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Elisabetta Croci Angelini

Francesco Farina

Enzo Valentini

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Abstract This paper investigates the causes of disproportionate increases of sovereign yields with respect to the interest rate on the 10 years German Bund within the Eurozone. Empirical evidence drawn from the BIS dataset on banks' portfolios shows that rapid financial integration, following the launch of the monetary union, resulted in excess exposure of Core countries' banks in the Peripheral countries' financial assets. In order to endogenize the possibility of contagion effects, we conduct econometric estimates through a GVAR model, where each country's spread depends upon all Eurozone countries' spreads. Results show that after the burst of the financial crisis the Core countries' sovereign yields are essentially determined by the international risk aversion, whereas the spreads of Peripheral countries mainly depend on fundamentals, namely the public debt/GDP ratio and the REER values with respect to the Eurozone average. Macroeconomic failures in public finances and competitiveness seem to originate the exceptional increases in sovereign spreads of the Periphery, through a contagion effect which is limited to this group of Eurozone countries.

Keywords Sovereign bond spreads · monetary union · international risk aversion.

Elisabetta Croci Angelini
University of Macerata

Francesco Farina
University of Siena
Tel:
E-mail: francesco.farina@unisi.it

Enzo Valentini
University of Macerata

1 Introduction

After the adoption of the euro and the end of the exchange rate risk, a rapid financial integration process developed in Europe, even more impressive than the 1990s unprecedented jump in worldwide capital movements. This paper investigates the causes of the varying distance between the interest rate on the 10-year bonds of Eurozone countries and the interest rate on the German 10-year Bund. By providing evidence of the huge portfolio diversification operated by highly interconnected banks, mainly consisting of large positions taken by the banks of the Core countries¹ financial assets of the Peripheral countries², we stress the importance of the financial integration within the Eurozone in the raise of sovereign spreads after the Lehman collapse.

In section 2, we review the literature on the factors at the origin of sovereign bond spreads from the inception of the monetary union onwards. In section 3, empirical evidence is provided of the evolution of the market sentiment – the flat path of which suddenly switched to a soaring risk aversion in 2007 – and of the huge increase in cross-border investments of the Core banks portfolios into the Periphery’s financial assets, which after the launch of the euro magnified interconnectivity across European financial markets.

In section 4, we introduce our GVAR model, where the dependent variable is computed with each country’s spread depending upon all Eurozone countries’ spreads. The objective consists in accounting for the huge raise in the Periphery’s sovereign spreads after the Lehman collapse, through the endogenous propagation of a contagion effect within the Eurozone. In section 5, econometric estimates are conducted with regressions for the whole panel of countries and separating out the Core and the Peripheral countries. Results show that the main drivers of the spreads are the international risk aversion for the Core and macroeconomic fundamentals such as the public debt / GDP and the REER for the Periphery. Section 6 concludes.

2 The literature on the Eurozone’s banking system and sovereign spreads

The completion of the monetary union with the adoption of the euro accelerated the integration across European credit and capital markets (Jappelli and Pagano, 2010). The end of the exchange rate risk and a diminishing international risk aversion were nourishing positive expectations about the future. As shown in Figure 1, all sovereign spreads of the Eurozone, considering nil the interest rate on the virtually risk-free German Bund functioning as the benchmark, exhibited a fall. From the inception of the monetary union to the financial crisis, the portfolios of European banks experienced a profound reshuffling. Within the cross-border positions in assets and liabilities of many

¹ Austria (at), Belgium (be), Finland (fi), France (fr), Germany and the Netherlands (nl).

² Greece (gr), Ireland (ie), Italy (it), Portugal (pt), Spain (sp).

banks of the Core countries, the yields of Peripheral countries' sovereign bonds disproportionately increased.

