected, except for the liquidity/funding measures (the bid-ask spreads, MTS trading volumes and the new issuance of government debt) and the US stock market implied volatility.[16] These results pave the way for tests of cointegration between the apparently nonstationary variables.

4.2   Cointegration tests

We study the cointegrating relationship between euro area sovereign spreads, the KfW-Bund spread (regional aggregate risk factor), the US corporate bond spread (international aggregate risk factor), the country's fiscal deficit and the credit rating reviews (country's credit risk factors) and the credit rating reviews from strained countries (the spillover effect).

   All specifications include a dummy variable on Monday 10 May 2010, given the impact on spreads on that day resulting from the ECB Governing Council announcement during the weekend of the Securities Markets Programme (SMP), contemplating purchases of euro area government bonds with the aim of enhancing depth and liquidity in dysfunctional markets and restoring an appropriate monetary transmission mechanism. However, the results are independent from this additive variable.

   The Phillips-Ouliaris (1990) test for cointegration is based on the residuals of an OLS regression linking the nonstationary (possibly cointegrated) variables. More precisely, it is based on the slope coefficient from an OLS regression of these residuals on their own lagged values. If the null hypothesis of a unit root in the regression error can be rejected, then the underlying equation represents a cointegrating relationship: a stationary linear combination of the highly autocorrelated variables.

   Table 3 displays the results associated with these Phillips-Ouliaris tests: the intercept and slope coefficients from a linear relationship of 10-year sovereign spreads and various variables, the slope coefficient (AR1 slope) from regression of the error term on its own lagged value (without a constant since the error has mean zero), and the Phillips-Ouliaris statistic Z_t for values of the Newey-West (1987) lag truncation parameter set equal to six.[17]

   Panel A of Table 3 displays the Phillips-Ouliaris tests, when regressing the 10-year sovereign spreads against the government budget balance-GDP ratio. The error terms are nonstationary.

   If instead the 10-year sovereign spreads are regressed against the 10-year KfW-Bund spread, the error terms remain nonstationary for the countries with weak fis-

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[16]The source of non-stationarity for some variables could be captured by a deterministic function of time. We have also tested for trend stationarity in the data, but the unit root tests cannot be rejected.

[17]The results are invariant to other lag truncation parameter values.

cal fundamentals (see Panel B); while they are stationary according to the Phillips-Ouliaris tests for Austria, Finland and the Netherlands suggesting a cointegrating relationship between 10-year sovereign spreads for these countries and the regional risk factor.

Panel C displays the Phillips-Ouliaris tests, when regressing the 10-year sovereign spreads against the government budget balance-GDP ratio and the 10-year KfW-Bund spread. The error terms become stationary for France, but not for all other countries with weak fiscal fundamentals.

Panel D displays the Phillips-Ouliaris tests, when regressing the 10-year sovereign spreads against the government budget balance-GDP ratio, the 10-year KfW-Bund spread, the country's credit ratings (excluding Austria, Finland, France and the Netherlands, which did not see their ratings change over the sample period) and the Greek credit ratings. The values of the Phillips-Ouliaris tests become strongly negative and the error terms of the cointegrating relationship for Greece, Ireland, Portugal, Belgium, Italy and Spain become stationary. Also the Phillips-Ouliaris tests for France improves from -4.579 to -5.814, but the static coefficient on the fiscal balance becomes much smaller. This suggests that the Greek credit ratings play an important role also for France; an issue that is further investigated using the DOLS estimation.

These results are corroborated when using Moody's (see Panel E) or Fitch (see Panel F) credit ratings, suggesting that sovereign solvency risk effect and the spillover effect from Greece are very relevant to explain developments in spreads.

The fiscal balance plays a minor role when including credit ratings. When studying the cointegration among the above mentioned variables with the exclusion of the fiscal variable, the null hypothesis of a unit root in the error can be rejected for all countries, except Greece (see Panels G-I); although the null hypothesis can be rejected also in the case of Greece if using Moody's decisions.

Finally, the results are not dissimilar when substituting the euro area aggregate risk factor with the international risk factor (compare Panels D-F with Panels J-L). This is because they comoved strongly up to end 2009. However, the DOLS estimates presented in the next section show that the regional factor dominates the international factor, with the exception of Greece and Spain where both factors play a role.

4.3 Dynamic OLS

Given the success of the specifications displayed in Table 3, we study the cointegrating relationship between the non-stationary variables. The DOLS method involves augmenting the cointegrating regression with lags and leads of $\Delta X_{i,t}$ so that the resulting cointegrating equation error term is orthogonal to the entire history of the stochastic

regressor innovations:

$$Y_{i,t}^j - Y_{b,t}^j = \beta_{i0} + X'_{i,t}\beta_i + D'_t\gamma_i + \sum_{j=-q}^{r} \Delta X'_{i,t+j}\delta_{i,j} + u_{i,t}, \qquad (4)$$

where $Y_{i,t}^j - Y_{b,t}^j$ denotes the sovereign yield spread of country i vis-à-vis the German Bund at time t, $X_{i,t}$ the vector of regressors, D_t the deterministic regressors such as the additive dummy on 10 May 2010 and $u_{i,t}$ are stationary processes uncorrelated with the regressors $X_{i,t}$. The lags q and the leads r are set equal to 6, so that the results are fully comparable across countries. However, the results do not change if we set the lags and leads according to the Akaike information criterion (AIC) or if we perform the regressions using a larger number of leads and lags (i.e. 20 business days). Adding leads and lags of non-sovereign spread variables controls for possible correlation between the non-spread variables and the residuals from the cointegrating relationship. Any serial correlation that remains in the error terms from the dynamic equation and heteroskedasticity are addressed by using the Newey-West (1987) estimator of the regression error variance.

First, we present DOLS estimates of the parameters of the cointegrating relationship linking the 10-year sovereign spreads with the 10-year KfW-Bund spread, the country's credit ratings, the Greek credit ratings and with and without the government budget balance. The specification for Austria, Finland and the Netherlands would require only the use of the KfW-Bund spread in accordance with the cointegration tests displayed in Panel B of Table 3. However, we include the other variables for completeness also because the point elasticities hardly change.

4.3.1 The baseline specification

Each of the parameter estimates in Table 4 comes from an OLS regression of 10-year sovereign spreads on a constant, the variables mentioned in the previous paragraph, and q leads and r lags of such variables, as in (4).

The quality of the results is first investigated looking at the residuals. Figure 7 shows that the error terms are stationary and highly mean-reverting, as already suggested by the Phillips-Ouliaris tests. The results overlap when using S&P and Fitch ratings, and are generally very similar when using ratings by Moody's. The error terms also point to the periods when the sovereign yield were under a strong pressure, such as for Greece before the introduction of the SMP on 10 May 2010 and for Italy, Spain and France in July 2011, before the implementation of the SMP announced on 7 August 2011.

The dynamic OLS estimates from Table 4 resemble quite closely their static counterparts shown in Table 3. Given that the estimates are corrected for heteroskedasticity and autocorrelation in the residuals, the t-statistic has the usual, normal asymptotic distribution confirming the following results:

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- The estimated KfW-Bund spread elasticities differ significantly from zero. This elasticity measures the sensitivity to portfolio shifts motivated by the need for liquid, safe haven assets. This explains why the coefficient on this risk factor is larger in Ireland (3.4), Greece (2.6) and Portugal (2.1), which suffered most from the European sovereign debt crisis, followed by Italy (1.5) and Spain (1.4); it is then equal to unity in Belgium and Austria and is less than unity in Finland (0.9), the Netherlands (0.8) and France (0.5). The overall regional aggregate risk factor is strongly statistically significant.

- The budget balance-GDP ratio published by Eurostat, often used as a measure of credit risk, enters with the correct sign and is statistically significant for Greece, Spain, Italy and Belgium. The point estimates suggest that one percentage point increase in the deficit is associated with a permanent increase in the spreads by 26 basis points for Greece, 11 basis points for Italy, 7 basis points for Spain and 3 basis points for Belgium. The budget-balance to GDP ratio would be negative for Ireland and Portugal, only if one does not control for developments in ratings in these countries.

- The country's credit rating plays a key role in Greece, Ireland and Portugal. On average one-notch downgrade of the country's debt by S&P is associated with an increase in spreads by 98 basis points for Greece, 65 basis points for Ireland and 33 basis points for Portugal. These effects differ only slightly across credit rating agencies (see Panel B for Moody's and Panel C for Fitch). Despite the downgrades of credit ratings for Spain, the ratings by S&P and Moody's are not statistically significant, while those by Fitch provide a point estimate amounting to 59 basis point increase, which is highly statistically significant. We also control for the ratings in Italy and Belgium. However, agencies have changed the credit outlook for these two countries during the sample period at most once. Therefore, the results on this variable for these countries should not be considered.

- Following Gande and Parsley (2005), who find that when one country's rating is downgraded, it has a significant negative effect on the sovereign bond spreads of the other countries, the spillover effect across countries is investigated studying the impact of developments in credit ratings in Greece on the sovereign spreads of other countries. The regression analysis indicate that rating events concerning Greek sovereign bonds lead to noticeable increases of sovereign yields in Ireland and Portugal, by around half of the Greek sovereign yield response when using S&P ratings, or one third when using Moody's and Fitch. The impact on Italy, Spain, Belgium and even France is estimated to be strongly statistically significant. The size of the impact is highly correlated with fiscal variables, as illustrated by the scatter plot presenting (x axis) the elasticities of the spreads

to the Greek credit ratings vs. (y axis) the government budget deficit (see Panel A of Figure A3 in the Appendix) or the product between government budget deficit and debt (see Panel B of Figure A3). This confirms the view that countries with weaker fiscal fundamentals are more exposed to contagion risk.

- The coefficient on the dummy variable calendared on 10 May 2010 shows that the yield spreads declined after the SMP announcement in Greece, Ireland, Portugal, Italy, Spain, Belgium and France. It is interesting to point out that these are also the countries with weaker fiscal imbalances whose sovereign spreads are under strong pressure (see Figure A4 in the Appendix). In other words, already on 10 May 2010, one could identify the bond yields that would have been under pressure if the financial crisis deteriorated further.

4.3.2 The spillover from Greece, Ireland and Portugal jointly estimated

To study the spillover effect also from Ireland and Portugal, we re-estimate the model controlling for the credit ratings of distressed countries all jointly. Figure 6 shows clearly that the three series are strongly correlated. Therefore, the results should be considered with a grain of salt. The results reported in Table 5 confirm the role of Greece as the key source of tension in the euro area sovereign spreads, as the estimated coefficients are strongly statistically significant regardless weather using S&P, Moody's or Fitch. There is also evidence of spillover from tensions in Ireland to Portugal, Spain and Italy and from tensions in Portugal to Greece. Overall, when considering the standard deviation of the series, the spillover effects from Greece are estimated to be sizeable, while those from Ireland are much milder.

4.3.3 The specification without the budget balance

Given that credit ratings soak up most of the variance making budget deficit to GDP ratio not statistically significant in some of the countries, we run the same model specification without the budget balance. The results for all other variables are similar to those reported in Table 4 except for rating in Greece, which in the model without the budget balance has a higher point estimate, and the ratings by S&P for Spain, which become strongly statistically significant (see Table 6). Moreover, the KfW-Bund spread is not statistically significant for Greece when using S&P's ratings. However, the residuals in this case do not pass the cointegration test.

This does not imply that government balances do not play a role on the crisis. On the contrary, euro area countries with the largest government deficits-debt combination and therefore with the highest credit risk were the countries subject to numerous credit rating changes and mostly affected during the crisis. Credit ratings are a key determinant of the euro area sovereign yield spreads, because they are the results of an assessment which consider past, current and future fiscal developments. Moreover,

rating agencies take into consideration the growth prospects of an economy and the government's commitment to repay. All this features make credit ratings a potential forward looking variable, which financial markets immediately react to.

Our results support the view by Aizenman, et al. (2011), who argue that the euro area spreads' fluctuations are difficult to reconcile with the fiscal stance in 2010. They point out that the market is pricing not on current fundamentals but future fundamentals. This may explain why credit ratings seem to be better at explaining the spreads, to the extent that the agencies base their ratings on forecasts of fundamentals.

However, it is fair to say that the least square estimator of the coefficients on the budget balance is strongly biased to zero due to measurement error, given that the budget balance data are available only every six months.

4.3.4 The regional versus the international risk factor

To assess the role of the international risk factor and directly compare the economic relevance of the regional and international risk factors, we standardize all the variables used in the regressions reported in Table 7.

The international risk factor is statistically significant in six out of ten cases when using S&P's and Fitch, and only in two cases when using Moody's. The variable seems to be particularly important for Greece and Spain, given that the coefficient on the KfW-Bund spread is statistically significant for Greece only when using Moody's ratings and is much smaller for Spain. The role of the KfW-Bund spread remains economically more important for all other countries, given that the standardized coefficients on the euro area aggregate risk factor are relatively larger. This is particularly the case for the countries with solid fiscal fundamentals, as Austria, Finland and the Netherlands.

Looking at the overall results reported in the three Panels of Table 7, it can be argued that the international risk factor (i.e. the US corporate bond spread) is a determinant of the sovereign spreads, it is important for Greece, but that it is not a key variable to explain the crisis. In fact, the US corporate spreads have continued to decline in 2010 and 2011, thereby contributing negatively to the rise in euro area sovereign spreads.

4.3.5 Flight-to-safety versus flight-to liquidity

The estimated KfW-Bund spread elasticities measure the sensitivity to portfolio shifts motivated by the need for liquid, safe haven assets. Separating flight-to-liquidity from flight-to-safety is difficult because liquidity premia and safe haven premia are positively correlated (Ericsson and Renault, 2006). However, to measure the liquidity risk factor, bond maturity-specific bid-ask spreads can be employed (Beber, et al., 2009). Beber et al. (2009) make explicit distinction between flight-to-quality, measured by

CDS, and flight-to-liquidity, measured among others by bid-ask spreads, and find relative importance of liquidity over credit quality rising during times of heightened market uncertainty.

Therefore, we extend the specification reported in Table 7 adding the bid-ask spread of 10-year bond of country i minus that of Germany. As suggested by Favero, *et al.* (2010), we also control for the differentials in the residual maturity of the benchmark bonds in country i and the benchmark country in order to filter out of the data the effect introduced by the different maturity of benchmark bonds and the effect of changes in benchmarks occurring at different dates for different countries in the sample period. The maturity differential variable is treated as a deterministic regressor.

Liquidity differentials are priced for a subset of euro area countries (see Table 8). The coefficients on the bid-ask spreads are always positive and statistically significant for Ireland, Italy and France. They are positive and statistically significant for Spain, when using Moody's or Fitch's credit ratings, for Greece and Portugal when using Moody's ratings.

Conversely, the elasticities on the KfW-Bund spread remain similar to those estimated in Table 7. This suggests that flight-to-safety motives might have prevailed on the flight-to-liquidity motives during the crisis period.

We reconfirm that the international risk factor (i.e. the US corporate bond spread) is a determinant of the sovereign spreads, but that it is not a key variable to explain the crisis.

We also employ the specification suggested by Favero, *et al.* (2010), who argue that bond yield differentials increase in both liquidity and aggregate international risks by adding the interaction between liquidity and the aggregate factor. The results reported in Table A5 of the Appendix are not very different from those already discussed. In line with Favero *et al.* (2010)'s hypothesis that the equilibrium value of liquidity tends to be lower in worse aggregate states, the interaction between liquidity and the aggregate risk factor has generally a negative impact on the yield differentials, although the coefficient is statistically significant in few cases.

Given the importance of funding in the primary market, we also assess the impact of new issuance of sovereign debt on sovereign spreads. The results indicate that the coefficients are not statistically significant (see Table 9).

The robustness checks based on transaction volumes described in the next subsection confirm that the bond-specific liquidity risk factor and the international aggregate risk did not play a cardinal role during the euro area sovereign debt crisis, while the safe haven portfolio shift effect seems key to understand the higher demand for the German Bund and the increase in sovereign spreads.

4.3.6 Robustness analysis

To ensure that our findings are solid, we run a battery of robustness checks. The results remain invariant when the aggregate risk factor is proxied by the US implied stock market volatility and/or the country-specific liquidity risk is proxied by actual trading volume on the electronic platform MTS.

Similarly, the results remain broadly invariant when we control for the difference between expected inflation and real GDP growth in country i vis-à-vis Germany. Expected inflation differential is statistically significant for the spreads of Austria, Belgium, Finland and the Netherlands. Expected real GDP growth differential is statistically significant for the spreads of Belgium, Greece, Italy, Portugal and Spain.

We also control for the government debt released by Eurostat while dropping the fiscal balance variable. The results are similar, though weaker as government debt is statistically significant only for Greece, Italy and Spain: 1 percentage point increase in government debt is associated with increases of 15 basis point spreads for Greece, 6 basis point spreads for Spain and 3 basis point spreads for Italy.

Finally, we control for expected fiscal balances released by the European Commission. Also in this case the results in the previous sections remain robust, and the estimates on the expected fiscal balances are either not statistically significant or have the incorrect positive sign.

The same specifications reported in Tables 3-5 have been estimated for 5-yr bond yield spreads and 5-year CDS (see Tables A2-A4 in the Appendix). The economic results remain invariant, only the point elasticities differ slightly.

The role of the sovereign credit ratings is reported in Tables A3-A4. The country's credit ratings play a key role in Greece, Ireland and Portugal, and confirm the size of spillover to other sovereign spreads from the deterioration of the solvency risk in Greece, Ireland and Portugal, although the spillover from Greece is predominant. It is worth mentioning that also the yield spreads of Austria and the Netherlands at 5 year maturity are marginally influenced by developments in Greek ratings.

The results for 5-year yield and 5-year CDS are not very dissimilar suggesting that the identified risk factors capture well the credit quality among countries.

4.4 Assessing causality and contagion using a SVECM

4.4.1 Assessing causality between credit ratings and yield spreads

Technically, the relationship between yield spreads and credit ratings is about comovement and the cointegrating results suggest that a rise in spreads is associated with a rise in ratings. To be sure, causation may not only run from ratings to sovereign spreads, but also from sovereign spreads to ratings.

Rating reviews might tend to lag the market rather than lead it. For instance, the empirical evidence available for developing countries suggests that credit rating

agencies systematically failed to anticipate currency crisis, but did considerably better predicting default (see Reinhart, 2002; Sy, 2004).

Ferri, *et al.* (1999) argue that in addition to failing to predict the Asian crisis, the credit rating agencies amplified the crisis by downgrading the countries more than the economic fundamentals would justify. Conversely, Mora (2006) finds that ratings are sticky rather than procyclical and that they react to lagged spreads.

The causality between credit ratings and sovereign spreads is an interesting question, which we cannot address by using Granger-causality, because a complex interaction between the variables of a system is required. The conventional Granger causality test specifies a bivariate vector autoregressive (VAR), as for example suggested by Sander and Kleimeier (2003), but it does not accommodate multivariate systems.

Therefore, we rely upon impulse response functions. If there is a reaction of one variable to an impulse in another variable, we may call the latter causal for the former. We know the limits of the approach related to the identification issue. However, we are interested in strengthening the hypothesis that the solvency risk, proxied by credit ratings, is a key explanation of developments in spreads.

Using the best specified model for Greece, Ireland and Portugal, for which we have a sufficient number of credit rating reviews to identify the shock, we construct a structural vector error correction model (SVECM) with a Cholesky identification. We make use of the long-run coefficients estimated using the DOLS method and construct a SVECM that takes the following form

$$\Delta \left(Y_{i,t}^j - Y_{b,t}^j \right) = \alpha_{i0} - \alpha_i \left[\left(Y_{i,t-1}^j - Y_{b,t-1}^j \right) - \widehat{\beta}_{i0} - X_{i,t-1}'\widehat{\beta}_i - D_{t-1}'\widehat{\gamma}_i \right] \quad (5)$$
$$+ \sum_{j=1}^6 \Delta \left(Y_{i,t-j}^j - Y_{b,t-j}^j \right) \delta_{i,j}^s + \sum_{j=1}^6 \Delta X_{i,t-j}' \delta_{i,j}^x + C\varepsilon_{i,t},$$

where $\widehat{\beta}_{i0}$, $\widehat{\beta}_i$ and $\widehat{\gamma}_i$ are the parameters estimated using (4), C is the lower triangular Cholesky factor of the residual covariance matrix and $\varepsilon_{i,t}$ are the identified structural shocks.

The ordering structure of the variables for Greece is as follows: budget deficit to GDP ratio, S&P's credit ratings for Greece, 10-year KfW-Bund spread and 10-year sovereign spread. The ordering structure of the variables for Ireland and Portugal is as follows: S&P's credit ratings for Greece, S&P's credit ratings for the country, 10-year KfW-Bund spread and 10-year sovereign spread. The block exogeneity assumption rests on the hypothesis that shocks to sovereign spread has no contemporaneous impact on the budget deficit and credit ratings in the VAR specification. The impulse and the confidence interval are bootstrapped using 1000 replications: for each replication, new parameters are drawn from their estimated asymptotic distribution (Bose, 1988) and 1000 impulse response functions are computed.

The results reported in Figure 8 suggest that sovereign spreads are strongly af-

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fected by unexpected developments in ratings. One unexpected notch downgrade on the Greek, Irish and Portuguese sovereign debt implies an accumulated rise in yield spreads after sixty business days amounting respectively to about 50 basis points in Greece, 40 basis points in Ireland and 30 basis points in Portugal. These results corroborate the solvency risk explanation.