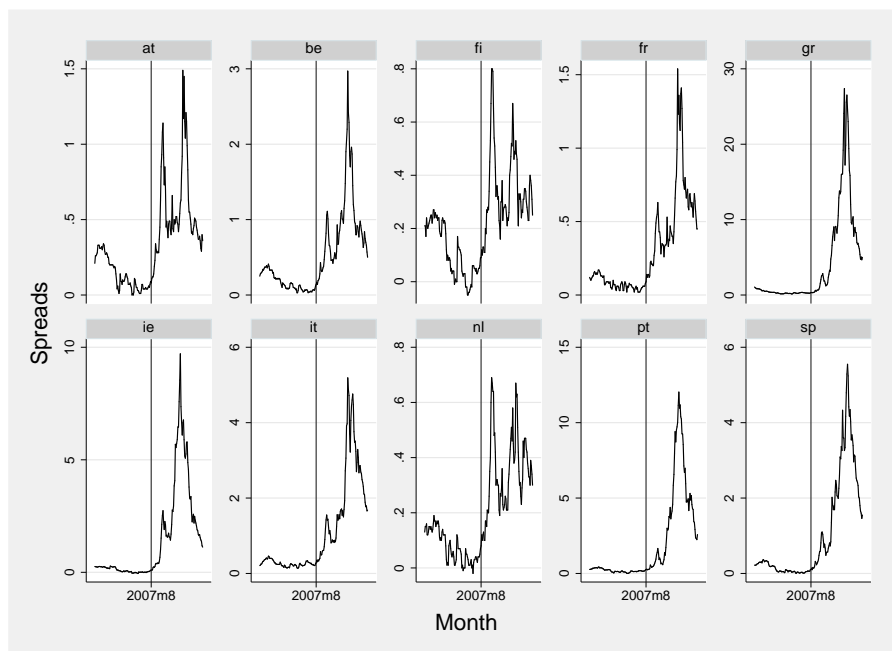


Fig. 1 Spreads path, 2000m1-2014m7. Source: own elaboration on Eurostat dataset

A likely driver of the cross-country portfolio diversification process, operated by European banks after the launch of the monetary union, was the mounting expectation of higher rates of return to be gained in countries with relatively scarcer capital and lower per capita GDP (Schmitz and von Hagen, 2011). Data on bilateral net foreign assets indicate that intra-Eurozone capital flows played an important role in financing large current account deficits (Waysand et al., 2010).

As a consequence, between January 1999 and August 2007, the average sovereign yield spreads of the Peripheral countries against Germany was never wider than 15 basis points, though the interest rate reduction was narrower in countries with high public debt relative to GDP (Codogno et al., 2003; Lane and Milesi-Ferretti, 2008; Balli et al., 2010). After the Lehman bankruptcy in September 2008, a drastic reversal in the market sentiment occurred worldwide. The period of negligible risk premia, started in 1999, was brought to an end by the transmission of a higher aversion to risk from the United States to Europe.

The literature mainly focuses on the international risk factor and worsening fiscal fundamentals as the drivers of the evolution of sovereign spreads in European financial markets (e.g. Attinasi et al., 2011). The rise in uncertainty stemming from the financial crisis compelled governments to put public money into the European banks burdened by derivatives with declining market values. This provoked a relevant rise in public debt/GDP ratios and the resumption of the risk of a default in countries with distressed public finances. The financial support and recapitalization funds propelled a self-aggravating process within European financial markets, as the decreasing value of Peripheral countries' sovereign bonds in portfolios substantially deteriorated the balance sheets of highly leveraged Core countries' banks (von Hagen et al., 2011; Allen and Moessner, 2013)³. The forecasts by rating agencies and market operators corrected upwards the risk premium on the loss of fiscal sustainability of Peripheral countries (Sgherri and Zoli, 2009; Arghyrou and Kontonikas, 2010).