However, also ratings respond to unanticipated developments in sovereign spreads. A 100 basis point shock on yield spreads brings about after sixty business days an accumulated rise in credit ratings amounting to 0.4 notch downgrade in Greece, 0.65 notch downgrade in Ireland and 0.25 notch downgrade in Portugal, which broadly corresponds to a negative outlook/watch decision.

It is also useful to point out that the estimated systems are stable as the error correction terms mean-revert with the propagation of the shocks.

The results are very similar if we add the international risk factor in the VAR or if we change the ordering structure of the variables.

4.4.2   Assessing contagion effects

We have defined a variable causal to another variable, if there is a reaction of the latter to an impulse in the former variable. Based on this definition, we extend the conventional measures of contagion by directly investigating causality patterns by employing impulse response functions.

We use the SVECM (5) with four variables and identify shocks using Cholesky ordering. The ordering structure of the variables for Ireland, Portugal, Spain, Italy and Belgium is as follows: S&P's credit ratings for Greece, S&P's credit ratings for the country, 10-year KfW-Bund spread and 10-year sovereign spread. The ordering structure of the variables for France is as follows: S&P's credit ratings for Greece, government budget deficit for the country, 10-year KfW-Bund spread and 10-year sovereign spread. We use a VAR with four variables for all countries for consistency.

The results reported in Figure 9 suggest that sovereign spreads are strongly affected by unexpected developments in credit ratings in Greece. One unexpected notch downgrade on the Greek sovereign debt implies an accumulated rise in yield spreads after sixty business days amounting respectively to about 40 basis points in Portugal, 25 basis points in Spain, 20 basis points in Ireland, 15 basis points in Italy, 7 basis points in Belgium and 3 basis points in France. These results are all strongly statistically significant corroborating the contagion risk explanation.

It is also useful to point out that the estimated systems are stable as the error correction terms mean-revert with the propagation of the shocks.

The results again are very similar if we add the international risk factor in the VAR or if we change the ordering structure of the variables.

5   Conclusions

The euro area sovereign debt crisis brought forward in the debate the importance of the safe assets, the sovereign solvency risk in countries with weak fiscal fundamentals and the risk of contagion among euro area countries' sovereign spreads.

The empirical model allows to quantify the role of regional versus international risk factors, the sovereign solvency risk effect and the spillover effect from the strained countries.

First, we show that spreads for Austria, Finland and the Netherlands depends largely on the higher demand for German sovereign bonds during the crisis. This implies that their spreads would become more stable, as the regional financial turbulence ends and risk aversion return to normality.

Second, the econometric evidence suggests that sovereign credit risk, proxied by credit rating information, is statistically significant, economically sizeable and is associated with higher yield spreads in Greece, Ireland, Portugal and Spain.

The empirical analysis also reveals that one-notch downgrade of sovereign bonds in Greece, Ireland and Portugal is associated with a rise in spreads in other sovereign spreads (spillover effect) with weak fiscal fundamentals, although the spillover effect from Greece is much stronger. The estimated spillover effect from Greece and the impulse response functions points to severe contagion risk hitting particularly Ireland, Portugal, Italy, Spain, Belgium and France.

If both rating agencies and market analysts assess the same set of information, it could be argued that asset price movements and credit ratings should jointly depend on fundamental factors. We do not enter in such discussion. However, a credit review can have an impact on bond yields for two reasons. First, most likely market analysts wait for a proper re-elaboration of the available information carried out by the rating agencies before allocating assets. Second, institutional investors are obliged to hold bonds with a minimum rating; while banks have to meet capital requirements set by regulators and can only use high quality assets as collateral to obtain credit from the central bank, both aspects based on credit ratings systems.

As for the fundamental factors, the model controls for current and forecasts of government budget deficit, government public debt, consensus forecasts of inflation and real GDP growth, countries' liquidity risk factors, regional and international aggregate risk factors. The sovereign solvency risk effect and the spillover effect from Greece both estimated through credit ratings remain important to explain sovereign spreads during the financial crisis. This is the case despite the credit ratings are discrete, which implies that we may underestimate the relative importance of credit risk, as any inframarginal movements in credit worthiness are not captured by these ratings. Clearly, causation may not only run from ratings to sovereign spreads, but also from sovereign spreads to ratings. In fact, credit ratings respond to developments in sovereign spreads. Overall, however, we find that rating reviews have strongly

affected the euro area sovereign debt market.

Finally, we find that the international aggregate risk factor has not been the variable that can explain the crisis and that liquidity risk has played a marginal role.

From a policy-making point of view, to safeguard the stability of the euro area financial system, the highest priorities are to reduce the sovereign solvency risk and to tackle contagion.

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Figure 1 – Developments in 5 and 10-year government bond yields and spreads

Panel A: Developments in 5-year and 10-year government bond spreads

Panel B: Developments in 5-year and 10-year government bond yields
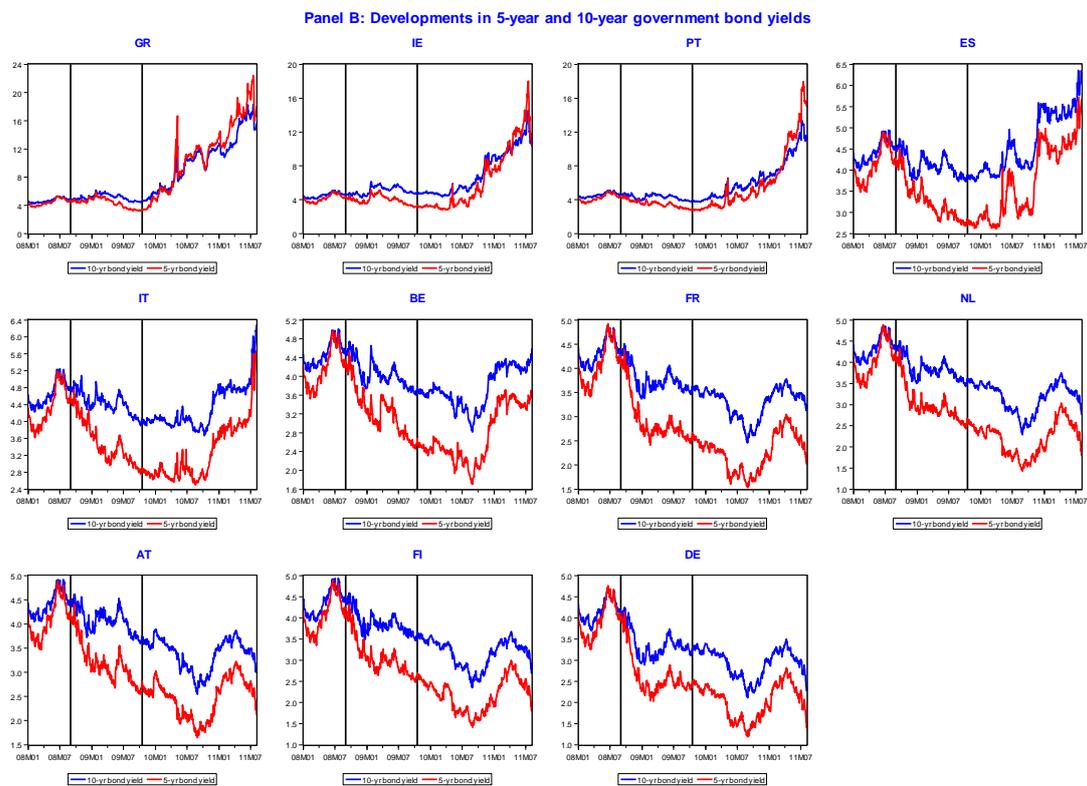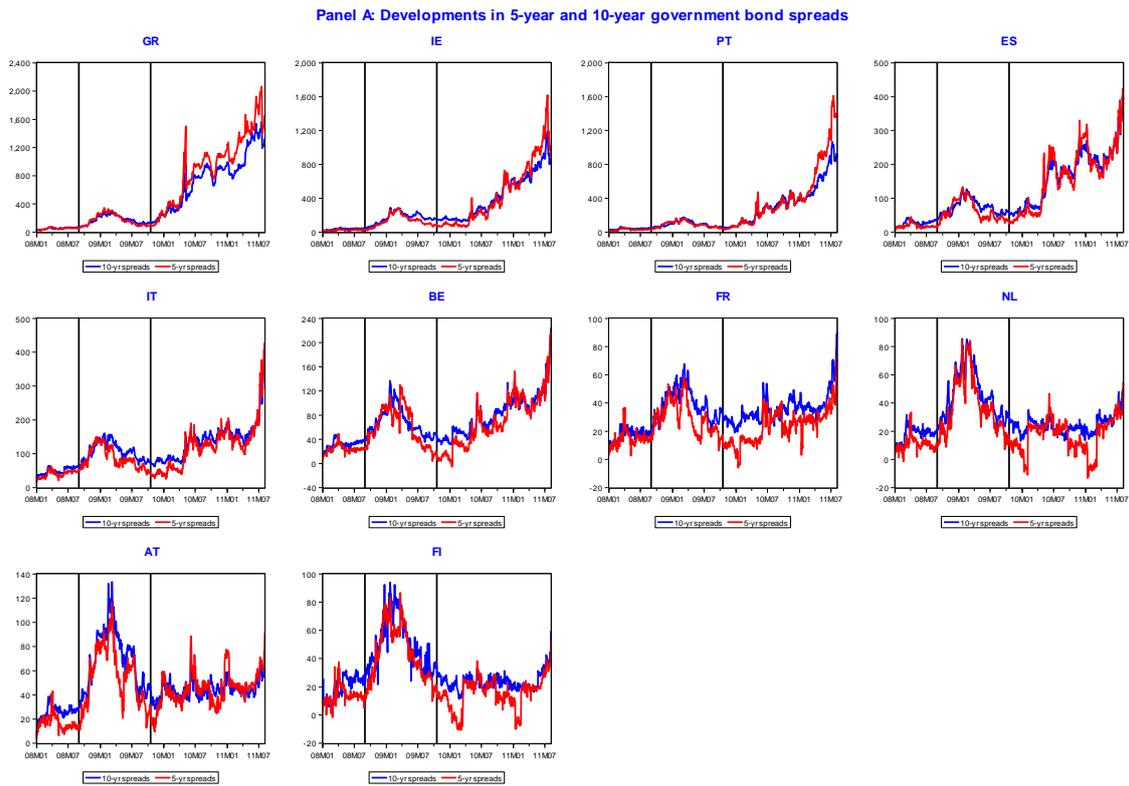
Source: Reuters DataStream.

Notes: Sample period: 1 Jan. 2008 – 4 Aug. 2011. The spread is defined as the difference between the benchmark bond yield in country *i* and the German Bund. The first vertical bar on 1 September 2008 denotes the beginning of the sample period for the empirical analysis. The second vertical bar on 16 October 2009 denotes the beginning of the euro area sovereign debt crisis after the parliamentary speech by the Greek prime minister George Papandreou.

Figure 2 – The Determinants of Government Bond Yields
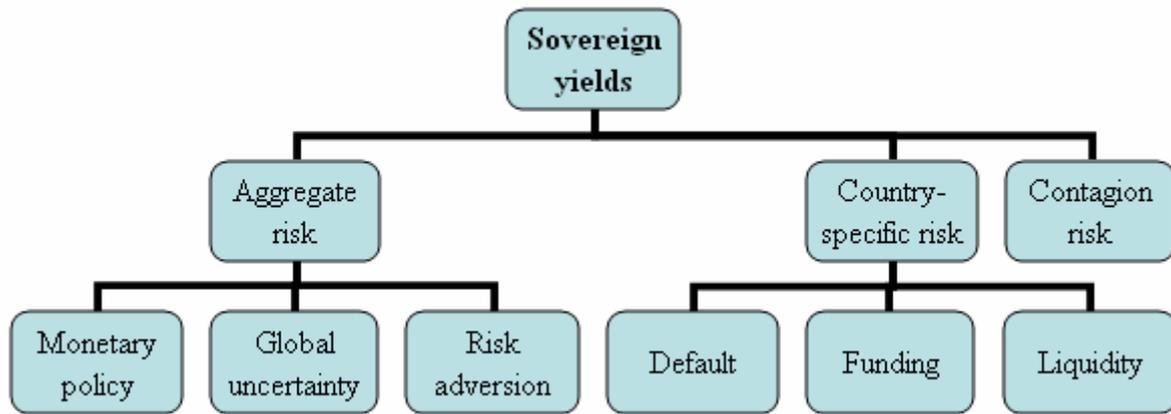
Figure 3 – The 10-year Spreads and the Regional Aggregate Risk Factor
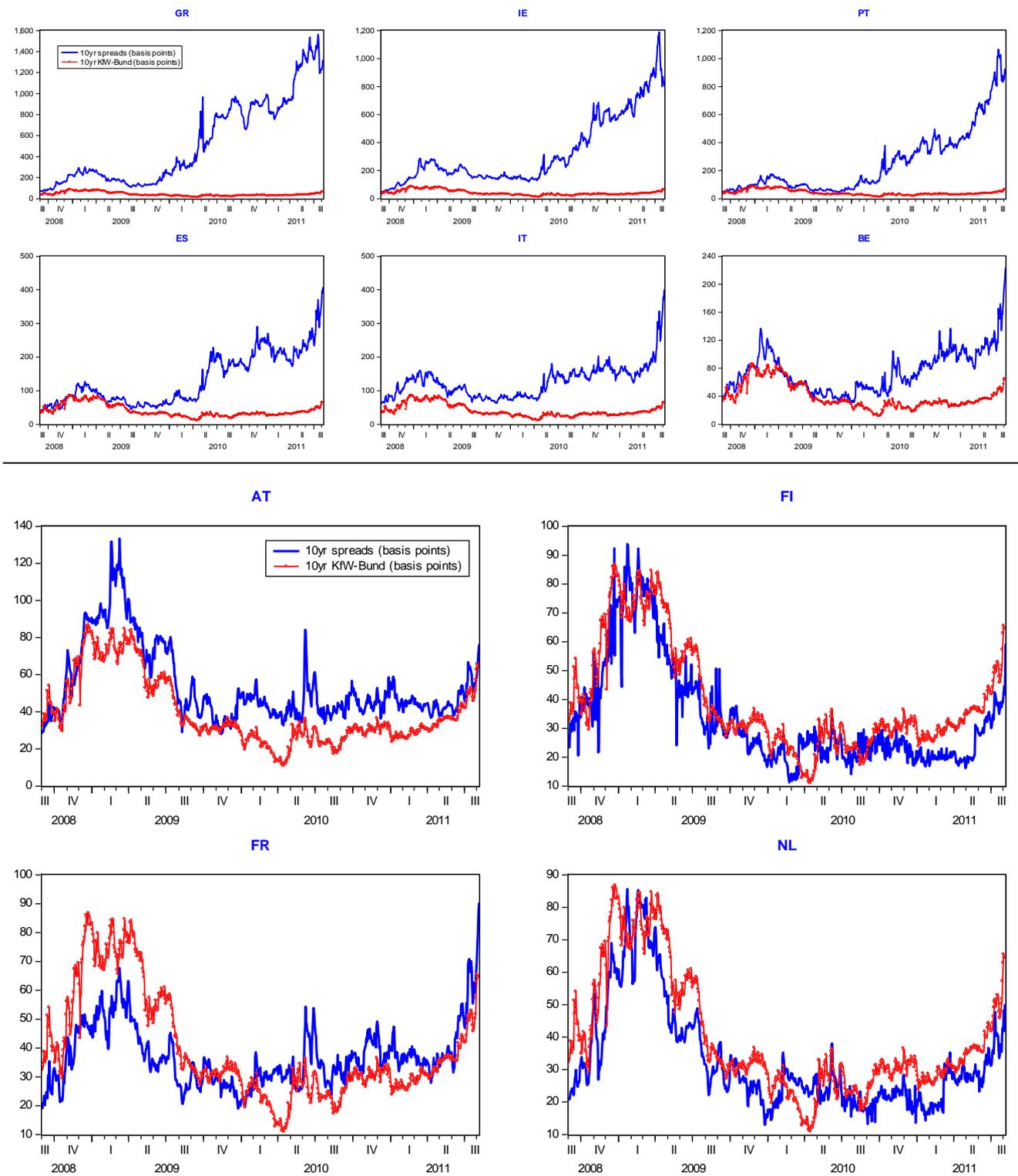
Source: Bloomberg, Reuters DataStream.
Notes: Sample period: 1 Sep. 2008 – 4 Aug. 2011.

Figure 4 – The Regional versus the International Aggregate Risk Factors

10-yr KfW-Bund and US corporate bond spread

- 10-yr KfW-Bund (basis points, LHS)
- US corporate bond spread (basis points, RHS)
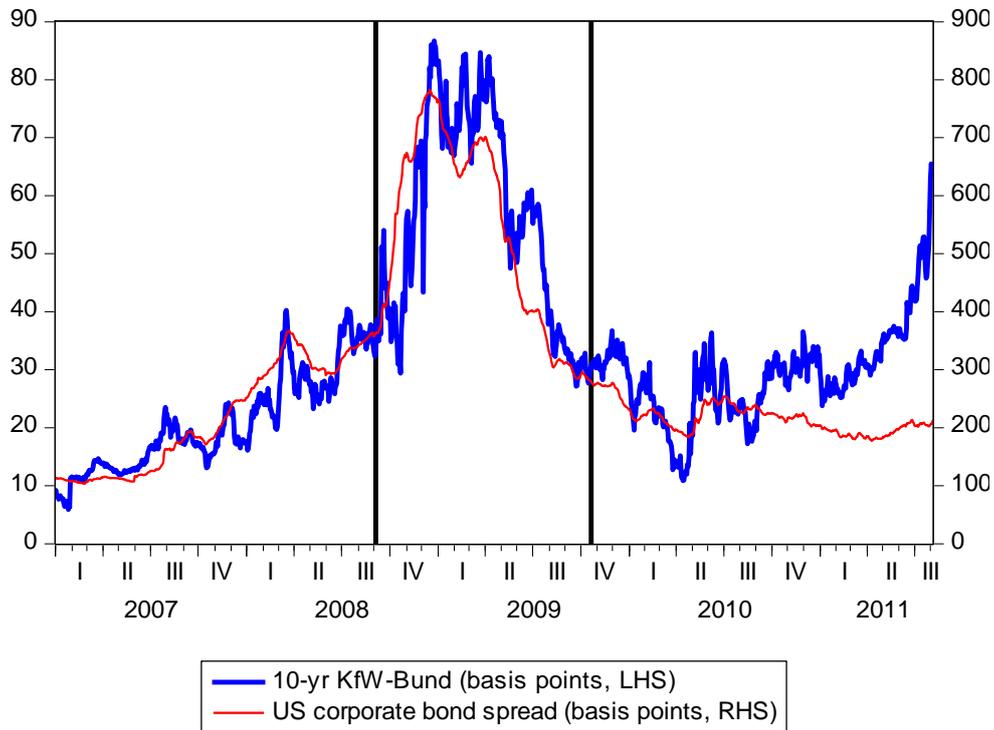
10-yr KfW-Bund and US implied volatility

- 10-yr KfW-Bund (basis points, LHS)
- VIX (RHS)
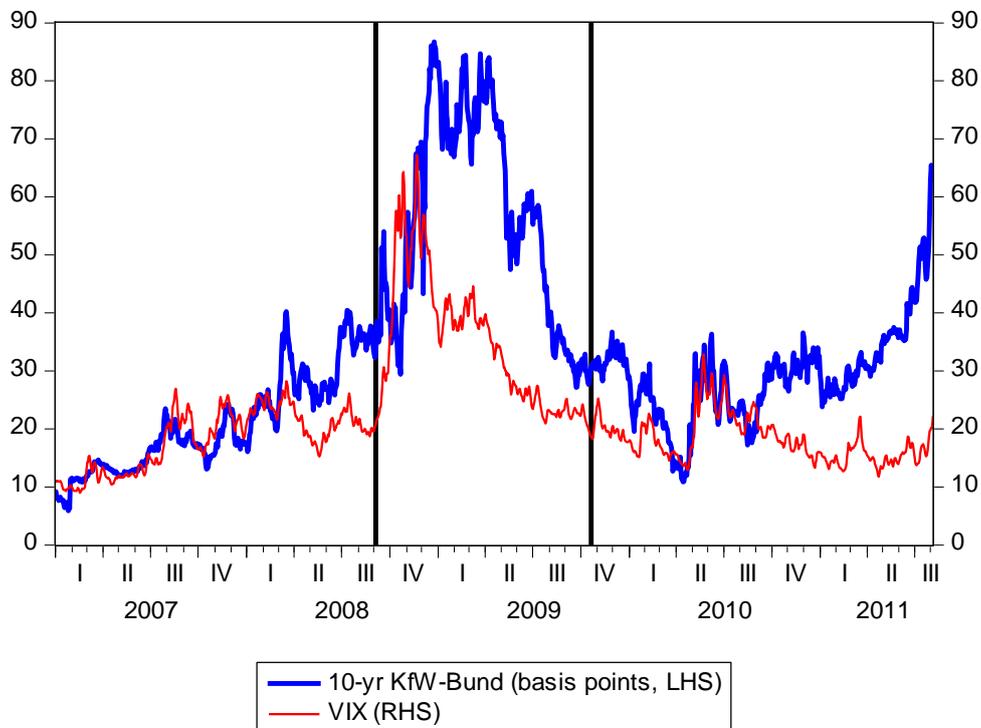
Source: Bloomberg, Reuters DataStream.
Notes: Sample period: 1 Jan. 2007 – 4 Aug. 2011. The first vertical bar on 1 September 2008 denotes the beginning of the sample period for the empirical analysis. The second vertical bar on 16 October 2009 denotes the beginning of the euro area sovereign debt crisis after the parliamentary speech by the Greek prime minister George Papandreou.