The fiscal solvency of some high-public-debt Eurozone countries was also endangered by the absence of a mutual guarantee on sovereign bonds and of the assignment of the LoLR function to the ECB (Forbes 2012; De Grauwe and Ji, 2013). The greater the size of the banking sector in a country, as measured by the aggregate balance sheet to GDP ratio, the higher the risk of a soaring sovereign spread as an effect of the expectation of the government's rescue of distressed banks (Gerlach et al., 2010). The probability of a sovereign debt default was also linked to short-term interest rates, a proxy for the ability of a country to meet its obligations (Manganelli and Wolswijk, 2009; Longstaff et al., 2011). Furthermore, the more interconnected the banks' portfolios, the more a situation of illiquidity of a bank easily diffuse within the network of banks, the faster the insolvency conditions in both the public and the bank sectors spread over (Tressel, 2010; Krause and Giansante, 2012).

As an effect of rocketing default risk premia, the Peripheral countries' sovereign spreads increased, with the yields of the public debt in the Core remaining constant (Barrios et al., 2009). The reversal of capital flows towards the Core banks contributed to open a sharp divergence between the widening spreads of the less advanced Peripheral countries and those of the Core (Caceres et al., 2010; Panetta, 2011, Croci Angelini and Farina, 2012). In the high-public-debt Peripheral countries, the raise in the sovereign spreads

³ The liquidity risk is a proxy for the relative size of markets among the variables used in the literature in order to determine the spread as the probability that a limited depth of the sovereign bond market could provoke heavy capital losses in case of early liquidation,.. In this paper, we waive this variable, as it does not appear to play any substantial role in a majority of studies (Attinasi et al., 2011; Sgherri and Zoli, 2009; Barrios et al., 2009; Haugh et al., 2009; and Manganelli and Wolswijk, 2009). The likely reason is that the impact of liquidity risk on the spread is at least partly captured by the credit risk (Favero, Pagano, and von Tadden, 2010). Also measures of country risk and the agencies' rating of sovereign bonds were inserted in regression models, with mixed results (Attinasi et al., 2009; Arghyrou and Kontonikas, 2011). A likely explanation is that the spreads feed-back on these two variables, so they cannot perform as independent variables contributing to the determination of the spread as the dependent variable (De Grauwe and Ji, 2012).

appears to directly stem from the deterioration in fiscal positions, holding international risk aversion constant (Haugh et al., 2009).

The interplay between rising public debt / GDP ratios and a plummeting value of sovereign assets after the burst of the financial crisis, revealed the mutual exposure of banks and governments to the other party's insolvency risk. The unfolding of insolvency conditions fuelled a reciprocal distrust across banks, eventually resulting in the collapse of the Eurozone's inter-bank channel of liquidity transmission (Calvo, et al., 2008). The "sudden stop" in the financing to Peripheral countries and the following severe recession emphasize that in these economies the central problem is growth, which should resume soon in order to fund their macroeconomic imbalances vis-à-vis Core countries (Shambaugh, 2012).

All in all, the literature has extensively taken into account that the financial integration across European markets caused the banking crisis and the fiscal crisis to become strictly interwoven. Although the literature has often remarked that cross-border investments were the starting point of the crisis of the euro⁴, possible linkages between the huge rise in interconnectivity across banks and the widening divide across sovereign spreads between the Core and the Peripheral countries has been overlooked. In fact, financial markets' evaluation of the country-risk, which reflects the diverging macroeconomic performance in the two areas of the Eurozone, could be at the origin of a contagion effect propagating the raise in sovereign spreads within the Periphery.

3 Contagion as an effect of high interconnectivity across financial markets

After the launch of the European monetary union, the financial integration was expected to induce a faster catching-up in the per capita GDP growth rates of Peripheral backward economies. Many investors perceived the adoption of a single currency as a guarantee offered to the redemption of the Eurozone countries' public debt. A more sustained GDP growth was expected, that would have improved public finances in high-public-debt countries and put their public debt/GDP ratios on a declining path. These premises were probably overstated. The huge fall in the cost of credit (first of all, in Ireland and Spain) allowed private investments to largely exceed private savings. The hike in the growth rate enjoyed by some Peripheral countries was taken as the windfall gain stemming from financial integration. Quite on the contrary, it was mainly triggered by the over-optimistic expectation of a continuously rising domestic demand. High growth rates were boosted by unsustainable speculative projects, which eventually brought about the burst of the housing and financial bubbles (Giavazzi and Spaventa, 2010).