Figure 5 – The 10-year Spreads and the Government Deficit in Real Time
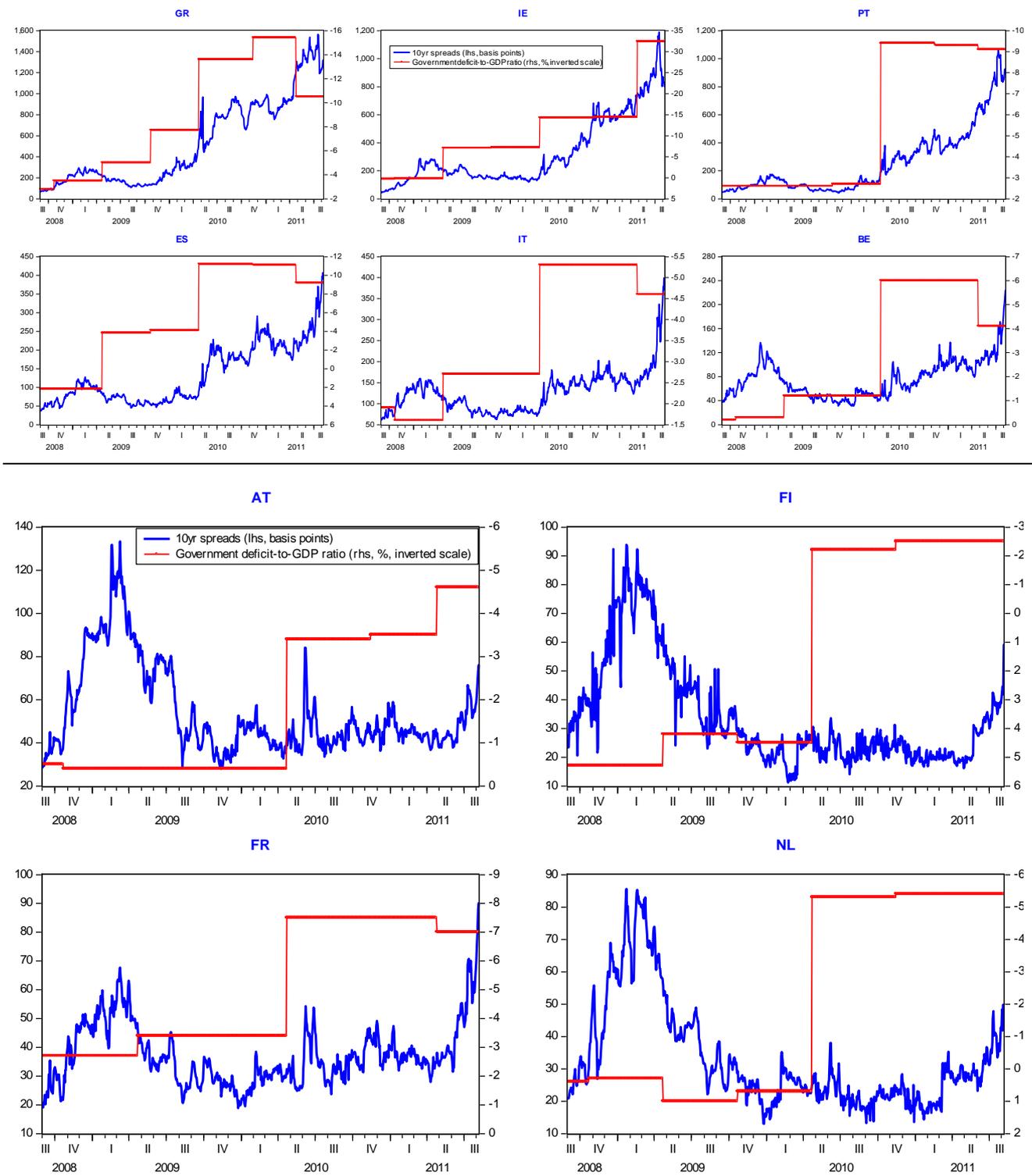
Source: Reuters DataStream and Eurostat.
Notes: Sample period: 1 Sep. 2008– 4 Aug. 2011.

Figure 6 – The 10-year Spreads and the Credit Ratings by S&P, Moody's and Fitch
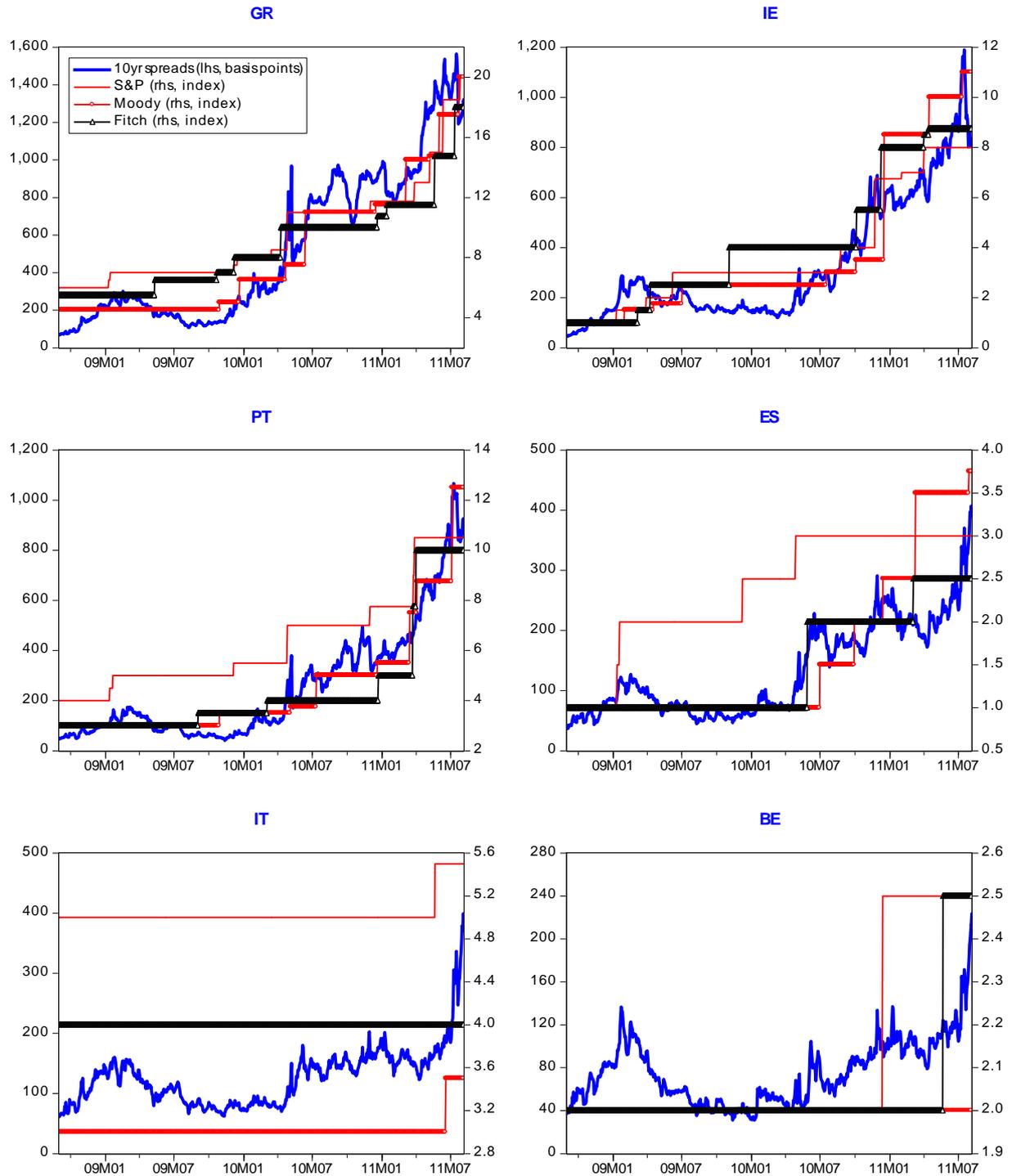
Source: Reuters and own calculations (see Table A1 in the Appendix).
Notes: Sample period: 1 Sep. 2008– 4 Aug. 2011.

Figure 7 – The 10-year Yield Spreads and the Residuals of the Dynamic OLS Regression
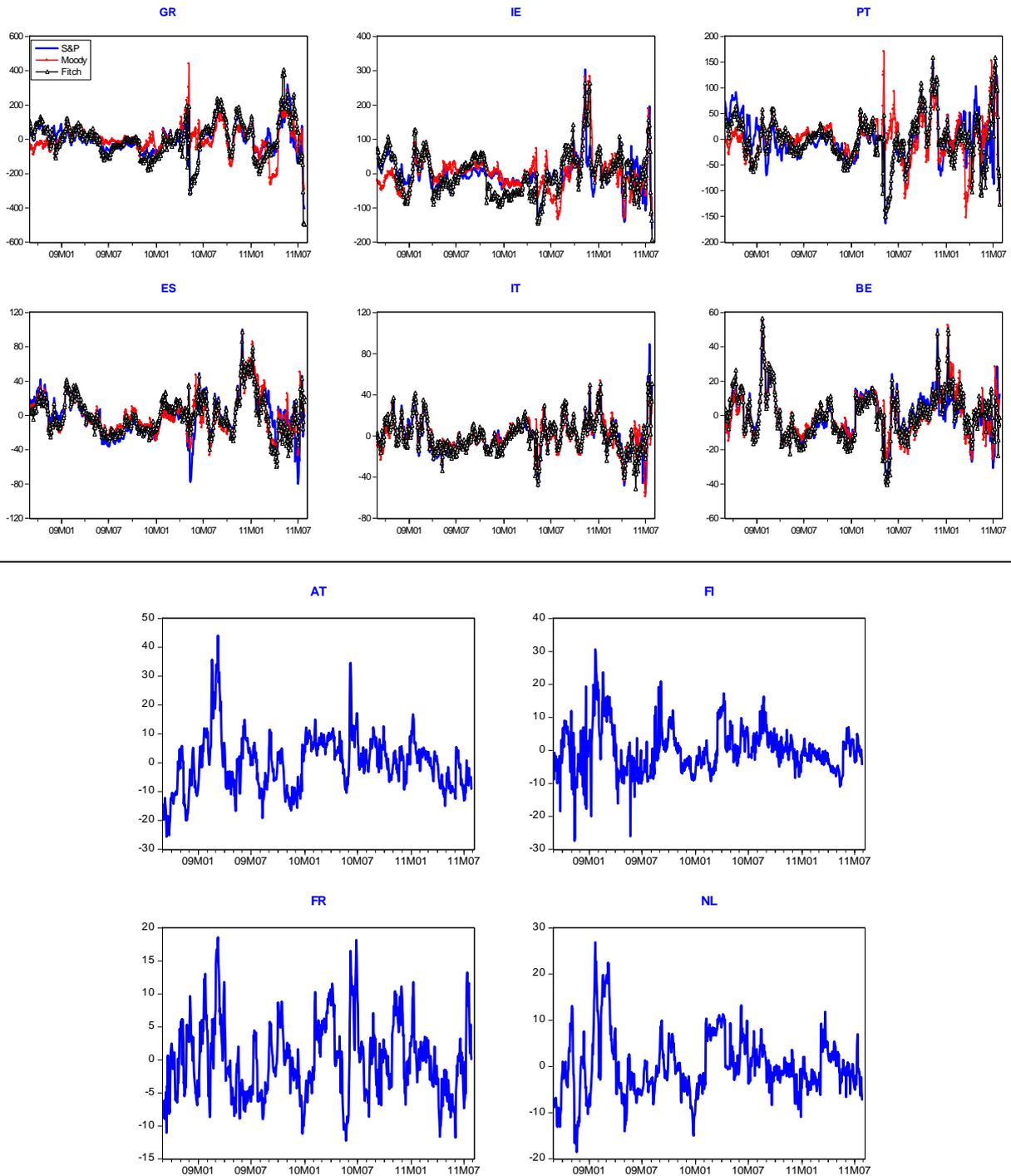
Notes: This figure reports the residuals in basis points from a dynamic ordinary least squares regression used to estimate the coefficients provided in Table 4. The regression estimates the 10-year yield spreads of country *i* on an intercept, a dummy on 10 May 2010, the fiscal balance-GDP ratio of country *i*, the credit rating of country *i*, the 10-year liquidity premium, the credit ratings on the Greek sovereign debt and *q* leads and *r* lags of the non-spread variables. The estimates are corrected for heteroscedasticity and autocorrelation in the residuals, computed using the Newey-West estimate of the error variance (HAC estimator). Sample period: 1 Sep. 2008 – 4 Aug. 2011. The number of observations is 758.

Figure 8 – Assessing Causation by means of Impulse Response Functions

Greece

Responses to 1 notch downgrade shock on Greek sovereign debt

10-yr GR-DE sovereign spreads

Error correction term
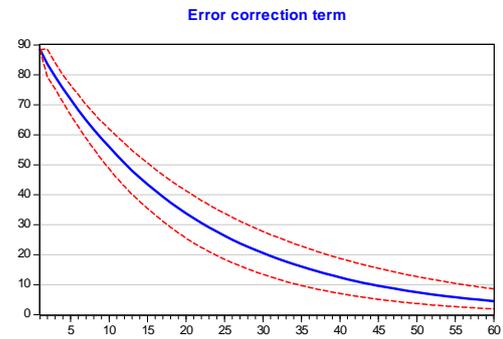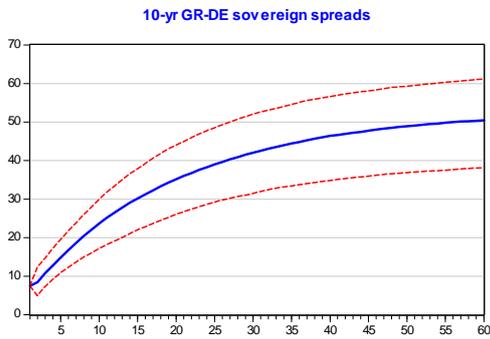
Responses to 100 basis point shock on 10-yr GR-DE sovereign spreads

Credit ratings on Greek sovereign debt

Error correction term
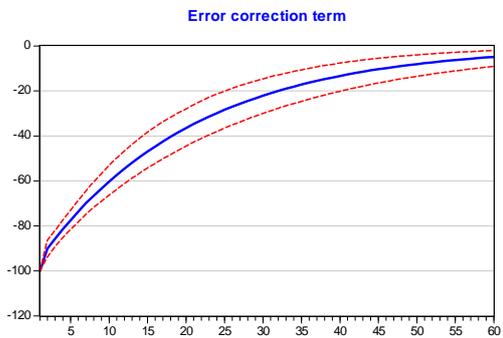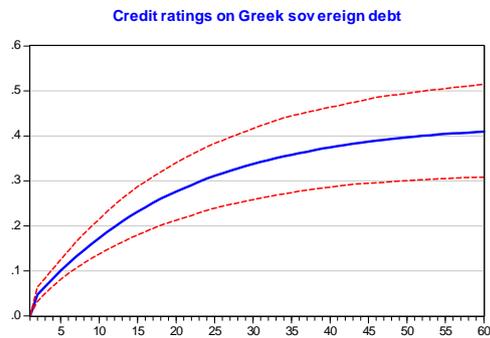
Ireland

Responses to 1 notch downgrade shock on Irish sovereign debt

10-yr IE-DE sovereign spreads

Error correction term
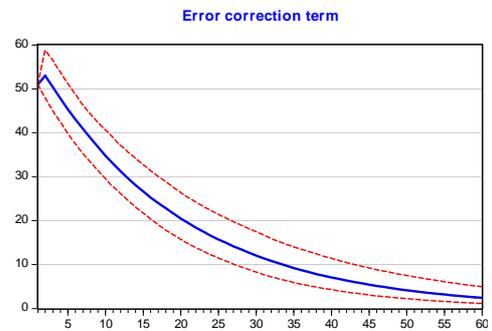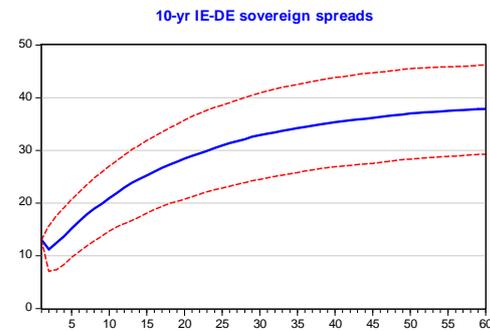
Responses to 100 basis point shock on 10-yr IE-DE sovereign spreads

Credit ratings on Irish sovereign debt

Error correction term
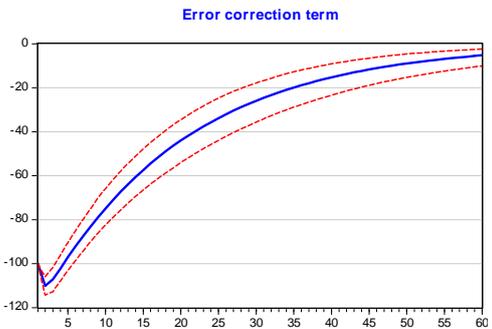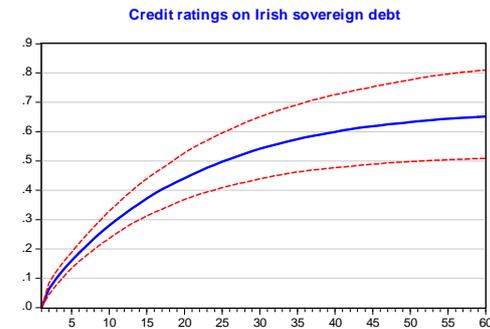
continues………

Portugal

Responses to 1 notch downgrade shock on Portuguese sovereign debt

10-yr PT-DE sovereign spreads

Error correction term
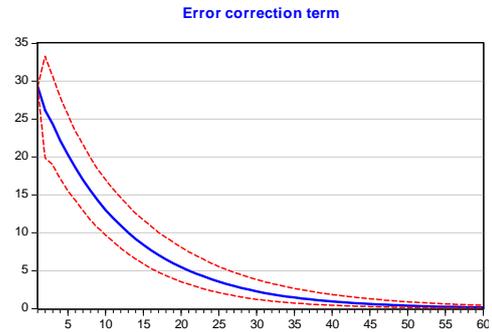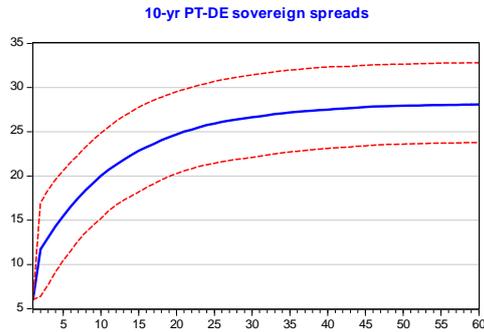
Responses to 100 basis point shock on 10-yr PT-DE sovereign spreads

Credit ratings on Portuguese sovereign debt

Error correction term
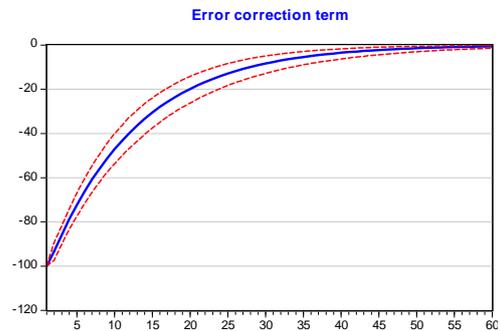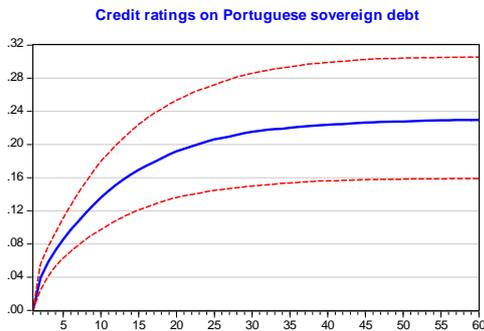
Notes: This figure reports the accumulated impulse response functions of the SVECM for Greece, Ireland and Portugal. The Cholesky ordering of the variables for Greece are: 10-yr KfW-Bund, Greek government budget balance, credit ratings by S&Ps on the Greece sovereign debt and 10-yr GR-Bund spreads. The Cholesky ordering of the variables for Ireland are: 10-yr KfW-Bund, credit ratings by S&Ps on the Greek sovereign debt, credit ratings by S&Ps on the Irish sovereign debt and 10-yr IE-Bund spreads. The Cholesky ordering of the variables for Portugal are: 10-yr KfW-Bund, credit ratings by S&Ps on the Greek sovereign debt, credit ratings by S&Ps on the Portuguese sovereign debt and 10-yr PT-Bund spreads. The impulse and the 68% confidence interval are bootstrapped using 1000 replications: for each replication, new parameters are drawn from their estimated asymptotic distribution and 1000 impulse response functions are computed. Sample period: 1 Sep. 2008 – 4 Aug. 2011. The number of observations is 758.