⁴ "(T)he creation of the euro led to a perception on the part of many investors that the big risks associated with cross-border investment within Europe had been eliminated (...); when private capital flows from the core to the periphery came to a sudden stop, leaving the peripheral economies with prices and unit labor costs that were well out of line with those in the core. Suddenly the euro faced a major adjustment problem" (Krugman, 2012, p.441).

Similarly, the wide current account imbalances vis-à-vis the Core countries, which soon opened in Peripheral countries due to the huge rise of imported consumption goods, was not correctly interpreted. The accumulation of trade surpluses and deficits - in the Core and in the Periphery, respectively - was deemed a physiological consequence of the higher GDP growth in the Periphery, triggered by more abundant liquidity and disproportionately lower interest rates in countries with an inflation rate higher than the Eurozone average (Blanchard and Giavazzi, 2002). Yet, it is now apparent that the main cause of the rising Peripheral countries' trade deficits was represented by inefficiencies in their productive structures, a comprehensive measure of which is the upward trends of unit labour cost (ULC) vis-à-vis the Eurozone-average starting after 1999, continuously enlarging real divergence within the Eurozone.

The financial integration was facilitating the GDP expansion in the Eurozone, but was also causing a more fragile macroeconomic environment due to a much higher interconnectivity across banks and financial markets of Core and Peripheral countries. Therefore, our tentative interpretation of the drivers of sovereign spreads draws on the role played by the complex linkages which have developed across the European financial markets after the monetary unification. We have collected data on the financial integration, with a special focus on the banks of the Core and the Periphery. Figure 2 documents the portfolio diversification by the banks of each Core country towards the Periphery's financial assets. Large amounts of capitals of Core countries' banks, invested in the Core at the inception of the monetary union, moved to the financial markets of the Periphery, eventually returning back home during the crisis. The share relative to Eurozone total of Periphery's financial assets owned by French, German and Austrian banks soared from 1999 to 2007, then started falling since 2009, and only the share of the French banks has recovered in the last two years.

The substantial increase in interconnectivity across European financial markets is also documented by the variation in the share of financial assets of Core countries held respectively by the banks of the Core and of the Peripheral countries. The Bank of International Settlements reports that portfolios of Peripheral banks remarkably widened as for the financial assets of Germany and France, and during the crisis also for the Austrian financial assets (BIS, various years). A dramatic upward trend of sovereign spread was exhibited from 2008 to 2012 first by Ireland, followed by Greece and Portugal, and to a more limited extent by Spain and Italy, and eventually by the Core countries but Germany (see Figure 1). Ranked from min to max - ranging from the minimum (0.65 points maximum spread in the Netherlands in 2009.1) to the maximum (around 3000 points in Greece in 2012.1) - in the third period all Eurozone sovereign spreads started soaring.

We believe that the empirical evidence above presented, namely the Core countries' banks substantial investments in the Periphery's financial assets, casts light on the importance of the peculiar characteristics of portfolio diversification induced by financial integration. First, the huge increase in financial