Figure 9 – Assessing Contagion Effects from Greece by means of Impulse Response Functions
(response to one notch downgrade shock on the Greek sovereign debt)
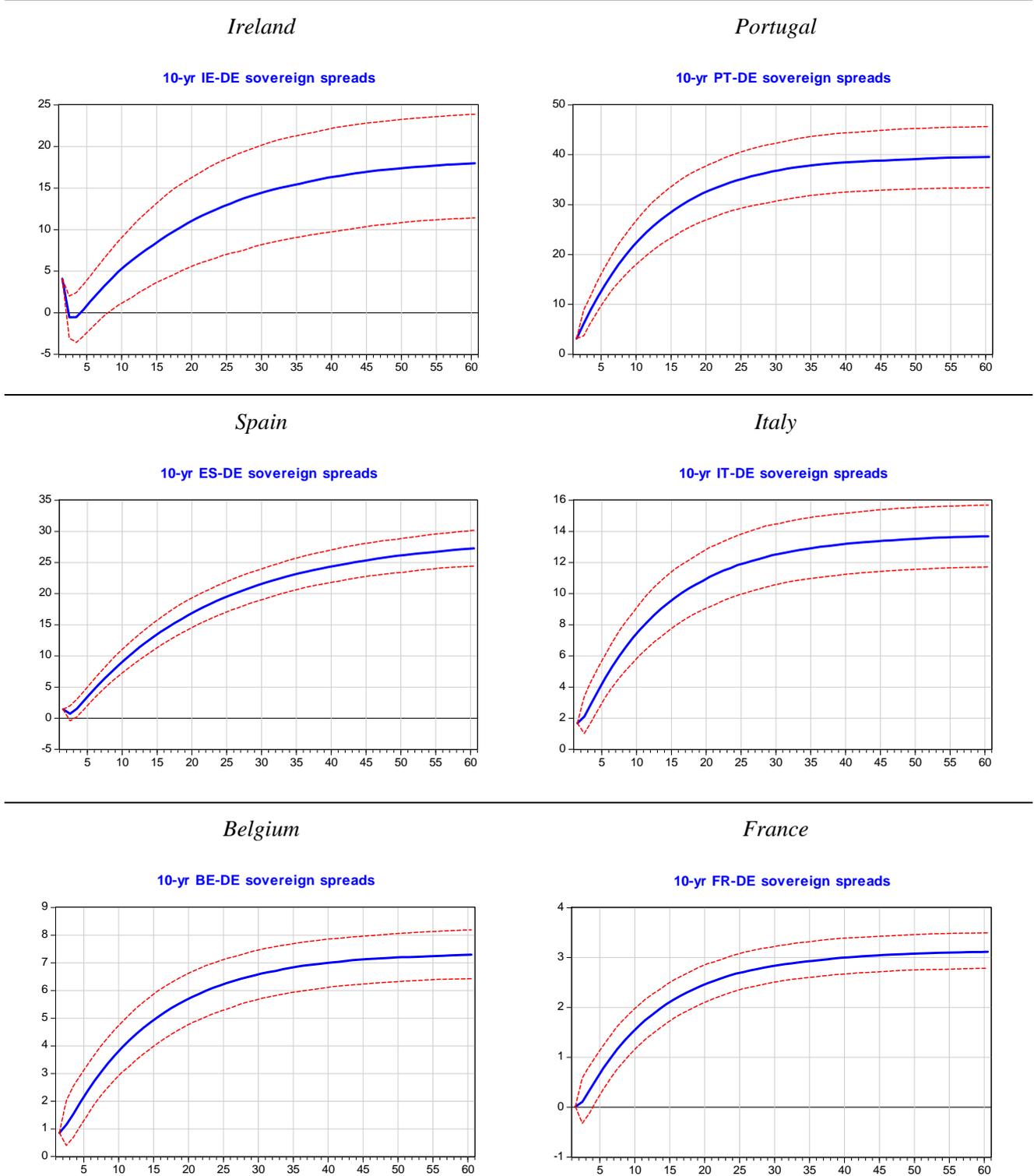
Notes: This figure reports the accumulated impulse response functions of the SVECM for Ireland, Portugal, Spain, Italy, Belgium and France. The Cholesky ordering of the variables for Ireland, Portugal, Spain, Italy and Belgium are: 10-yr KfW-Bund, credit ratings by S&Ps on the Greek sovereign debt, credit ratings by S&Ps on the country's sovereign debt and 10-yr sovereign spreads. The Cholesky ordering of the variables for France are: 10-yr KfW-Bund, credit ratings by S&Ps on the Greek sovereign debt, French government budget balance and 10-yr FR-Bund spreads. The impulse and the 68% confidence interval are bootstrapped using 1000 replications: for each replication, new parameters are drawn from their estimated asymptotic distribution and 1000 impulse response functions are computed. Sample period: 1 Sep. 2008 – 4 Aug. 2011. The number of observations is 758.

Table 1 – Estimation of a System of Simultaneous Equations for Euro-Area Yield Spreads

Panel A: Model specification à la Favero, *et al.* (2010)

	Constant	Own Lag	Maturity	International Risk Factor	Bid-Ask Spread	Bid-Ask Spread * Risk Factor
AT	-0.278	0.952	-0.001	0.006	0.055	-0.006
	(0.453)	(0.008)	(0.003)	(0.001)	(0.012)	(0.002)
BE	1.202	0.979	-0.004	0.000	0.048	-0.004
	(0.505)	(0.005)	(0.003)	(0.001)	(0.018)	(0.005)
ES	2.224	0.985	0.007	-0.001	0.054	-0.011
	(0.895)	(0.003)	(0.006)	(0.002)	(0.016)	(0.006)
FI	0.098	0.835	0.001	0.015	0.041	-0.001
	(0.405)	(0.018)	(0.004)	(0.002)	(0.013)	(0.003)
IT	1.969	0.984	0.013	0.000	0.050	-0.006
	(0.811)	(0.005)	(0.007)	(0.001)	(0.013)	(0.003)
NL	0.482	0.941	-0.002	0.004	0.001	-0.001
	(0.229)	(0.009)	(0.002)	(0.001)	(0.009)	(0.003)
PT	4.892	0.961	-0.020	-0.002	0.144	-0.036
	(1.733)	(0.004)	(0.014)	(0.004)	(0.027)	(0.012)
GR	12.312	0.974	-0.006	-0.012	0.248	-0.077
	(3.509)	(0.004)	(0.029)	(0.007)	(0.046)	(0.022)
IE	6.957	0.961	-0.015	-0.001	-0.001	-0.008
	(2.057)	(0.005)	(0.016)	(0.001)	(0.001)	(0.005)

Panel B: Model specification à la Gerlach, *et al.* (2010)

	Constant	Own Lag	Maturity	International Risk Factor	Bid-Ask Spread	Bank Assets	Bank Assets * Risk Factor
AT	2.230	0.943	-0.001	-0.001	0.032	-0.038	0.013
	(2.185)	(0.01)	(0.003)	(0.01)	(0.005)	(0.038)	(0.018)
BE	0.959	0.982	-0.005	-0.001	0.039	0.015	0.000
	(0.967)	(0.006)	(0.003)	(0.003)	(0.009)	(0.018)	(0.005)
ES	3.022	0.982	0.005	-0.004	0.029	0.063	-0.019
	(0.946)	(0.003)	(0.006)	(0.002)	(0.006)	(0.041)	(0.013)
FI	-7.127	0.807	0.001	0.052	0.035	-0.071	0.033
	(2.802)	(0.021)	(0.004)	(0.013)	(0.006)	(0.029)	(0.012)
IT	5.829	0.980	0.009	-0.009	0.023	0.041	-0.011
	(3.954)	(0.005)	(0.007)	(0.015)	(0.007)	(0.049)	(0.019)
NL	-0.196	0.935	-0.002	0.009	-0.003	0.012	-0.006
	(0.912)	(0.009)	(0.002)	(0.003)	(0.004)	(0.013)	(0.004)
PT	7.678	0.962	-0.019	-0.014	0.064	0.089	-0.034
	(2.773)	(0.004)	(0.014)	(0.009)	(0.007)	(0.086)	(0.024)
GR	44.045	0.973	-0.025	-0.025	0.094	0.273	-0.112
	(27.612)	(0.004)	(0.029)	(0.029)	(0.009)	(0.231)	(0.08)
IE	-0.956	0.961	-0.022	0.008	0.075	0.013	-0.002
	(23.569)	(0.005)	(0.017)	(0.092)	(0.008)	(0.035)	(0.014)

Panel C: Model specification à la Arghyrou and Kontonikas (2010)

	Constant	Own Lag	International Risk Factor	Real Exchange Rate
AT	-1.335	0.967	1.162	-0.174
	(1.724)	(0.006)	(0.445)	(0.239)
BE	-0.516	0.981	-0.020	0.359
	(2.375)	(0.006)	(0.499)	(0.229)
ES	1.488	0.988	-1.463	0.306
	(7.416)	(0.004)	(0.792)	(0.399)
FI	-6.601	0.911	3.080	0.002
	(3.646)	(0.014)	(0.895)	(0.407)
IT	9.549	0.993	-0.984	-0.531
	(7.3)	(0.004)	(0.755)	(0.604)
NL	-4.028	0.961	1.281	0.151
	(2.775)	(0.007)	(0.303)	(0.284)
PT	2.986	0.988	-6.208	1.546
	(13.248)	(0.003)	(1.829)	(1.062)
GR	-30.403	0.980	-6.334	2.349
	(31.818)	(0.005)	(3.706)	(0.995)
IE	17.047	0.991	-3.353	-0.188
	(6.194)	(0.003)	(2.452)	(0.502)

Notes: Each panel reports the estimated coefficients from a seemingly unrelated regression of the variable on an intercept and its own lag, together with: an aggregate risk factor (the US corporate bond spread), the bid-ask spread differential and its interaction with the risk factor (see Panel A); an aggregate risk factor (the US corporate bond spread), the country's bid-ask spread differential, the country's bank assets to GDP ratio and its interaction with the risk factor (see Panel B); an aggregate risk factor (the log of the US stock market implied volatility), the country's log real effective exchange rate differential (see Panel C). Standard errors are reported within parentheses below the coefficient estimates. Sample period: 1 Sep. 2008 – 4 Aug. 2011. The number of observations is 758.

Table 2 – Phillips-Perron and NG- Perron Unit Root Test Results

	GR	IE	PT	ES	IT	BE	AT	FI	FR	NL
				10-year spreads of sovereign bond yields						
Intercept	2.157	1.109	0.499	0.168	-0.805	0.240	0.843	1.267	0.621	0.434
Slope coefficient	0.999	1.000	1.003	1.002	1.010	1.000	0.985	0.963	0.986	0.988
Phillips-Perron statistic	-0.115	-0.439	1.093	0.974	1.797	0.491	-2.380	-2.434	-1.630	-2.099
NG-Perron statistic	1.662	1.980	3.706	3.775	7.608	5.333	-4.311	-3.844	3.063	-2.581
				5-year spreads of sovereign bond yields						
Intercept	3.331	1.650	0.516	0.610	0.035	0.576	1.527	0.466	0.898	0.618
Slope coefficient	0.998	0.998	1.004	0.999	1.004	0.995	0.971	0.984	0.968	0.977
Phillips-Perron statistic	-0.556	-0.823	2.469	-0.179	1.368	-0.198	-3.105	-1.943	-2.861	-2.426
NG-Perron statistic	1.584	0.668	4.658	2.063	6.982	1.708	-2.731	-4.376	-10.054	-7.550
				5-year sovereign credit default swaps						
Intercept	2.771	1.342	0.753	0.864	0.675	0.433	1.089	0.326	0.238	0.470
Slope coefficient	0.999	0.999	1.002	0.998	0.998	0.999	0.989	0.992	0.999	0.992
Phillips-Perron statistic	-0.276	-0.788	0.914	-0.462	-0.738	-0.659	-2.798	-2.111	-0.758	-2.276
NG-Perron statistic	0.727	1.723	3.405	1.911	3.003	1.296	-2.123	-1.026	1.484	-1.430
				Bid-ask 10-year spread differential						
Intercept	9.552	10.181	15.913	9.069	5.354	6.206	17.425	8.823	7.712	10.727
Slope coefficient	0.885	0.904	0.836	0.663	0.661	0.434	0.216	0.284	0.300	0.154
Phillips-Perron statistic	-5.692	-5.555	-9.372	-16.927	-15.824	-26.887	-29.316	-25.609	-24.504	-29.376
NG-Perron statistic	4.090	3.101	3.728	0.146	-16.638	-6.006	-8.250	-8.735	-3.310	-9.865
				Government debt issuance ratio						
Intercept	0.449	0.760	0.385	2.870	3.669	0.940	0.239	0.349	5.337	1.310
Slope coefficient	0.975	0.949	0.961	0.954	0.972	0.959	0.978	0.946	0.946	0.954
Phillips-Perron statistic	-3.171	-4.821	-4.110	-4.554	-3.344	-4.272	-2.898	-5.000	-5.017	-4.538
NG-Perron statistic	-17.663	-20.253	-24.770	-30.248	-20.840	-10.004	-9.611	-27.912	-34.636	-26.696
				MTS trading volume ratio						
Intercept	24.670	14.932	59.894	84.979	1055.879	281.721	17.218	18.344	203.698	230.399
Slope coefficient	0.342	0.237	0.359	0.360	0.275	0.162	0.274	0.207	0.295	0.197
Phillips-Perron statistic	-25.297	-25.323	-25.450	-23.115	-22.792	-28.224	-20.889	-24.824	-27.007	-25.154
NG-Perron statistic	-10.546	-7.068	-4.631	-4.958	-10.894	-7.292	-4.731	-3.520	-2.495	-3.370
				Fiscal balance to GDP ratio						
Intercept	-0.040	-0.048	-0.022	-0.034	-0.014	-0.016	-0.007	-0.007	-0.019	-0.012
Slope coefficient	0.997	1.000	0.998	0.997	0.997	0.996	0.999	0.998	0.997	0.998
Phillips-Perron statistic	-1.376	-0.149	-0.926	-1.416	-1.174	-1.311	-0.421	-0.893	-1.051	-0.848
NG-Perron statistic	-0.184	1.666	-0.155	0.174	-0.211	-0.558	0.659	0.210	-0.030	-0.188
				Credit ratings by S&P's						
Intercept	-0.024	0.009	0.003	0.011	0.008	0.004				
Slope coefficient	1.004	1.000	1.001	0.996	0.999	0.998				
Phillips-Perron statistic	2.472	0.014	0.184	-1.812	-0.273	-0.529				
NG-Perron statistic	3.958	1.553	1.787	0.472	-0.187	-0.103				
				Credit ratings by Moody's						
Intercept	-0.006	0.009	-0.012	0.000	0.005					
Slope coefficient	1.003	1.001	1.005	1.002	0.999					
Phillips-Perron statistic	1.877	0.499	2.316	1.118	-0.216					
NG-Perron statistic	3.345	2.137	5.100	2.531	-0.263					
				Credit ratings by Fitch						
Intercept	-0.016	0.011	0.000	0.003		0.004				
Slope coefficient	1.004	1.000	1.002	0.999		0.999				
Phillips-Perron statistic	1.798	-0.060	0.448	-0.321		-0.275				
NG-Perron statistic	3.627	1.448	1.666	0.801		-0.185				

	10-year KfW-Bund	5-year KfW-Bund	10-year US corporate bond spread	US implied volatility
Intercept	0.321	0.380	-0.203	0.830
Slope coefficient	0.993	0.993	1.000	0.971
Phillips-Perron statistic	-1.499	-1.539	-0.795	-2.950
NG-Perron statistic	-4.320	-3.731	-2.407	-7.814

Notes: Each panel reports the estimated coefficients from an ordinary least squares regression of the variable on an intercept and its own lag, together with the Phillips-Perron (1998) and the MZ_α^{GLS} NG-Perron (2001) statistics corrected for the autocorrelation in the regression error, computed using the Newey-West estimate of the error variance. The length of the lag structure is computed using the AIC criteria. The frequency zero spectrum default method is kernel (Bartlett) sum-of-covariances for the Phillips-Perron test and autoregressive spectral regression (GLS-detrended) for the NG-Perron test. The critical values for the Phillips-Perron statistic are reported by Hamilton (1994, Table B.6, 763): -2.86 (10 percent), -3.12 (5 percent), -3.51 (1 percent). The critical values for the MZ_α^{GLS} NG-Perron statistic are reported by NG and Perron (2001, Table 1, 1524): -5.7 (10 percent), -8.1 (5 percent), -13.8 (1 percent). Sample period: 1 Sep. 2008 – 4 Aug. 2011.

Table 3 – Phillips-Ouliaris Cointegration Test Results and the 10-Year Yield Spread

	GR	IE	PT	ES	IT	BE	AT	FI	FR	NL
Panel A: Fiscal balance										
Intercept	-81.197	94.765	-46.685	74.374	66.302	61.134	61.833	29.387	35.680	37.601
10-May-10	-372.594	-242.697	-270.984	-91.009	-52.242	-43.162	-3.251	0.100	-8.196	-5.890
Fiscal balance	-68.977	-22.904	-53.986	-10.816	-17.121	-4.938	4.201	2.721	-0.295	2.323
AR1 slope	0.995	0.982	0.993	0.997	1.005	1.000	0.984	0.949	0.987	0.984
Z(t)	-0.787	-2.768	-0.661	-0.170	0.848	-0.069	-2.596	-2.857	-1.781	-2.447
Panel B: 10-year KfW-Bund										
Intercept	798.051	390.906	330.509	163.179	110.355	56.178	15.346	-1.283	22.782	1.595
10-May-10	-134.995	-170.525	-89.770	-38.610	-15.944	-21.088	3.603	1.779	-2.459	-2.725
10-year KfW-Bund	-6.870	-1.567	-1.958	-0.771	0.399	0.481	0.974	0.884	0.360	0.789
AR1 slope	0.999	1.000	1.003	1.003	1.009	0.998	0.933	0.786	0.968	0.922
Z(t)	-0.256	-0.434	1.075	0.690	1.681	-0.350	-5.050	-9.107	-2.952	-5.550
Panel C: Fiscal balance and 10-year KfW-Bund										
Intercept	-473.549	-81.224	-196.584	-55.501	-63.954	0.174	16.028	0.229	4.498	3.933
10-May-10	-360.828	-205.018	-257.319	-90.605	-50.767	-41.525	3.832	3.705	-6.681	-1.463
Fiscal balance	-84.812	-25.914	-60.646	-16.629	-31.675	-9.688	0.213	0.747	-2.483	0.519
10-year KfW-Bund	6.350	3.662	2.830	2.473	1.985	1.185	0.967	0.815	0.510	0.756
AR1 slope	0.989	0.975	0.989	0.974	0.987	0.977	0.933	0.769	0.938	0.920
Z(t)	-1.746	-3.249	-1.236	-2.489	-0.978	-2.139	-5.056	-9.644	-4.579	-5.648
Panel D: Fiscal balance, 10-year KfW-Bund, country's credit ratings and Greek credit ratings by S&P										
Intercept	-712.915	-386.888	-525.526	-110.245	-82.000	-89.082	17.701	3.533	1.707	2.798
10-May-10	-281.809	-109.882	-141.156	-72.228	-35.855	-26.756	3.498	3.259	-4.221	-1.242
Fiscal balance	-25.978	1.369	-1.842	-6.610	-10.496	-2.927	-0.313	0.470	-0.254	0.660
Country's credit ratings	96.526	67.116	36.400	0.301	2.520	33.278				
10-year KfW-Bund	2.457	3.181	2.085	1.398	1.497	1.010	0.969	0.823	0.466	0.756
Greek credit ratings		37.438	48.192	15.970	10.497	4.822	-0.289	-0.333	1.653	0.152
AR1 slope	0.957	0.955	0.922	0.948	0.948	0.938	0.933	0.768	0.914	0.920
Z(t)	-3.879	-4.931	-5.774	-4.328	-3.994	-4.899	-5.073	-9.710	-5.814	-5.655
Panel E: Fiscal balance, 10-year KfW-Bund, country's credit ratings and Greek credit ratings by Moody's										
Intercept	-388.300	-193.431	-285.593	-70.818	-403.048	-17.861	18.890	5.479	6.440	4.074
10-May-10	-26.688	-58.983	-23.645	-36.621	-22.425	-14.151	0.591	1.074	-1.155	-1.578
Fiscal balance	-15.590	-3.209	-9.635	-5.685	-15.572	-1.559	-1.549	0.124	-0.443	0.490
Country's credit ratings	83.791	34.076	48.318	-13.210	123.762					
10-year KfW-Bund	2.261	2.930	1.738	1.520	1.502	1.052	0.967	0.827	0.479	0.756
Greek credit ratings		29.959	24.273	16.256	4.983	5.720	-0.749	-0.573	1.150	-0.024
AR1 slope	0.935	0.968	0.936	0.944	0.933	0.938	0.932	0.762	0.923	0.920
Z(t)	-5.013	-4.149	-5.332	-4.775	-5.029	-5.021	-5.103	-9.882	-5.474	-5.647
Panel F: Fiscal balance, 10-year KfW-Bund, country's credit ratings and Greek credit ratings by Fitch										
Intercept	-851.693	-371.100	-455.828	-121.472	-90.167	12.348	18.856	5.884	-1.021	4.303
10-May-10	-260.974	-126.245	-129.015	-22.315	-33.436	-29.952	3.316	2.941	-4.084	-1.529
Fiscal balance	-30.104	-5.059	-18.170	-4.246	-11.052	-1.713	-0.440	0.355	-0.504	0.484
Country's credit ratings	105.833	59.365	40.148	55.281		-37.399				
10-year KfW-Bund	4.966	4.827	2.799	1.374	1.785	1.275	0.960	0.813	0.510	0.755
Greek credit ratings		24.154	37.042	10.969	12.338	9.654	-0.435	-0.570	1.774	-0.047
AR1 slope	0.968	0.964	0.924	0.946	0.932	0.926	0.933	0.766	0.914	0.920
Z(t)	-3.198	-4.213	-5.507	-4.266	-4.639	-5.234	-5.077	-9.768	-5.851	-5.646

	GR	IE	PT	ES	IT	BE	AT	FI	FR	NL
Panel G: 10-year KfW-Bund, country's credit ratings and Greek credit ratings by S&P										
Intercept	-568.100	-372.858	-527.315	-144.245	251.261	-84.345	17.070	7.247	2.151	5.360
10-May-10	-229.647	-110.375	-137.000	-63.677	-30.466	-22.110	3.723	2.371	-3.886	-2.463
Country's credit ratings	117.595	66.312	37.318	29.735	-64.589	30.845				
10-year KfW-Bund	-0.442	3.259	2.022	0.840	1.293	0.876	0.966	0.844	0.458	0.771
Greek credit ratings		34.463	49.115	18.304	15.755	6.325	-0.149	-0.735	1.775	-0.324
AR1 slope	0.969	0.956	0.922	0.960	0.945	0.943	0.933	0.768	0.914	0.921
Z(t)	-3.006	-4.855	-5.776	-3.743	-4.264	-4.714	-5.067	-9.696	-5.825	-5.600
Panel H: 10-year KfW-Bund, country's credit ratings and Greek credit ratings by Moody's										
Intercept	-274.865	-199.580	-277.628	-50.413	-209.779	-15.783	17.544	6.194	7.725	5.159
10-May-10	33.696	-42.520	12.774	-14.668	2.171	-9.771	3.257	0.603	-0.091	-3.285
Country's credit ratings	94.382	36.164	36.970	-24.150	70.446					
10-year KfW-Bund	0.677	2.746	1.701	0.845	1.123	0.987	0.959	0.832	0.466	0.764
Greek credit ratings		34.644	36.235	22.899	9.581	6.329	-0.194	-0.658	1.324	-0.314
AR1 slope	0.939	0.967	0.933	0.952	0.954	0.940	0.933	0.762	0.923	0.920
Z(t)	-4.791	-4.246	-5.467	-4.528	-4.138	-5.031	-5.073	-9.902	-5.502	-5.623
Panel I: 10-year KfW-Bund, country's credit ratings and Greek credit ratings by Fitch										
Intercept	-709.535	-433.157	-496.232	-117.876	-73.901	46.633	17.625	8.645	-1.004	6.571
10-May-10	-192.622	-121.872	-93.199	0.254	-23.000	-27.794	3.690	2.157	-3.371	-2.534
Country's credit ratings	133.228	62.072	32.315	71.577		-59.924				
10-year KfW-Bund	2.082	4.772	2.620	0.847	1.503	1.290	0.961	0.826	0.504	0.760
Greek credit ratings		36.218	58.179	12.852	16.260	11.503	-0.202	-0.880	2.096	-0.440
AR1 slope	0.978	0.966	0.947	0.948	0.940	0.924	0.933	0.764	0.917	0.921
Z(t)	-2.487	-4.011	-4.526	-4.239	-4.584	-5.222	-5.102	-9.785	-5.709	-5.607
Panel J: Fiscal balance, US corporate bond spread, country's credit ratings and Greek credit ratings by S&P										
Intercept	-820.837	-448.924	-592.038	-171.732	-20.109	-119.586	-4.633	-19.256	-7.087	-16.736
10-May-10	-286.663	-99.670	-137.799	-75.480	-36.891	-26.515	2.979	2.558	-4.497	-1.148
Fiscal balance	-27.562	-0.026	0.541	-5.524	-6.530	-2.037	2.873	1.120	0.361	1.712
Country's credit ratings	103.675	76.032	44.179	15.144	-15.529	38.915				
US corporate BBB-AAA	0.362	0.415	0.254	0.176	0.161	0.113	0.102	0.093	0.052	0.084
Greek credit ratings		37.456	51.069	18.849	15.525	7.258	3.102	2.096	3.000	2.600
AR1 slope	0.950	0.951	0.915	0.946	0.957	0.948	0.958	0.812	0.928	0.945
Z(t)	-4.259	-5.225	-6.099	-4.380	-3.583	-4.529	-4.259	-8.139	-5.299	-4.663
Panel K: Fiscal balance, US corporate bond spread, country's credit ratings and Greek credit ratings by Moody's										
Intercept	-403.412	-192.561	-288.218	-81.910	-520.115	-25.244	11.361	-6.208	4.267	-5.584
10-May-10	-18.803	-61.904	-22.800	-31.221	-19.305	-9.411	4.187	4.241	0.954	3.036
Fiscal balance	-14.520	-4.557	-9.591	-5.728	-14.873	-0.307	0.274	0.583	0.212	1.496
Country's credit ratings	87.866	38.722	55.731	-4.262	160.534					
US corporate BBB-AAA	0.237	0.291	0.158	0.156	0.156	0.109	0.099	0.091	0.050	0.082
Greek credit ratings		28.072	22.428	16.626	6.792	7.662	1.163	1.001	2.071	1.685
AR1 slope	0.931	0.970	0.941	0.955	0.947	0.956	0.963	0.836	0.948	0.952
Z(t)	-5.253	-4.075	-5.144	-4.204	-4.442	-4.310	-4.016	-7.308	-4.440	-4.310
Panel L: Fiscal balance, US corporate bond spread, country's credit ratings and Greek credit ratings by Fitch										
Intercept	-1000.843	-455.532	-504.944	-158.296	-130.971	-9.615	-1.730	-17.405	-12.971	-16.242
10-May-10	-266.739	-121.532	-128.569	-26.604	-35.070	-30.488	1.950	2.130	-4.424	-1.648
Fiscal balance	-29.638	-7.048	-16.464	-4.355	-9.289	-0.559	0.880	0.706	-0.066	1.199
Country's credit ratings	121.636	69.106	43.070	53.017		-43.599				
US corporate BBB-AAA	0.627	0.604	0.308	0.166	0.209	0.152	0.107	0.097	0.060	0.088
Greek credit ratings		25.196	43.132	15.246	17.749	13.953	2.453	1.977	3.384	2.498
AR1 slope	0.963	0.968	0.933	0.947	0.947	0.938	0.961	0.825	0.934	0.951
Z(t)	-3.580	-4.228	-5.185	-4.191	-4.010	-4.791	-4.122	-7.705	-5.141	-4.410

Notes: Each panel reports (a) the estimated coefficients from an ordinary least squares regression of the 10-year yield spreads of country *i* on the intercept and a vector of variables displayed in each panel; (b) AR1, the slope coefficient from an ordinary least squares regression of the corresponding regression error on its own lagged value; and (c) Z(t), the Phillips-Ouliaris statistic for the coefficient to be equal to one. The critical values for Phillips-Ouliaris statistic are reported by Hamilton (1994, Table B.9, case 2 with zero drift, pg. 766): -3.07 (10 percent), -3.37 (5 percent), -3.96 (1 percent) with 2 variables in regression; -3.45 (10 percent), -3.77 (5 percent), -4.31 (1 percent) with 3 variables in regression; -3.83 (10 percent), -4.11 (5 percent), -4.73 (1 percent) with 4 variables in regression; -4.16 (10 percent), -4.45 (5 percent), -5.07 (1 percent) with 5 variables in regression. Sample period: 1 Sep. 2008 – 4 Aug. 2011.

Table 4 – Dynamic OLS Estimates and the 10-year Yield Spread

Panel A: S&P's credit ratings

	GR	IE	PT	ES	IT	BE	AT	FI	FR	NL
Intercept	-728.581	-443.471	-540.838	-110.026	-47.278	-94.159	10.466	0.551	0.416	-0.747
	(40.807)	(28.815)	(25.569)	(15.351)	(169.55)	(15.547)	(5.287)	(2.572)	(2.761)	(2.411)
10-May-10	-292.878	-122.904	-147.861	-74.574	-37.016	-27.925	2.665	3.909	-5.141	-0.811
	(21.253)	(15.975)	(13.169)	(5.497)	(3.846)	(3.905)	(2.748)	(1.689)	(1.527)	(1.827)
Fiscal balance	-25.575	2.424	0.708	-6.916	-11.232	-3.341	0.240	0.361	-0.382	0.711
	(4.025)	(1.545)	(3.291)	(1.281)	(3.54)	(0.902)	(1.195)	(0.311)	(0.551)	(0.321)
Country's ratings	97.516	64.727	32.742	-1.759	-4.200	38.174				
	(7.091)	(4.891)	(9.75)	(6.876)	(35.036)	(9.126)				
10-year KfW-Bund	2.641	3.411	2.125	1.412	1.485	1.008	1.021	0.878	0.482	0.799
	(0.369)	(0.241)	(0.159)	(0.167)	(0.087)	(0.092)	(0.068)	(0.054)	(0.039)	(0.054)
Greek ratings		44.478	53.695	16.401	10.259	4.128	0.427	-0.245	1.667	0.349
		(4.337)	(7.194)	(2.099)	(2.427)	(0.845)	(0.66)	(0.256)	(0.362)	(0.243)

Panel B: Moody's credit ratings

	GR	IE	PT	ES	IT	BE	AT	FI	FR	NL
Intercept	-414.107	-222.508	-302.655	-69.985	-379.543	-16.608	16.160	3.434	5.765	1.126
	(28.838)	(16.666)	(13.775)	(6.387)	(113.555)	(4.155)	(3.59)	(2.31)	(2.922)	(2.124)
10-May-10	-9.402	-57.487	-5.803	-34.379	-22.857	-15.366	0.926	1.788	-1.657	-0.545
	(21.957)	(14.597)	(18.119)	(6.077)	(4.544)	(3.763)	(3.404)	(1.851)	(1.856)	(1.99)
Fiscal balance	-12.143	-3.519	-5.699	-5.750	-17.050	-1.977	-1.438	-0.016	-0.679	0.580
	(3.247)	(1.217)	(4.092)	(1.001)	(2.056)	(0.847)	(1.34)	(0.33)	(0.619)	(0.355)
Country's ratings	90.406	32.718	44.219	-15.431	115.738					
	(3.845)	(5.048)	(9.159)	(7.533)	(38.022)					
10-year KfW-Bund	2.415	3.261	1.961	1.540	1.514	1.057	1.006	0.878	0.490	0.797
	(0.357)	(0.268)	(0.208)	(0.135)	(0.093)	(0.089)	(0.069)	(0.053)	(0.041)	(0.053)
Greek ratings		32.397	30.181	16.290	4.251	5.289	-0.607	-0.576	0.993	0.146
		(4.443)	(7.428)	(1.91)	(0.835)	(0.417)	(0.509)	(0.233)	(0.33)	(0.214)

Panel C: Fitch's credit ratings

	GR	IE	PT	ES	IT	BE	AT	FI	FR	NL
Intercept	-886.375	-418.620	-477.185	-110.970	-79.175	31.496	12.215	6.212	-0.334	1.854
	(73.981)	(47.958)	(34.487)	(7.962)	(7.817)	(26.387)	(5.963)	(3.134)	(2.783)	(2.619)
10-May-10	-268.699	-129.400	-134.237	-16.854	-32.728	-30.869	2.785	3.527	-4.572	-1.121
	(26.978)	(15.557)	(13.229)	(7.481)	(3.935)	(3.542)	(2.801)	(1.683)	(1.524)	(1.804)
Fiscal balance	-28.132	-4.710	-16.929	-4.686	-14.775	-1.840	-0.002	0.057	-0.967	0.425
	(6.146)	(1.392)	(3.226)	(1.041)	(2.172)	(1.272)	(1.138)	(0.289)	(0.532)	(0.322)
Country's ratings	110.954	58.600	37.691	58.915		-46.742				
	(13.241)	(5.541)	(4.701)	(8.359)		(17.443)				
10-year KfW-Bund	5.199	5.234	2.945	1.349	1.759	1.283	1.017	0.863	0.518	0.797
	(0.483)	(0.359)	(0.27)	(0.152)	(0.093)	(0.098)	(0.069)	(0.051)	(0.039)	(0.051)
Greek ratings		28.482	40.974	8.854	9.495	9.507	0.200	-0.821	1.351	0.011
		(7.813)	(6.196)	(1.645)	(1.253)	(1.376)	(0.747)	(0.312)	(0.38)	(0.307)

Notes: The table shows the estimated cointegrating vector's coefficients together with their respective robust standard errors from a dynamic ordinary least squares regression of 10-year yield spreads of country i on an intercept, a dummy on 10 May 2010, the fiscal balance-GDP ratio of country i, the credit rating of country i, the 10-year KfW-Bund spread, the credit ratings on the Greek sovereign debt and q leads and r lags of the non-spread variables. The estimates are corrected for heteroskedasticity and autocorrelation in the residuals, computed using the Newey-West estimate of the error variance. Robust standard errors are reported within parentheses below the coefficient estimates. Sample period: 1 Sep. 2008 – 4 Aug. 2011. The number of observations is 758.

Credit rating spillovers are estimated all jointly controlling for the country's credit rating

S&P

	GR	IE	PT	ES	IT	BE	AT	FI	FR	NL
Greek ratings	62.682	52.540	54.586	19.917	27.149	6.927	1.154	1.282	3.615	-0.133
s.e.	(14.324)	(7.824)	(7.549)	(3.675)	(3.91)	(1.598)	(1.05)	(0.426)	(0.537)	(0.373)
t-stat.	[4.376]	[6.715]	[7.231]	[5.42]	[6.944]	[4.335]	[1.099]	[3.009]	[6.732]	[-0.355]
Irish ratings	-14.107	70.700	8.930	5.299	3.889	-0.818	-1.785	-2.063	0.002	-2.556
s.e.	(12.544)	(5.094)	(5.41)	(3.725)	(1.606)	(2.381)	(1.043)	(0.505)	(0.613)	(0.535)
t-stat.	[-1.125]	[13.879]	[1.651]	[1.423]	[2.421]	[-0.344]	[-1.712]	[-4.085]	[0.003]	[-4.778]
Portuguese ratings	79.532	-25.307	21.335	-11.449	-25.240	-5.855	1.168	-0.384	-3.456	4.287
s.e.	(32.171)	(16.53)	(12.275)	(6.169)	(4.148)	(2.957)	(2.138)	(0.876)	(0.91)	(0.941)
t-stat.	[2.472]	[-1.531]	[1.738]	[-1.856]	[-6.085]	[-1.98]	[0.546]	[-0.439]	[-3.797]	[4.556]

Moody's

	GR	IE	PT	ES	IT	BE	AT	FI	FR	NL
Greek ratings	99.484	35.007	30.000	24.845	12.323	7.536	4.763	1.149	2.607	1.091
s.e.	(10.395)	(5.75)	(7.279)	(2.389)	(1.884)	(1.614)	(1.024)	(0.611)	(0.742)	(0.571)
t-stat.	[9.57]	[6.088]	[4.121]	[10.4]	[6.541]	[4.669]	[4.652]	[1.88]	[3.514]	[1.911]
Irish ratings	-5.776	34.761	0.172	8.441	2.219	2.759	0.280	-0.876	-0.478	-0.347
s.e.	(6.718)	(4.928)	(3.166)	(3.802)	(1.293)	(0.964)	(0.501)	(0.253)	(0.438)	(0.264)
t-stat.	[-0.86]	[7.054]	[0.054]	[2.22]	[1.716]	[2.863]	[0.56]	[-3.463]	[-1.091]	[-1.315]
Portuguese ratings	-0.723	-10.431	44.192	-14.647	-15.649	-6.372	-7.613	-1.389	-1.836	-1.032
s.e.	(22.475)	(11.786)	(10.4)	(4.906)	(3.748)	(2.674)	(1.48)	(0.691)	(1.404)	(0.722)
t-stat.	[-0.032]	[-0.885]	[4.249]	[-2.985]	[-4.175]	[-2.383]	[-5.144]	[-2.01]	[-1.308]	[-1.429]

Fitch

	GR	IE	PT	ES	IT	BE	AT	FI	FR	NL
Greek ratings	55.048	27.775	41.862	16.354	16.356	6.035	2.783	1.197	2.996	0.363
s.e.	(22.966)	(7.829)	(7.495)	(1.66)	(1.712)	(2.245)	(1.066)	(0.516)	(0.48)	(0.498)
t-stat.	[2.397]	[3.548]	[5.585]	[9.852]	[9.554]	[2.688]	[2.611]	[2.319]	[6.242]	[0.73]
Irish ratings	-31.625	57.195	-1.334	5.028	-1.580	3.053	0.474	-2.478	-0.574	-1.475
s.e.	(14.441)	(6.354)	(4.71)	(2.624)	(1.788)	(1.646)	(0.786)	(0.43)	(0.488)	(0.459)
t-stat.	[-2.19]	[9.001]	[-0.283]	[1.916]	[-0.884]	[1.855]	[0.603]	[-5.763]	[-1.176]	[-3.213]
Portuguese ratings	85.632	-4.391	38.357	-14.778	-5.889	-0.622	-3.784	-0.024	-1.198	0.969
s.e.	(22.916)	(7.662)	(4.598)	(2.469)	(1.49)	(1.241)	(0.612)	(0.371)	(0.381)	(0.419)
t-stat.	[3.737]	[-0.573]	[8.342]	[-5.985]	[-3.952]	[-0.501]	[-6.183]	[-0.065]	[-3.145]	[2.314]

Notes: The table shows the estimated cointegrating vector's coefficients together with their respective robust standard errors and *t*-statistics from a dynamic ordinary least squares regression of 10-year yield spreads of country *i* on an intercept, a dummy on 10 May 2010, the fiscal balance-GDP ratio of country *i*, the credit rating of country *i* (in the case of Belgium, Italy and Spain), the 10-year safe-haven premium, the credit ratings on the Greek, Irish and Portuguese sovereign debt (see reported coefficients) and *q* leads and *r* lags of the non-spread variables. The estimates are corrected for heteroskedasticity and autocorrelation in the residuals, computed using the Newey-West estimate of the error variance (HAC estimator). Robust standard errors are reported within parentheses below the coefficient estimates. Sample period: 1 Sep. 2008 – 4 Aug. 2011. The number of observations is 758.

Table 6 – Dynamic OLS Estimates and the 10-year Yield Spread without Budget Balance

Panel A: S&P's credit ratings

	GR	IE	PT	ES	IT	BE	AT	FI	FR	NL
Intercept	-634.096	-418.150	-540.952	-148.388	355.303	-88.961	13.344	6.066	2.398	4.764
	(77.668)	(25.5)	(20.808)	(14.147)	(157.062)	(16.605)	(4.55)	(3.017)	(2.554)	(2.922)
10-May-10	-257.132	-123.450	-149.197	-70.224	-32.881	-23.948	2.281	3.264	-4.712	-2.021
	(24.784)	(15.806)	(10.851)	(5.771)	(4.02)	(3.838)	(2.632)	(1.733)	(1.431)	(1.854)
Country's ratings	122.964	63.776	32.753	28.674	-86.281	34.447				
	(6.701)	(4.4)	(9.741)	(8.394)	(32.187)	(10.291)				
10-year KfW-Bund	0.031	3.553	2.157	0.817	1.294	0.862	0.997	0.870	0.456	0.789
	(0.641)	(0.235)	(0.184)	(0.121)	(0.093)	(0.086)	(0.067)	(0.05)	(0.033)	(0.051)
Greek ratings		39.013	53.163	19.333	16.412	6.089	0.175	-0.736	1.769	-0.358
		(3.785)	(6.487)	(2.295)	(0.97)	(0.803)	(0.311)	(0.183)	(0.192)	(0.172)

Panel B: Moody's credit ratings

	GR	IE	PT	ES	IT	BE	AT	FI	FR	NL
Intercept	-316.058	-229.504	-291.865	-52.490	-156.413	-13.952	15.641	4.910	8.581	4.212
	(33.498)	(18.088)	(14.549)	(7.231)	(114.62)	(3.776)	(3.582)	(2.569)	(2.272)	(2.537)
10-May-10	30.944	-40.046	11.231	-13.436	3.366	-10.239	2.966	1.322	-0.317	-3.154
	(18.925)	(13.384)	(11.024)	(5.047)	(3.568)	(2.765)	(2.722)	(1.788)	(1.329)	(1.949)
Country's ratings	98.232	34.511	35.595	-28.327	52.630					
	(2.715)	(4.952)	(6.434)	(7.407)	(39.119)					
10-year KfW-Bund	1.056	3.057	1.881	0.880	1.110	0.973	0.986	0.858	0.460	0.783
	(0.424)	(0.257)	(0.205)	(0.119)	(0.088)	(0.079)	(0.066)	(0.049)	(0.035)	(0.051)
Greek ratings		37.678	37.912	23.632	9.626	6.082	-0.106	-0.644	1.216	-0.294
		(4.107)	(3.3)	(1.484)	(0.723)	(0.306)	(0.215)	(0.138)	(0.164)	(0.131)

Panel C: Fitch's credit ratings

	GR	IE	PT	ES	IT	BE	AT	FI	FR	NL
Intercept	-861.417	-490.843	-556.223	-111.012	-67.424	69.027	13.126	8.477	0.444	6.047
	(108.828)	(39.909)	(38.524)	(9.734)	(10.221)	(20.031)	(5.057)	(3.242)	(2.616)	(3.085)
10-May-10	-228.752	-129.595	-110.454	5.617	-22.731	-29.101	2.405	3.057	-3.579	-2.201
	(25.892)	(15.592)	(12.421)	(6.789)	(4.105)	(3.125)	(2.689)	(1.746)	(1.402)	(1.856)
Country's ratings	146.544	58.743	28.330	76.784		-72.893				
	(9.293)	(5.496)	(5.519)	(8.766)		(12.771)				
10-year KfW-Bund	3.284	5.238	3.131	0.780	1.443	1.327	1.002	0.843	0.495	0.774
	(0.97)	(0.382)	(0.355)	(0.107)	(0.104)	(0.097)	(0.069)	(0.05)	(0.034)	(0.051)
Greek ratings		42.245	65.197	11.413	15.776	11.761	0.184	-0.962	1.949	-0.465
		(5.884)	(5.048)	(1.797)	(0.939)	(0.691)	(0.384)	(0.219)	(0.209)	(0.2)

Notes: The table shows the estimated cointegrating vector's coefficients together with their respective robust standard errors from a dynamic ordinary least squares regression of 10-year yield spreads of country i on an intercept, a dummy on 10 May 2010, the credit rating of country i, the 10-year KfW-Bund spread, the credit ratings on the Greek sovereign debt and q leads and r lags of the non-spread variables. The estimates are corrected for heteroskedasticity and autocorrelation in the residuals, computed using the Newey-West estimate of the error variance. Robust standard errors are reported within parentheses below the coefficient estimates. Sample period: 1 Sep. 2008 – 4 Aug. 2011. The number of observations is 758.