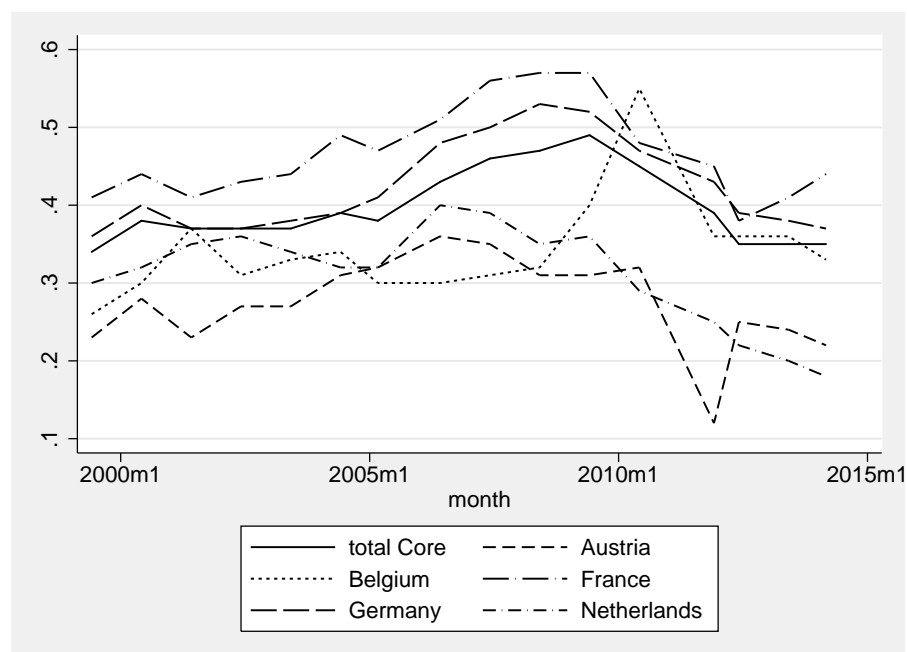


Fig. 2 Cross-border financial integration within the Eurozone: Positions in Periphery's financial assets held by the banks of five Core countries (Percentage of the total of each Peripheral country). Source: own elaboration on BIS dataset (the nationality of a bank depends on the ultimate controlling parent, be it a bank or non-bank. To determine nationality the BIS considers at least 50% ownership)

investments across European banks boosted the interconnectivity of the Eurozone financial markets mainly through cross-border operations. Second, the strategy of portfolio diversification pursued by the Core banks happened to be very similar, as it mostly ended up in the “grouping” of their investment in Periphery's financial assets.

The view is widely shared that balance between pros and cons of diversification is contingent on the specific context. On the one hand, portfolio diversification puts forward the fractionalisation of risk across a larger number of investors, which favours the shrinking of the default risk premium on sovereign bonds. On the other hand, excessive concentration of portfolios in specific financial assets can magnify markets' volatility after a large shock, thus raising the contagion costs (Greenwald and Stiglitz, 1986; Stiglitz, 2010)⁵.

⁵ “Whether greater interconnectivity is net positive or negative thus depends on whether the first set of effects, the diversification benefits, outweighs the second, the contagion costs. That depends both on the degree of risk aversion, the concavity of production functions (the extent to which they exhibit diminishing returns), the costs of bankruptcy, and the impact of sharing on the probability of bankruptcy.” (Stiglitz, 2010, p.24)

We put forward the hypothesis that within the Eurozone the benefits stemming from diversification were overtaken by its costs. The concentration of Core banks' portfolios in the Periphery's financial assets suggests that the net effect of risk fractionalisation was negative. By prompting time-varying co-movements across yields, diversification initially favoured the shrinking of the default risk premium on sovereign bonds, but after the Lehman bankruptcy determined the propagation of rising sovereign spreads within the Eurozone.

A perverse interaction developed during the financial crisis between the expected returns of the banks turning negative and the heterogeneous degree of riskiness of the stock of public debt. The co-movements of their yields could have triggered a contagion effect across the countries of the currency area. Since during crisis periods co-movements across markets are systematically observed, the contagion across financial assets is described as an exceptional hike in cross-market correlation coefficients after a large shock to one country or a group of countries, such as members of a currency area (Forbes and Rigobon, 2002).

After the Lehman shock, the similar exposure of the portfolios of the Core countries' financial institutions could have provoked a severe worsening of banks' balance sheets. The pronounced co-movements across Eurozone markets in 2008-09, as witnessed by the widening government bonds' spreads of Figure 1, could be taken as the necessary condition for the outbreak of a systemic risk⁶. The dismissal of Periphery's financial assets and the "flight to quality" resulted in the raise of the sovereign bonds' yields. The exceptional Greek crisis, consisting of distressed banks and public finances, represented the large shock propagating as a contagion across the Periphery's sovereign spreads.