Table 7 – Standardised Dynamic OLS Estimates and the 10-year Yield Spread: The Regional versus the International Risk Factors

Panel A: S&P's credit ratings

	GR	IE	PT	ES	IT	BE	AT	FI	FR	NL
Intercept	-0.007	-1.039	-1.092	-0.716	3.006	-2.776	0.029	-0.004	0.021	-0.002
	(0.023)	(0.094)	(0.276)	(0.221)	(3.817)	(0.672)	(0.047)	(0.031)	(0.052)	(0.037)
10-May-10	-0.753	-0.498	-0.669	-1.173	-0.829	-1.018	0.164	0.200	-0.528	-0.039
	(0.057)	(0.073)	(0.064)	(0.094)	(0.084)	(0.157)	(0.158)	(0.118)	(0.161)	(0.139)
Fiscal balance	-0.300	0.046	0.038	-0.414	-0.258	-0.246	0.000	0.116	-0.018	0.158
	(0.045)	(0.051)	(0.051)	(0.075)	(0.11)	(0.076)	(0.088)	(0.054)	(0.109)	(0.059)
Country's ratings	0.869	0.280	0.174	0.311	-0.592	1.317				
	(0.053)	(0.022)	(0.042)	(0.09)	(0.758)	(0.313)				
10-year KfW-Bund	-0.065	0.206	0.111	0.114	0.350	0.341	0.814	0.591	0.499	0.733
	(0.048)	(0.045)	(0.05)	(0.064)	(0.072)	(0.125)	(0.148)	(0.127)	(0.151)	(0.143)
Greek ratings		0.563	0.788	0.720	0.923	0.599	0.070	0.134	0.714	0.176
		(0.054)	(0.094)	(0.082)	(0.164)	(0.105)	(0.115)	(0.066)	(0.131)	(0.079)
US corp. BBB-AAA	0.244	0.088	0.093	0.364	0.261	0.350	0.099	0.374	0.406	0.221
	(0.052)	(0.06)	(0.059)	(0.082)	(0.085)	(0.14)	(0.143)	(0.142)	(0.148)	(0.147)

Panel B: Moody's credit ratings

	GR	IE	PT	ES	IT	BE	AT	FI	FR	NL
Intercept	-1.847	-1.590	-1.895	-1.430	-9.145	-1.575	0.268	0.028	-0.953	-0.196
	(0.069)	(0.081)	(0.101)	(0.101)	(2.307)	(0.157)	(0.22)	(0.127)	(0.255)	(0.156)
10-May-10	0.006	-0.267	-0.034	-0.530	-0.485	-0.537	0.060	0.152	-0.130	0.014
	(0.055)	(0.066)	(0.071)	(0.098)	(0.102)	(0.159)	(0.189)	(0.132)	(0.203)	(0.153)
Fiscal balance	-0.127	-0.023	-0.064	-0.437	-0.529	-0.153	-0.136	0.020	-0.100	0.122
	(0.037)	(0.052)	(0.057)	(0.076)	(0.06)	(0.07)	(0.102)	(0.059)	(0.122)	(0.066)
Country's ratings	0.227	0.119	0.164	-0.183	2.739					
	(0.009)	(0.02)	(0.042)	(0.104)	(0.778)					
10-year KfW-Bund	0.076	0.443	0.285	0.319	0.399	0.551	0.838	0.681	0.712	0.799
	(0.04)	(0.065)	(0.046)	(0.071)	(0.076)	(0.118)	(0.141)	(0.116)	(0.156)	(0.134)
Greek ratings		0.142	0.142	0.209	0.104	0.190	-0.034	-0.005	0.113	0.023
		(0.017)	(0.032)	(0.025)	(0.017)	(0.019)	(0.026)	(0.016)	(0.032)	(0.019)
US corp. BBB-AAA	0.030	-0.270	-0.144	0.087	0.211	0.130	0.049	0.268	0.159	0.139
	(0.043)	(0.081)	(0.048)	(0.086)	(0.08)	(0.132)	(0.131)	(0.128)	(0.148)	(0.134)

Panel C: Fitch's credit ratings

	GR	IE	PT	ES	IT	BE	AT	FI	FR	NL
Intercept	-2.651	-2.053	-2.346	-2.331	-2.261	1.270	-0.024	-0.112	-1.715	-0.185
	(0.248)	(0.206)	(0.221)	(0.197)	(0.271)	(0.792)	(0.376)	(0.213)	(0.426)	(0.275)
10-May-10	-0.685	-0.562	-0.606	-0.431	-0.734	-1.076	0.164	0.182	-0.463	-0.068
	(0.073)	(0.072)	(0.064)	(0.143)	(0.088)	(0.139)	(0.161)	(0.118)	(0.162)	(0.138)
Fiscal balance	-0.324	-0.173	-0.236	-0.389	-0.433	-0.028	-0.027	0.051	-0.145	0.088
	(0.065)	(0.059)	(0.05)	(0.084)	(0.07)	(0.108)	(0.084)	(0.052)	(0.107)	(0.061)
Country's ratings	0.308	0.253	0.160	0.619		-2.523				
	(0.03)	(0.024)	(0.021)	(0.124)		(0.574)				
10-year KfW-Bund	0.090	0.384	0.263	0.213	0.433	0.570	0.825	0.647	0.623	0.821
	(0.061)	(0.061)	(0.049)	(0.068)	(0.075)	(0.12)	(0.154)	(0.125)	(0.151)	(0.145)
Greek ratings		0.116	0.191	0.164	0.259	0.447	0.004	0.011	0.196	0.020
		(0.032)	(0.031)	(0.028)	(0.032)	(0.057)	(0.043)	(0.025)	(0.05)	(0.032)
US corp. BBB-AAA	0.218	0.033	-0.015	0.212	0.332	0.379	0.078	0.314	0.373	0.122
	(0.071)	(0.081)	(0.059)	(0.091)	(0.087)	(0.155)	(0.16)	(0.148)	(0.163)	(0.161)

Notes: The table shows the estimated cointegrating vector's coefficients together with their respective robust standard errors from a dynamic ordinary least squares regression of 10-year yield spreads of country i on an intercept, a dummy on 10 May 2010, the fiscal balance-GDP ratio of country i, the S&P credit rating of country i, the 10-year KfW-Bund spread, the credit ratings on the Greek sovereign debt, the US corporate bond spreads rescaled by the ratio between the sample mean of the 10-year KfW-Bund spread and the US corporate bond spreads, and q leads and r lags of the non-spread variables. The estimates are corrected for heteroskedasticity and autocorrelation in the residuals, computed using the Newey-West estimate of the error variance. Robust standard errors are reported within parentheses below the coefficient estimates. All variables are standardised. Sample period: 1 Sep. 2008 – 4 Aug. 2011. The number of observations is 758.

Table 8 – Standardised Dynamic OLS Estimates and the 10-year Yield Spread:
Safe Haven, Liquidity Risk and Global Uncertainty

Panel A: S&P's credit ratings

	GR	IE	PT	ES	IT	BE	AT	FI	FR	NL
Intercept	-0.006	0.005	0.009	0.021	0.023	-0.005	0.034	-0.005	0.024	0.000
	(0.023)	(0.018)	(0.019)	(0.029)	(0.039)	(0.042)	(0.047)	(0.031)	(0.051)	(0.036)
10-May-10	-0.732	-0.550	-0.721	-1.247	-1.201	-0.759	-0.118	0.207	-0.624	0.016
	(0.126)	(0.104)	(0.139)	(0.279)	(0.164)	(0.256)	(0.194)	(0.151)	(0.202)	(0.16)
Fiscal balance	-0.314	0.030	0.043	-0.508	-0.106	-0.255	0.050	0.125	0.022	0.174
	(0.043)	(0.053)	(0.045)	(0.074)	(0.101)	(0.077)	(0.096)	(0.057)	(0.115)	(0.078)
Country's ratings	0.910	0.509	0.345	0.163	-0.119	0.292				
	(0.081)	(0.06)	(0.097)	(0.06)	(0.076)	(0.077)				
10-year KfW-Bund	-0.078	0.170	0.100	0.094	0.283	0.279	0.800	0.647	0.597	0.695
	(0.05)	(0.05)	(0.052)	(0.076)	(0.071)	(0.13)	(0.131)	(0.127)	(0.144)	(0.132)
Greek ratings		0.410	0.745	0.717	0.998	0.668	0.072	0.135	0.741	0.214
		(0.067)	(0.104)	(0.082)	(0.137)	(0.12)	(0.126)	(0.067)	(0.129)	(0.087)
US corp. BBB-AAA	0.255	0.060	0.107	0.401	0.281	0.402	0.099	0.315	0.240	0.264
	(0.054)	(0.064)	(0.063)	(0.106)	(0.08)	(0.143)	(0.144)	(0.136)	(0.154)	(0.14)
Country's bid-ask spread	-0.073	0.204	0.053	-0.033	0.181	-0.121	0.099	0.055	0.251	0.026
	(0.077)	(0.082)	(0.084)	(0.064)	(0.052)	(0.091)	(0.092)	(0.047)	(0.102)	(0.091)
Maturity differential	-0.015	-0.063	-0.037	-0.071	-0.075	-0.062	0.123	-0.052	0.018	-0.055
	(0.022)	(0.022)	(0.018)	(0.031)	(0.026)	(0.056)	(0.049)	(0.048)	(0.048)	(0.041)

Panel B: Moody's credit ratings

	GR	IE	PT	ES	IT	BE	AT	FI	FR	NL
Intercept	0.011	0.016	0.003	-0.010	-0.010	-0.021	-0.008	-0.018	-0.027	-0.007
	(0.018)	(0.019)	(0.014)	(0.026)	(0.031)	(0.042)	(0.045)	(0.031)	(0.049)	(0.036)
10-May-10	-0.197	-0.412	-0.152	-0.842	-0.722	-0.393	-0.027	0.153	-0.248	-0.001
	(0.099)	(0.098)	(0.101)	(0.219)	(0.161)	(0.243)	(0.206)	(0.16)	(0.216)	(0.158)
Fiscal balance	-0.105	-0.010	0.024	-0.350	-0.364	-0.173	0.062	0.015	-0.075	0.099
	(0.042)	(0.06)	(0.049)	(0.07)	(0.068)	(0.075)	(0.129)	(0.062)	(0.123)	(0.075)
Country's ratings	0.893	0.275	0.261	0.214	0.259					
	(0.051)	(0.056)	(0.085)	(0.122)	(0.078)					
10-year KfW-Bund	0.049	0.330	0.245	0.147	0.327	0.564	0.765	0.740	0.797	0.755
	(0.041)	(0.052)	(0.041)	(0.067)	(0.073)	(0.12)	(0.115)	(0.119)	(0.152)	(0.139)
Greek ratings		0.304	0.535	0.536	0.528	0.786	0.049	-0.042	0.500	0.083
		(0.072)	(0.118)	(0.128)	(0.064)	(0.094)	(0.131)	(0.069)	(0.138)	(0.08)
US corp. BBB-AAA	0.071	-0.221	-0.100	0.170	0.229	0.132	0.136	0.200	0.031	0.180
	(0.042)	(0.064)	(0.044)	(0.079)	(0.074)	(0.131)	(0.123)	(0.123)	(0.164)	(0.145)
Country's bid-ask spread	0.126	0.380	0.280	0.227	0.175	0.031	0.131	0.029	0.215	0.073
	(0.038)	(0.101)	(0.055)	(0.064)	(0.047)	(0.082)	(0.097)	(0.051)	(0.104)	(0.075)
Maturity differential	-0.004	-0.063	-0.028	-0.101	-0.100	-0.040	0.131	-0.060	0.042	-0.048
	(0.019)	(0.022)	(0.014)	(0.028)	(0.024)	(0.049)	(0.051)	(0.049)	(0.046)	(0.042)

Panel C: Fitch's credit ratings

	GR	IE	PT	ES	IT	BE	AT	FI	FR	NL
Intercept	-0.001	-0.005	0.000	-0.009	-0.023	0.004	0.026	-0.019	-0.020	-0.015
	(0.03)	(0.02)	(0.019)	(0.024)	(0.029)	(0.041)	(0.048)	(0.031)	(0.051)	(0.038)
10-May-10	-0.611	-0.500	-0.602	-0.473	-1.067	-0.810	-0.109	0.198	-0.566	-0.075
	(0.161)	(0.096)	(0.136)	(0.205)	(0.155)	(0.271)	(0.193)	(0.153)	(0.205)	(0.147)
Fiscal balance	-0.339	-0.054	-0.255	-0.192	-0.341	0.027	0.059	0.043	-0.124	0.053
	(0.067)	(0.055)	(0.055)	(0.09)	(0.078)	(0.138)	(0.091)	(0.057)	(0.109)	(0.074)
Country's ratings	0.755	0.367	0.370	0.565		-0.386				
	(0.129)	(0.064)	(0.071)	(0.084)		(0.098)				
10-year KfW-Bund	0.069	0.257	0.247	0.214	0.389	0.508	0.795	0.710	0.702	0.777
	(0.059)	(0.06)	(0.043)	(0.063)	(0.073)	(0.123)	(0.129)	(0.128)	(0.148)	(0.141)
Greek ratings		0.153	0.446	0.285	0.757	1.543	0.080	0.005	0.580	0.020
		(0.086)	(0.097)	(0.087)	(0.095)	(0.252)	(0.133)	(0.081)	(0.143)	(0.102)
US corp. BBB-AAA	0.229	-0.048	-0.017	0.050	0.336	0.466	0.114	0.238	0.244	0.155
	(0.068)	(0.069)	(0.053)	(0.083)	(0.084)	(0.157)	(0.149)	(0.147)	(0.176)	(0.16)
Country's bid-ask spread	0.100	0.444	0.065	0.172	0.158	-0.171	0.113	0.035	0.187	0.081
	(0.091)	(0.072)	(0.105)	(0.053)	(0.054)	(0.104)	(0.091)	(0.051)	(0.104)	(0.075)
Maturity differential	-0.073	-0.112	-0.063	-0.078	-0.068	-0.066	0.128	-0.058	0.014	-0.050
	(0.034)	(0.031)	(0.022)	(0.025)	(0.025)	(0.059)	(0.051)	(0.05)	(0.05)	(0.043)

Notes: The table shows the estimated cointegrating vector's coefficients together with their respective robust standard errors from a dynamic ordinary least squares regression of 10-year yield spreads of country i on an intercept, a dummy on 10 May 2010, the fiscal balance-GDP ratio of country i, the credit rating of country i, the 10-year KfW-Bund spread, the credit ratings on the Greek sovereign debt, the US corporate bond spreads rescaled by the ratio between the sample mean of the 10-year KfW-Bund spread and the US corporate bond spreads, the country's bid-ask spread differential, the differentials in the residual maturity of the benchmark bonds in country i and the benchmark country and q leads and r lags of the non-spread variables. The estimates are corrected for heteroskedasticity and autocorrelation in the residuals, computed using the Newey-West estimate of the error variance. Robust standard errors are reported within parentheses below the coefficient estimates. All variables are standardised. Sample period: 1 Sep. 2008 – 4 Aug. 2011. The number of observations is 758.

Panel A: S&P's credit ratings

	GR	IE	PT	ES	IT	BE	AT	FI	FR	NL
Intercept	-0.007	0.003	0.013	0.022	0.025	0.004	0.033	-0.007	0.018	-0.006
	(0.023)	(0.02)	(0.018)	(0.03)	(0.042)	(0.04)	(0.045)	(0.029)	(0.051)	(0.032)
10-May-10	-0.707	-0.392	-0.602	-1.112	-0.788	-0.821	-0.159	0.304	-0.619	-0.105
	(0.094)	(0.084)	(0.079)	(0.095)	(0.08)	(0.191)	(0.201)	(0.142)	(0.237)	(0.194)
Fiscal balance	-0.308	0.032	-0.004	-0.491	-0.239	-0.256	-0.004	0.111	-0.063	0.117
	(0.043)	(0.052)	(0.047)	(0.066)	(0.107)	(0.076)	(0.094)	(0.054)	(0.121)	(0.055)
Country's ratings	0.851	0.602	0.359	0.148	-0.096	0.251				
	(0.055)	(0.048)	(0.084)	(0.063)	(0.092)	(0.067)				
10-year KfW-Bund	-0.078	0.146	0.135	0.098	0.343	0.375	0.700	0.696	0.461	0.608
	(0.056)	(0.049)	(0.055)	(0.073)	(0.077)	(0.123)	(0.13)	(0.123)	(0.151)	(0.12)
Greek ratings		0.522	0.720	0.725	0.948	0.614	0.065	0.091	0.687	0.147
		(0.056)	(0.094)	(0.084)	(0.156)	(0.122)	(0.123)	(0.061)	(0.137)	(0.077)
US corp. BBB-AAA	0.251	0.121	0.073	0.378	0.268	0.273	0.150	0.248	0.441	0.260
	(0.06)	(0.056)	(0.066)	(0.083)	(0.083)	(0.136)	(0.129)	(0.133)	(0.148)	(0.137)
Country's gross debt issuance	0.012	-0.050	-0.069	0.017	-0.026	0.120	0.147	0.140	0.108	0.208
	(0.014)	(0.024)	(0.018)	(0.032)	(0.027)	(0.056)	(0.058)	(0.037)	(0.061)	(0.051)
Maturity differential	-0.030	-0.060	-0.043	-0.065	-0.077	-0.044	0.092	-0.055	0.032	-0.024
	(0.033)	(0.023)	(0.02)	(0.026)	(0.028)	(0.05)	(0.047)	(0.045)	(0.055)	(0.035)

Panel B: Moody's credit ratings

	GR	IE	PT	ES	IT	BE	AT	FI	FR	NL
Intercept	0.011	0.016	0.005	-0.012	-0.010	-0.015	-0.008	-0.014	-0.022	-0.006
	(0.018)	(0.024)	(0.016)	(0.027)	(0.033)	(0.042)	(0.043)	(0.028)	(0.049)	(0.032)
10-May-10	-0.074	-0.267	-0.036	-0.438	-0.416	-0.397	-0.060	0.226	-0.262	-0.057
	(0.06)	(0.078)	(0.071)	(0.091)	(0.096)	(0.188)	(0.21)	(0.145)	(0.25)	(0.182)
Fiscal balance	-0.095	-0.027	-0.051	-0.527	-0.515	-0.173	0.029	0.010	-0.133	0.102
	(0.039)	(0.052)	(0.059)	(0.082)	(0.058)	(0.069)	(0.116)	(0.059)	(0.126)	(0.056)
Country's ratings	1.017	0.343	0.338	-0.042	0.292					
	(0.042)	(0.062)	(0.107)	(0.101)	(0.084)					
10-year KfW-Bund	0.047	0.430	0.293	0.247	0.365	0.585	0.643	0.788	0.619	0.643
	(0.04)	(0.074)	(0.054)	(0.079)	(0.079)	(0.119)	(0.118)	(0.113)	(0.158)	(0.115)
Greek ratings		0.598	0.627	0.749	0.463	0.783	0.068	-0.066	0.511	0.108
		(0.075)	(0.145)	(0.114)	(0.065)	(0.08)	(0.122)	(0.064)	(0.141)	(0.073)
US corp. BBB-AAA	0.014	-0.266	-0.151	0.174	0.232	0.067	0.198	0.139	0.265	0.210
	(0.047)	(0.086)	(0.055)	(0.09)	(0.078)	(0.129)	(0.114)	(0.12)	(0.156)	(0.129)
Country's gross debt issuance	0.069	0.013	0.002	0.015	-0.001	0.076	0.160	0.144	0.157	0.222
	(0.014)	(0.021)	(0.019)	(0.035)	(0.029)	(0.063)	(0.06)	(0.038)	(0.057)	(0.052)
Maturity differential	0.051	-0.026	0.009	-0.105	-0.103	-0.032	0.101	-0.063	0.066	-0.016
	(0.021)	(0.024)	(0.014)	(0.03)	(0.026)	(0.048)	(0.046)	(0.046)	(0.052)	(0.033)

Panel C: Fitch's credit ratings

	GR	IE	PT	ES	IT	BE	AT	FI	FR	NL
Intercept	0.006	-0.006	0.002	-0.011	-0.029	-0.006	0.018	-0.029	-0.019	-0.024
	(0.031)	(0.027)	(0.02)	(0.026)	(0.03)	(0.039)	(0.047)	(0.028)	(0.051)	(0.032)
10-May-10	-0.632	-0.417	-0.493	-0.302	-0.703	-0.904	-0.134	0.298	-0.574	-0.149
	(0.107)	(0.1)	(0.084)	(0.118)	(0.084)	(0.195)	(0.202)	(0.141)	(0.235)	(0.186)
Fiscal balance	-0.337	-0.174	-0.285	-0.285	-0.447	-0.112	-0.001	0.014	-0.180	0.019
	(0.068)	(0.058)	(0.048)	(0.076)	(0.075)	(0.102)	(0.093)	(0.052)	(0.113)	(0.053)
Country's ratings	0.871	0.592	0.387	0.409		-0.263				
	(0.103)	(0.057)	(0.055)	(0.06)		(0.074)				
10-year KfW-Bund	0.077	0.279	0.258	0.189	0.413	0.591	0.691	0.775	0.569	0.693
	(0.067)	(0.072)	(0.055)	(0.071)	(0.076)	(0.123)	(0.127)	(0.121)	(0.15)	(0.121)
Greek ratings		0.332	0.459	0.410	0.739	1.180	0.054	-0.078	0.569	-0.024
		(0.086)	(0.094)	(0.085)	(0.107)	(0.165)	(0.128)	(0.076)	(0.148)	(0.084)
US corp. BBB-AAA	0.216	0.086	-0.026	0.227	0.339	0.309	0.160	0.142	0.423	0.138
	(0.075)	(0.079)	(0.064)	(0.082)	(0.084)	(0.158)	(0.134)	(0.141)	(0.163)	(0.15)
Country's gross debt issuance	0.021	0.002	-0.016	0.018	0.013	0.072	0.147	0.152	0.123	0.222
	(0.02)	(0.032)	(0.022)	(0.035)	(0.033)	(0.066)	(0.059)	(0.038)	(0.062)	(0.051)
Maturity differential	-0.033	-0.101	-0.060	-0.102	-0.075	-0.053	0.095	-0.067	0.037	-0.019
	(0.04)	(0.039)	(0.022)	(0.025)	(0.026)	(0.055)	(0.049)	(0.046)	(0.057)	(0.035)

Notes: The table shows the estimated cointegrating vector's coefficients together with their respective robust standard errors from a dynamic ordinary least squares regression of 10-year yield spreads of country i on an intercept, a dummy on 10 May 2010, the fiscal balance-GDP ratio of country i, the credit rating of country i, the 10-year KfW-Bund spread, the credit ratings on the Greek sovereign debt, the US corporate bond spreads rescaled by the ratio between the sample mean of the 10-year KfW-Bund spread and the US corporate bond spreads, the country's gross debt issuance for maturity above 1 year, the differentials in the residual maturity of the benchmark bonds in country i and the benchmark country and q leads and r lags of the non-spread variables. The estimates are corrected for heteroskedasticity and autocorrelation in the residuals, computed using the Newey-West estimate of the error variance. Robust standard errors are reported within parentheses below the coefficient estimates. All variables are standardised. Sample period: 1 Sep. 2008 – 4 Aug. 2011. The number of observations is 758.

Appendix

Figure A1 – Developments 10-year government bid-ask spreads in euro area countries
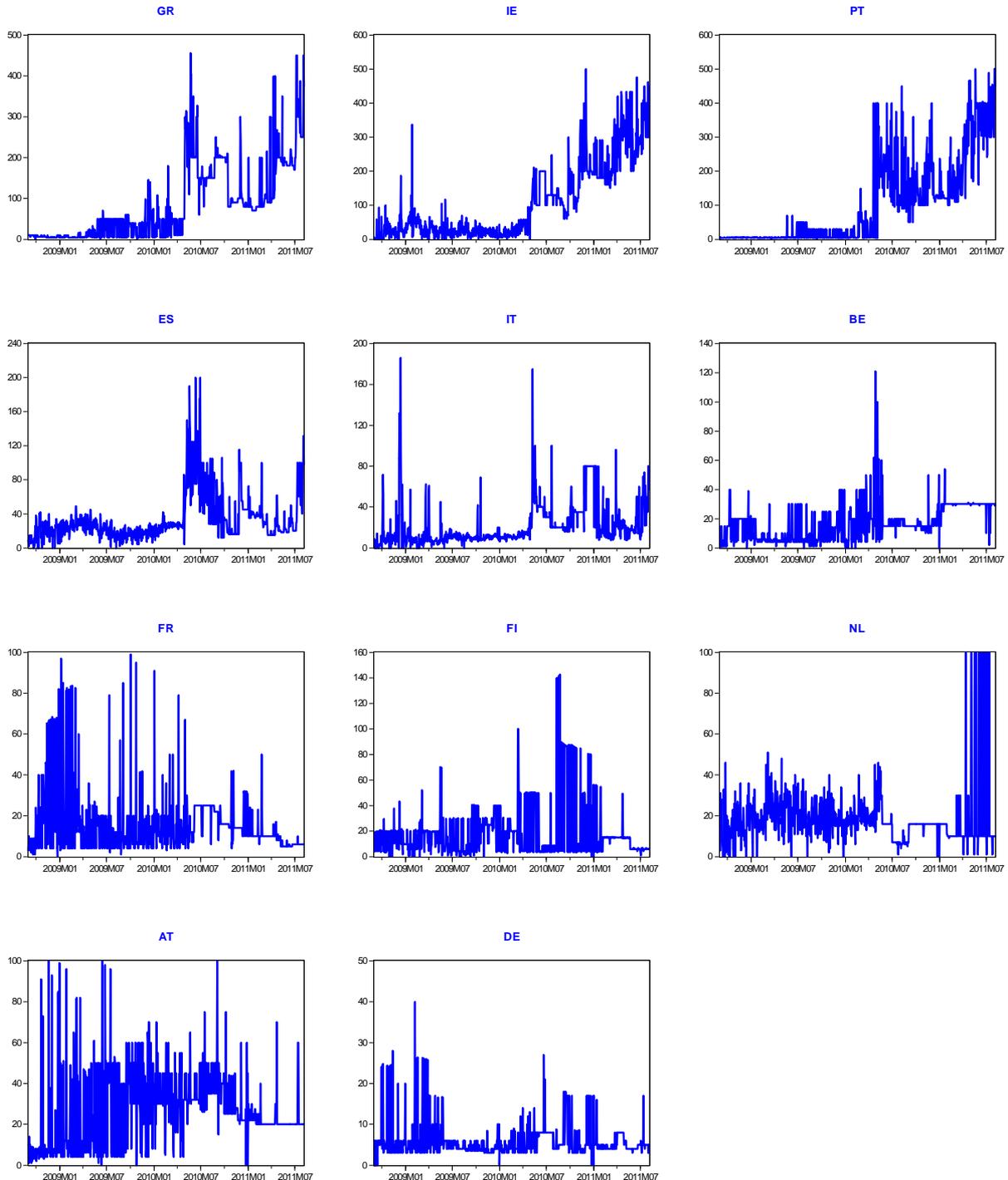
Figure A2 – Government debt issuance with maturity above 1-year
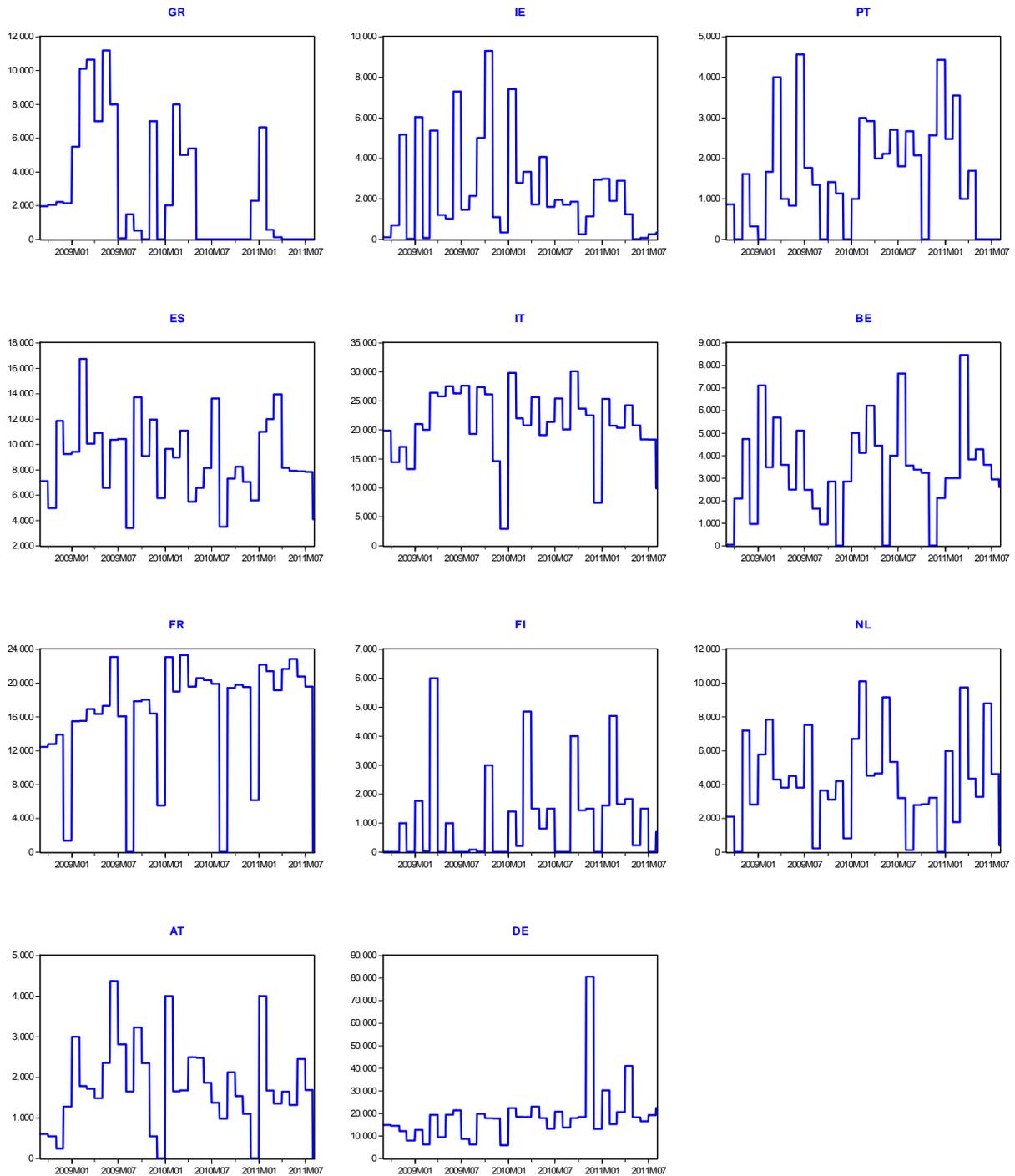
Figure A3 – The Spillover from Greece and the Fiscal Situation in Other Euro Area Countries
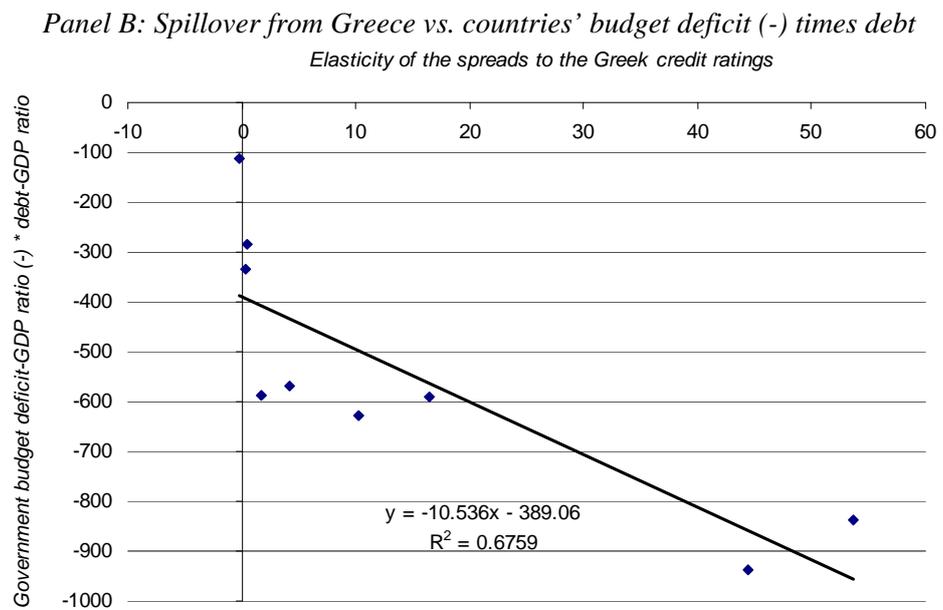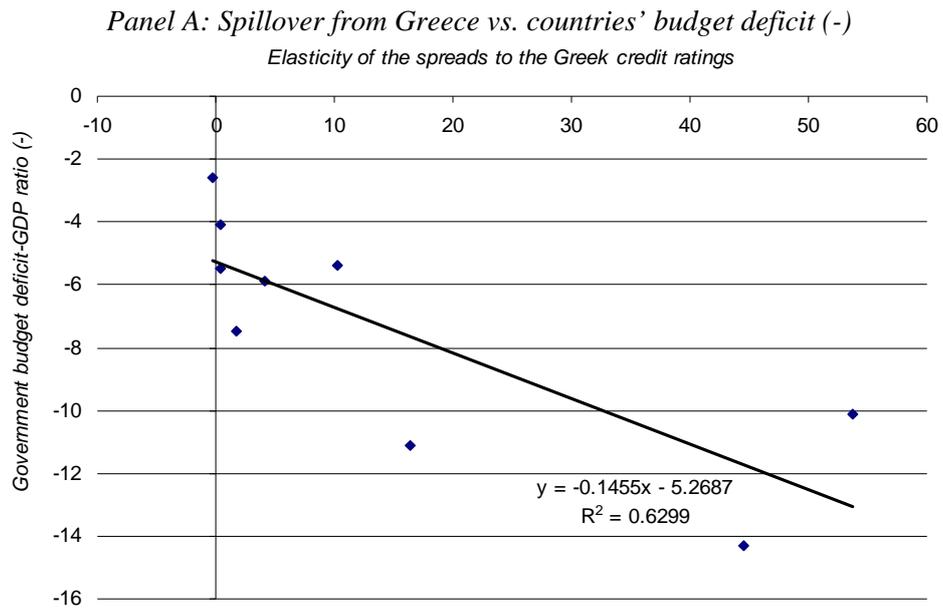
Panel A: Spillover from Greece vs. countries' budget deficit (-)

Elasticity of the spreads to the Greek credit ratings

$$y = -0.1455x - 5.2687$$
$$R^2 = 0.6299$$

Panel B: Spillover from Greece vs. countries' budget deficit (-) times debt

Elasticity of the spreads to the Greek credit ratings

$$y = -10.536x - 389.06$$
$$R^2 = 0.6759$$

Notes: This figure illustrates the scatter plot between (x axis) the elasticities of the spreads to the Greek credit ratings as reported in Panel A of Table 4 vs. (y axis) the government budget deficit (Panel A) and the product between government budget deficit and debt (Panel B).

Figure A4 – The Conditional Impact of the Eurosystem intervention on 10 May 2010 and
the Fiscal Situation in Euro Area Countries

Panel A: The impact of the Eurosystem intervention on 10 May 2010 vs. countries' budget deficit (-)
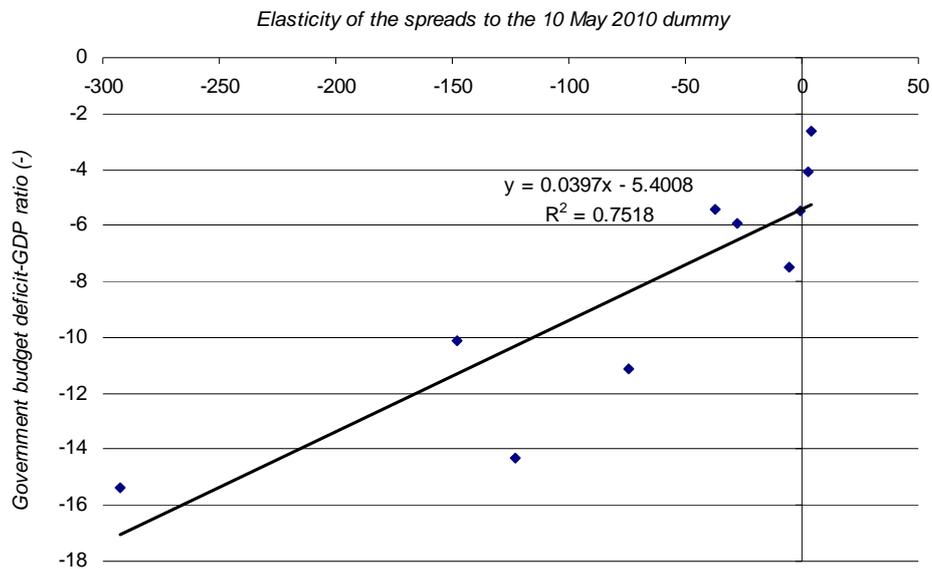
Panel B: The impact of the Eurosystem intervention on 10 May 2010 vs. countries' budget deficit (-) times debt
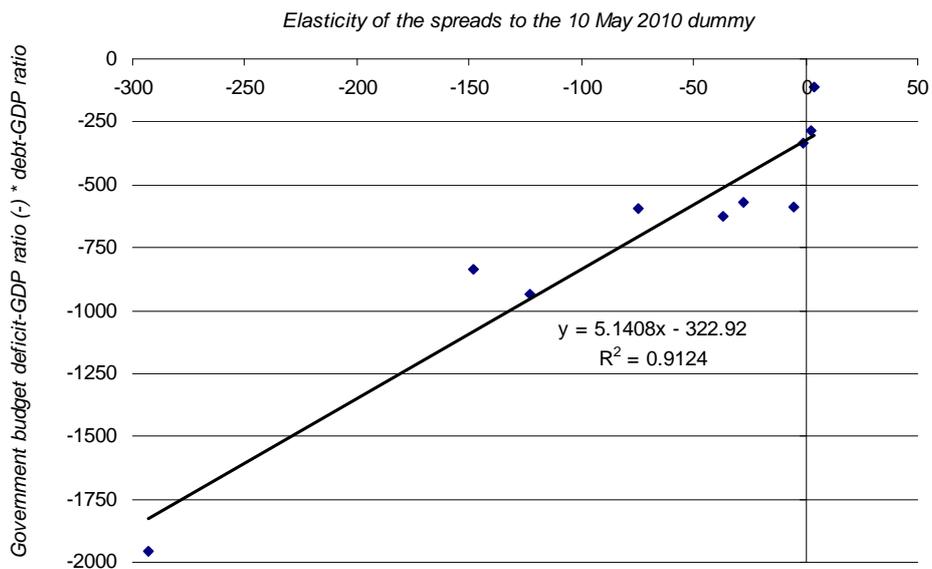
Notes: This figure illustrates the scatter plot between (x axis) the elasticities of the spreads to the 10 May 2010 additive dummy as reported in Panel A of Table 4 vs. (y axis) the government budget deficit (Panel A) and the product between government budget deficit and debt (Panel B).

Table A1 – Construction of the credit rating measure

	S&P/Fitch	Credit rating variable	Moodys	Credit rating variable
Explicit credit rating				
Exceptional	AAA	1	Aaa	1
	AA+	2	Aa1	2
Excellent	AA	3	Aa2	3
	AA-	4	Aa3	4
	A+	5	A1	5
Good	A	6	A2	6
	A-	7	A3	7
	BBB+	8	Baa1	8
Adequate	BBB	9	Baa2	9
	BBB-	10	Baa3	10
	BB+	11	Ba1	11
Questionable	BB	12	Ba2	12
	BB-	13	Ba3	13
	B+	14	B1	14
Poor	B	15	B2	15
	B-	16	B3	16
	CCC+	17	Caa1	17
	CCC	18	Caa2	18
	CCC-	19	Caa3	19
	CC	20	Ca	20
	C	21	C	21
Default	D	22		22
Credit outlook				
Positive	-0.5 or -0.25			
Negative	+0.5 or +0.25			
Credit watch				
Positive	-0.5 or -0.25			
Negative	+0.5 or +0.25			

Note: The size of the credit outlook / watch depends on what comes first: the first negative news (either outlook or watch) is set equal to +0.5, the second bad news is set equal to +0.25; similarly, the first positive news (either outlook or watch) is set equal to -0.5, the second good news is set equal to -0.25.