Empirical evidence supports our hypothesis. The scatter diagrams in Figure 3 portray the estimated fitting line between the volatility of the international risk aversion (on the horizontal axis) - proxied by the S&P index of the difference in yields between corporate bonds and Treasury securities of similar maturity - and the spread (on the vertical axis) in each Eurozone country. Once investors took accurate account of divergent macroeconomic performances within the Eurozone, the Core's and the Periphery's sovereign bonds yields started entertaining an idiosyncratic correlation with the evolution of market sentiment towards risk. While the value on the horizontal axis is common to all countries' diagrams, the spreads on the vertical axis widely differ between Core and Periphery. It is apparent that the Core countries exhibit a positive correlation whereas the correlation is absent for the Peripheral countries, which is a clue of a possible breakdown of the Eurozone.

The different market evaluation of the country-risk in the two areas of the Eurozone could have been influenced by banks and governments' exposure

⁶ Systemic risk consists in the "probability that cumulative losses will accrue from an event that sets in motion a series of successive losses along a chain of institutions or markets comprising a system (...). That is, systemic risk is the risk of a chain reaction of falling interconnected dominos" (Kaufman, 1995, p. 47).

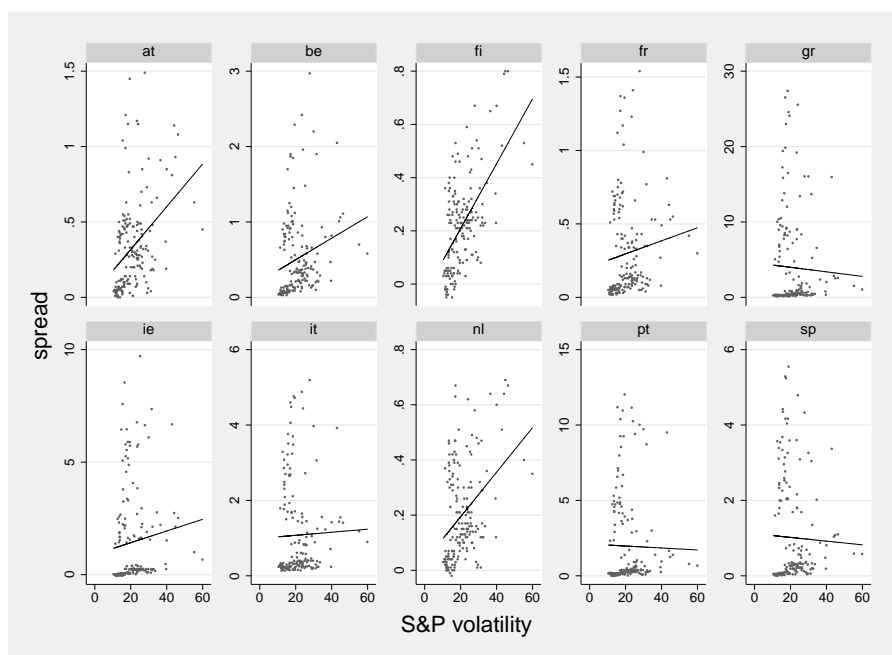


Fig. 3 Spreads and Volatility. Source: own elaboration on Datastream dataset

to the other party's insolvency risk. After burst of the financial crisis, this *liaison dangereuse* led to the “flight to quality” put into operation by the Core banks, which was crucial to the formation of a higher country-risk for the Peripheral countries, so that their sovereign bonds' spreads rose much more than the spreads on the Core sovereign bonds. Moreover, the financial markets' distrust in the fiscal solvency of Peripheral countries did not just depend on the increasing height of the public debt/GDP ratio after the banks' rescue, but also on the “credit crunch”, triggering to negative values their GDP growth⁷.