Table A2 – Phillips-Ouliaris Cointegration Test Results and the 5-Year Yield Spreads and CDS

Fiscal balance, 5-year KfW-Bund, country's credit ratings and Greek credit ratings by S&P

Panel A: 5-Year Yield Spreads

Intercept	-997.409	-589.881	-933.805	-189.348	-454.525	-177.819	0.746	-11.311	-11.911	-14.891
10-May-10	-339.056	-95.765	-17.372	-80.341	-45.438	-27.170	-2.320	-1.965	-16.592	0.732
Fiscal balance	-37.395	-5.068	28.983	-9.352	-13.432	-3.127	0.864	0.922	-0.952	1.821
Country's credit ratings	117.770	87.950	79.176	10.863	68.700	63.653				
5-year KfW-Bund	3.732	5.616	3.461	2.499	1.807	1.356	0.755	0.796	0.514	0.714
Greek credit ratings		26.897	75.102	12.278	8.513	3.550	1.281	-0.348	0.780	0.864
AR1 slope	0.943	0.956	0.922	0.938	0.947	0.936	0.938	0.949	0.889	0.947
Z(t)	-4.647	-4.716	-5.728	-4.856	-3.727	-4.851	-4.625	-3.883	-6.290	-4.044

Panel B: 5-Year CDS

Intercept	-1128.534	-386.453	-561.443	-156.279	231.495	-170.755	34.400	2.124	-32.133	19.476	6.409
10-May-10	-272.148	-126.775	-120.421	-79.514	-36.196	-50.094	-14.010	-8.745	-16.599	-8.768	2.583
Fiscal balance	1.389	3.659	0.054	-8.761	-17.071	-13.018	1.275	-0.015	-8.577	-2.241	-3.091
Country's credit ratings	168.853	69.128	34.437	38.652	-63.052	71.795				
5-year KfW-Bund	2.834	3.558	1.911	2.166	1.766	1.193	1.312	0.615	0.657	0.867	0.457
Greek credit ratings		33.470	54.821	7.925	8.716	2.283	-0.948	0.181	1.768	-1.935	0.647
AR1 slope	0.924	0.958	0.936	0.943	0.970	0.965	0.982	0.973	0.975	0.981	0.982
Z(t)	-6.198	-4.894	-5.740	-4.589	-3.635	-3.657	-3.350	-3.653	-3.295	-3.246	-3.132

Notes: Panel A (Panel B) reports the estimated coefficients from an ordinary least squares regression of the 5-year yield (CDS) spreads of country *i* on the intercept, a dummy on 10-May-2010, the fiscal balance-GDP ratio of country *i*, the credit rating of country *i*, the 5-year safe-haven premium and the credit ratings on the Greek sovereign debt; AR1, the slope coefficient from an ordinary least squares regression of the corresponding regression error on its own lagged value; and Z(t), the Phillips-Ouliaris statistic for the coefficient to be equal to one, corrected for autocorrelation in the residuals, computed using the Newey-West estimate of the error variance. Robust standard errors are reported within parentheses below the coefficient estimates. The critical values for Phillips-Ouliaris statistic are reported by Hamilton (1994, Table B.9, case 2 with zero drift, pg. 766): -3.07 (10 percent), -3.37 (5 percent), -3.96 (1 percent) with 2 variables in regression; -3.45 (10 percent), -3.77 (5 percent), -4.31 (1 percent) with 3 variables in regression; -3.83 (10 percent), -4.11 (5 percent), -4.73 (1 percent) with 4 variables in regression; -4.16 (10 percent), -4.45 (5 percent), -5.07 (1 percent) with 5 variables in regression. Sample period: 1 Sep. 2008 – 4 Aug. 2011.

Table A3 – Dynamic OLS Estimates, the 5-Year Yield Spread and the 5-Year CDS

Panel A: 5-Year Yield Spreads

	GR	IE	PT	ES	IT	BE	AT	FI	FR	NL
Intercept	-1015.558	-646.190	-951.002	-183.118	-583.903	-190.776	-6.626	-14.463	-12.579	-18.829
	(51.389)	(49.356)	(48.248)	(15.994)	(193.836)	(16.992)	(6.801)	(4.735)	(2.984)	(4.682)
10-May-10	-358.179	-121.583	-32.425	-79.463	-48.878	-21.594	-0.421	1.028	-17.250	4.743
	(36.107)	(37.326)	(23.142)	(10.939)	(6.296)	(5.811)	(4.427)	(3.066)	(2.111)	(3.73)
Fiscal balance	-35.793	-4.642	33.058	-10.469	-17.025	-3.186	1.744	0.867	-1.036	2.020
	(4.436)	(2.634)	(5.822)	(1.39)	(4.319)	(1.016)	(1.494)	(0.587)	(0.611)	(0.591)
Country's ratings	120.391	84.289	78.503	3.712	96.139	70.075				
	(6.378)	(9.519)	(17.914)	(7.735)	(39.755)	(10.257)				
5-year KfW-Bund	3.842	5.944	3.449	2.576	1.801	1.374	0.790	0.844	0.521	0.747
	(0.584)	(0.406)	(0.381)	(0.24)	(0.126)	(0.095)	(0.075)	(0.074)	(0.044)	(0.078)
Greek ratings		32.587	79.827	12.503	6.366	3.405	2.109	-0.284	0.786	1.129
		(7.808)	(15.536)	(2.267)	(2.827)	(0.907)	(0.86)	(0.472)	(0.311)	(0.445)

Panel B: 5-Year CDS

	GR	IE	PT	ES	IT	BE	AT	FI	FR	NL
Intercept	-1177.481	-435.345	-575.703	-162.176	386.007	-180.728	20.506	-1.805	-36.140	13.145
	(52.826)	(39.972)	(38.512)	(15.81)	(303.055)	(32.459)	(18.744)	(4.393)	(5.796)	(7.209)
10-May-10	-323.933	-146.306	-139.510	-84.641	-35.881	-47.503	-4.532	-5.458	-15.571	-2.897
	(31.417)	(29.88)	(15.577)	(10.313)	(9.248)	(8.993)	(11.452)	(3.345)	(4.135)	(6.106)
Fiscal balance	7.794	5.293	3.322	-9.346	-14.664	-12.715	2.520	0.051	-8.784	-2.147
	(4.648)	(2.24)	(4.893)	(1.422)	(6.274)	(1.401)	(3.348)	(0.312)	(1.057)	(0.572)
Country's ratings	181.504	68.442	30.828	39.887	-96.587	75.738				
	(9.212)	(6.507)	(11.933)	(7.837)	(62.828)	(19.245)				
5-year KfW-Bund	2.693	3.617	1.881	2.295	1.787	1.204	1.390	0.645	0.690	0.922
	(0.489)	(0.409)	(0.222)	(0.249)	(0.172)	(0.147)	(0.243)	(0.071)	(0.087)	(0.123)
Greek ratings		40.502	60.773	7.261	11.188	2.531	0.499	0.455	1.968	-1.464
		(6.944)	(12.184)	(1.926)	(4.228)	(1.282)	(2.212)	(0.377)	(0.751)	(0.735)

Notes: The table shows the estimated cointegrating vector's coefficients together with their respective robust standard errors from a dynamic ordinary least squares regression of the 5-year yield spreads (Panel A) and the 5-year CDS (Panel B) of country i on an intercept, a dummy on 10 May 2010, the fiscal balance-GDP ratio of country i, the credit rating of country i, the 5-year KfW-Bund spread, the credit ratings on the Greek sovereign debt and q leads and r lags of the non-spread variables. The estimates are corrected for heteroskedasticity and autocorrelation in the residuals, computed using the Newey-West estimate of the error variance (HAC estimator). Robust standard errors are reported within parentheses below the coefficient estimates. Sample period: 1 Sep. 2008 – 4 Aug. 2011. The number of observations is 758.

Table A4 – The Spread of the Fever: Dynamic OLS Estimates, the 5-year Yield and CDS

Credit ratings are estimated all jointly controlling for the country's credit rating

Panel A: 5-Year Yield Spreads

	GR	IE	PT	ES	IT	BE	AT	FI	FR	NL
Greek ratings	78.539	34.909	80.249	15.631	20.771	4.378	1.074	-0.694	1.088	-0.595
s.e.	(13.606)	(13.134)	(15.881)	(3.471)	(4.539)	(1.654)	(1.07)	(0.588)	(0.465)	(0.599)
t-stat.	[5.772]	[2.658]	[5.053]	[4.503]	[4.576]	[2.647]	[1.003]	[-1.181]	[2.34]	[-0.993]
Irish ratings	-4.817	86.976	10.219	13.529	8.424	4.482	-0.114	-3.968	-0.036	-7.951
s.e.	(16.402)	(12.498)	(8.882)	(4.07)	(1.667)	(3.285)	(1.387)	(1.235)	(0.938)	(1.031)
t-stat.	[-0.294]	[6.959]	[1.151]	[3.324]	[5.053]	[1.364]	[-0.082]	[-3.213]	[-0.038]	[-7.712]
Portuguese ratings	88.834	-15.064	66.564	-21.290	-26.679	-5.704	2.386	5.795	-0.433	13.103
s.e.	(25.316)	(24.126)	(22.045)	(6.515)	(4.709)	(3.442)	(2.562)	(1.623)	(1.137)	(1.752)
t-stat.	[3.509]	[-0.624]	[3.019]	[-3.268]	[-5.665]	[-1.657]	[0.931]	[3.571]	[-0.381]	[7.479]

Panel B: 5-Year CDS

	GR	IE	PT	ES	IT	BE	AT	FI	FR	NL
Greek ratings	185.609	55.641	61.886	10.393	36.138	2.085	-2.400	-0.192	2.384	-1.865
s.e.	(21.293)	(10.124)	(12.463)	(2.956)	(7.004)	(2.727)	(3.036)	(0.709)	(1.459)	(1.357)
t-stat.	[8.717]	[5.496]	[4.966]	[3.516]	[5.16]	[0.765]	[-0.791]	[-0.27]	[1.634]	[-1.374]
Irish ratings	10.085	80.953	30.375	15.813	2.252	18.117	-1.414	0.396	3.897	1.065
s.e.	(11.196)	(7.084)	(4.533)	(4.313)	(2.776)	(3.713)	(2.34)	(0.753)	(1.098)	(1.199)
t-stat.	[0.901]	[11.428]	[6.701]	[3.666]	[0.811]	[4.879]	[-0.604]	[0.527]	[3.55]	[0.888]
Portuguese ratings	-15.304	-44.373	-6.741	-23.866	-31.913	-10.307	8.014	0.987	-5.121	-0.031
s.e.	(31.937)	(21.654)	(13.711)	(6.249)	(7.248)	(5.876)	(7.528)	(1.833)	(2.658)	(3.421)
t-stat.	[-0.479]	[-2.049]	[-0.492]	[-3.819]	[-4.403]	[-1.754]	[1.065]	[0.538]	[-1.927]	[-0.009]

Notes: The table shows a subset of the estimated cointegrating vector's coefficients together with their respective robust standard errors and *t*-statistics from a dynamic ordinary least squares regression of 5-year yield spreads (Panel A) and the 5-year CDS (Panel B) of country i on an intercept, a dummy on 10 May 2010, the fiscal balance-GDP ratio of country i, the credit rating of country i (in the case of Belgium, Italy and Spain), the 5-year KfW-Bund spread, the credit ratings on the Greek, Irish and Portuguese sovereign debt (see reported coefficients) and q leads and r lags of the non-spread variables (Panel B). The estimates are corrected for heteroskedasticity and autocorrelation in the residuals, computed using the Newey-West estimate of the error variance (HAC estimator). Sample period: 1 Sep. 2008 – 4 Aug. 2011. The number of observations is 758.

Table A5 – Standardised Dynamic OLS Estimates and the 10-year Yield Spread:
Safe Haven, Liquidity Risk and Global Uncertainty Interacted

Panel A: S&P's credit ratings

	GR	IE	PT	ES	IT	BE	AT	FI	FR	NL
Intercept	-0.298	0.023	-0.535	-0.138	0.012	-0.125	0.008	-0.092	0.080	0.001
	(0.111)	(0.039)	(0.103)	(0.048)	(0.061)	(0.036)	(0.062)	(0.036)	(0.062)	(0.036)
10-May-10	-0.902	-0.572	-0.928	-1.390	-1.591	-0.908	-0.050	0.134	-0.612	0.045
	(0.133)	(0.107)	(0.149)	(0.329)	(0.253)	(0.313)	(0.196)	(0.145)	(0.217)	(0.153)
Fiscal balance	-0.295	0.004	-0.020	-0.430	-0.094	-0.258	0.035	0.157	0.073	0.179
	(0.043)	(0.061)	(0.047)	(0.071)	(0.098)	(0.073)	(0.097)	(0.057)	(0.116)	(0.074)
Country's ratings	0.826	0.531	-0.111	0.347	-0.118	0.107				
	(0.073)	(0.069)	(0.127)	(0.088)	(0.073)	(0.093)				
10-year KfW-Bund	-0.073	0.161	0.145	0.155	0.270	0.235	0.856	0.627	0.632	0.654
	(0.052)	(0.047)	(0.047)	(0.087)	(0.07)	(0.112)	(0.13)	(0.133)	(0.15)	(0.145)
Greek ratings		0.395	0.865	0.653	0.993	0.736	0.059	0.172	0.824	0.226
		(0.066)	(0.096)	(0.087)	(0.133)	(0.113)	(0.127)	(0.067)	(0.132)	(0.092)
US corp. BBB-AAA	-0.227	0.110	-0.789	0.165	0.275	0.359	0.028	0.210	0.231	0.308
	(0.201)	(0.097)	(0.194)	(0.153)	(0.081)	(0.118)	(0.158)	(0.132)	(0.161)	(0.168)
Country's bid-ask spread	-0.337	0.214	-0.452	-0.368	0.182	-0.016	0.119	-0.232	0.557	0.075
	(0.13)	(0.072)	(0.103)	(0.096)	(0.052)	(0.084)	(0.089)	(0.106)	(0.19)	(0.165)
Interaction	-53.528	4.104	-104.175	-60.644	-4.537	-30.893	-9.298	-58.086	-21.092	9.030
	(20.673)	(8.542)	(20.138)	(20.365)	(2.658)	(8.095)	(10.321)	(17.199)	(10.705)	(23.623)
Maturity differential	0.005	-0.061	-0.028	-0.064	-0.077	-0.125	0.110	-0.005	0.024	-0.056
	(0.02)	(0.023)	(0.015)	(0.033)	(0.026)	(0.052)	(0.052)	(0.04)	(0.046)	(0.042)

Panel B: Moody's credit ratings

	GR	IE	PT	ES	IT	BE	AT	FI	FR	NL
Intercept	-0.178	-0.021	0.002	-0.048	-0.032	-0.148	-0.039	-0.103	0.046	-0.008
	(0.085)	(0.041)	(0.104)	(0.04)	(0.038)	(0.058)	(0.036)	(0.063)	(0.063)	(0.037)
10-May-10	-0.377	-0.419	-0.153	-0.921	-1.043	-0.408	0.046	0.114	-0.109	0.036
	(0.119)	(0.101)	(0.106)	(0.248)	(0.236)	(0.274)	(0.202)	(0.155)	(0.222)	(0.151)
Fiscal balance	-0.110	-0.018	0.019	-0.356	-0.316	-0.206	0.042	0.048	0.016	0.103
	(0.04)	(0.062)	(0.049)	(0.071)	(0.072)	(0.068)	(0.131)	(0.063)	(0.119)	(0.075)
Country's ratings	0.837	0.256	0.271	0.196	0.246					
	(0.053)	(0.066)	(0.103)	(0.117)	(0.072)					
10-year KfW-Bund	0.032	0.311	0.237	0.174	0.308	0.445	0.834	0.726	0.850	0.721
	(0.042)	(0.05)	(0.042)	(0.073)	(0.07)	(0.103)	(0.116)	(0.125)	(0.158)	(0.143)
Greek ratings		0.293	0.529	0.548	0.548	0.724	0.034	-0.009	0.638	0.093
		(0.073)	(0.118)	(0.123)	(0.066)	(0.083)	(0.133)	(0.073)	(0.138)	(0.086)
US corp. BBB-AAA	-0.213	-0.250	-0.095	0.096	0.214	0.121	0.048	0.095	0.014	0.215
	(0.157)	(0.09)	(0.163)	(0.106)	(0.074)	(0.107)	(0.145)	(0.122)	(0.169)	(0.162)
Country's bid-ask spread	-0.058	0.349	0.271	0.145	0.182	-0.011	0.154	-0.240	0.577	0.107
	(0.098)	(0.084)	(0.127)	(0.083)	(0.042)	(0.065)	(0.093)	(0.107)	(0.191)	(0.172)
Interaction	-34.196	-7.261	-0.270	-14.462	-8.048	-30.434	-11.813	-54.947	-24.852	4.984
	(16.463)	(9.159)	(18.794)	(13.878)	(2.274)	(7.246)	(10.515)	(17.313)	(10.838)	(23.939)
Maturity differential	-0.001	-0.070	-0.029	-0.102	-0.096	-0.077	0.113	-0.015	0.062	-0.048
	(0.019)	(0.024)	(0.014)	(0.028)	(0.023)	(0.047)	(0.055)	(0.041)	(0.044)	(0.042)

Panel C: Fitch's credit ratings

	GR	IE	PT	ES	IT	BE	AT	FI	FR	NL
Intercept	-0.421	-0.056	-0.112	-0.074	-0.044	-0.141	-0.005	-0.106	0.064	-0.015
	(0.142)	(0.045)	(0.134)	(0.044)	(0.027)	(0.046)	(0.059)	(0.037)	(0.063)	(0.038)
10-May-10	-0.878	-0.510	-0.610	-0.506	-1.355	-0.896	-0.036	0.130	-0.572	-0.046
	(0.163)	(0.095)	(0.169)	(0.232)	(0.196)	(0.302)	(0.194)	(0.147)	(0.222)	(0.144)
Fiscal balance	-0.304	-0.054	-0.217	-0.181	-0.297	-0.169	0.056	0.084	-0.044	0.051
	(0.068)	(0.063)	(0.065)	(0.091)	(0.078)	(0.124)	(0.091)	(0.057)	(0.11)	(0.07)
Country's ratings	0.660	0.331	0.298	0.591		-0.178				
	(0.137)	(0.077)	(0.112)	(0.084)		(0.091)				
10-year KfW-Bund	0.058	0.234	0.255	0.255	0.360	0.353	0.870	0.680	0.745	0.752
	(0.054)	(0.058)	(0.04)	(0.073)	(0.068)	(0.113)	(0.128)	(0.135)	(0.154)	(0.145)
Greek ratings		0.164	0.474	0.245	0.774	1.142	0.088	0.064	0.743	0.021
		(0.086)	(0.096)	(0.092)	(0.092)	(0.21)	(0.129)	(0.082)	(0.147)	(0.1)
US corp. BBB-AAA	-0.465	-0.099	-0.190	-0.098	0.328	0.415	0.019	0.157	0.273	0.178
	(0.26)	(0.096)	(0.209)	(0.123)	(0.082)	(0.127)	(0.157)	(0.143)	(0.184)	(0.177)
Country's bid-ask spread	-0.302	0.395	-0.014	0.052	0.162	-0.152	0.140	-0.245	0.569	0.104
	(0.15)	(0.07)	(0.118)	(0.092)	(0.049)	(0.085)	(0.086)	(0.11)	(0.184)	(0.167)
Interaction	-77.125	-10.218	-21.778	-24.612	-9.808	-32.949	-13.578	-57.681	-26.974	2.781
	(25.455)	(8.992)	(25.691)	(16.152)	(2.532)	(7.082)	(10.044)	(17.807)	(10.47)	(23.457)
Maturity differential	-0.033	-0.118	-0.054	-0.082	-0.062	-0.117	0.111	-0.008	0.032	-0.051
	(0.029)	(0.03)	(0.02)	(0.026)	(0.025)	(0.056)	(0.053)	(0.042)	(0.047)	(0.044)

Notes: The table shows the estimated cointegrating vector's coefficients together with their respective robust standard errors from a dynamic ordinary least squares regression of 10-year yield spreads of country i on an intercept, a dummy on 10 May 2010, the fiscal balance-GDP ratio of country i, the credit rating of country i, the 10-year KfW-Bund spread, the credit ratings on the Greek sovereign debt, the US corporate bond spreads rescaled by the ratio between the sample mean of the 10-year KfW-Bund spread and the US corporate bond spreads, the country's bid-ask spread differential, an interaction term between the US corporate bond spreads and the country's bid-ask spread differential, the differentials in the residual maturity of the benchmark bonds in country i and the benchmark country and q leads and r lags of the non-spread variables. The estimates are corrected for heteroskedasticity and autocorrelation in the residuals, computed using the Newey-West estimate of the error variance. Robust standard errors are reported within parentheses below the coefficient estimates. All variables are standardised. Sample period: 1 Sep. 2008 – 4 Aug. 2011. The number of observations is 758.