4 A model of contagion across sovereign spreads

The investigating of a contagion effect across sovereign spreads entails the consideration of the exposure of each country's spread to the other spreads. The fear of sovereign bonds' default spread over, thus nourishing the lift in the spreads independently from each country's macroeconomic conditions. We construct a GVAR model with a Global Spread variable (Favero, 2013), computed

⁷ This is the likely reason why the introduction of the public debt/GDP ratio as an independent variable in econometric estimates of sovereign spreads of the Eurozone has often delivered poor results. According to one among many similar reports on econometric results, “government debt and higher fiscal deficits are associated with rising bond yields. The correlation is however in both cases relatively weak” (Barrios et al., 2009, p.7)

as the time-varying “distance” among the Eurozone countries’ fiscal fundamentals. The mutually reinforcing increases in the spreads – that is a contagion in the form of each country’s spread depending on the others countries’ spreads - could be held responsible for the worsening in Eurozone countries’ fiscal solvency after the financial crisis, thus signalling rising expectations of one or more currencies exiting the Eurozone.

We formalize the dynamics of the spreads as a partial adjustment around a long run equilibrium determined by market volatility, public debt/GDP ratio, REER, and Global Spread. We state that contagion costs could have overtaken diversification benefits directly as an effect of higher markets’ volatility, or due to macroeconomic failures such as the worsening of public debt/GDP ratios or REER as the indicator of competitiveness. The objective is to model the interdependence among risk premia on sovereign bonds by taking into consideration these different drivers through which the worsening in fiscal solvency transformed in varying expectations of default across countries, finally affecting their spreads⁸.

Drawing on Favero (2013), we use the following specification:

$$\begin{aligned} \Delta(Y_t^i - Y_t^G) &= \beta_{i0} + \beta_{i1}(Y_{t-1}^i - Y_{t-1}^G) + \beta_{i2}\Delta VOL_t + \beta_{i3}VOL_{t-1} \\ &+ \beta_{i4}(b_t^i - b_t^G) + \beta_{i5}(reer_t^i - reer_t^G) \\ &+ \beta_{i6}(Y_{t-1}^i - Y_{t-1}^G)^{E,b} + u_{it} \\ (Y_t^i - Y_t^G)^{E,b} &= \sum_{j \neq i} w_{ji}^k (Y_t^j - Y_t^G) \\ w_{ji}^k &= \frac{w_{ji}^*}{\sum_{j \neq i} w_{ji}^*}, w_{ji}^* = \frac{1}{dist_{j,i}^b} \\ dist_{j,i}^b &= \frac{|b_t^j - b_t^i|}{60} \end{aligned}$$

where

- $Y_t^i - Y_t^G$: spread between government bonds of country i and Germany government bonds (Eurostat);
- VOL : VIX index: implied volatility of S&P 500 index options (CBOE);
- b_t^i : average for a 2-year ahead period of the expected debt to GDP ratio (European Commission);
- $reer_t^i$: Real Effective Exchange Rate (Eurostat)

⁸ “The crisis in FX [Foreign Exchange] came relatively late. In the early summer of 2007, it was apparent that fixed income markets were under considerable stress. Then, in July 2007 equity markets appeared to experience remarkable volatility. In particular, supposedly market-neutral equity portfolios suffered huge losses and it was common to hear people referring to a ‘five (or larger) standard deviation event’ (Melvin and Taylor, 2009, pp.1317-1330)

- $(Y_t^i - Y_t^G)^{E,b}$: this term consist in a Global Variable designed to capture a time-varying interdependence among spreads in the euro area. For each country this variable defines global spreads which are weighted average of other countries spreads where weights depend on the distance, measured in terms of differences in debt to GDP ratio (b_t^i), mutually separating Eurozone countries;
- $i = 1, \dots, 10$ identifies the ten countries, while t indicates the time, and u the error term.

We collected monthly data from Eurostat and our analysis refers to the initial EMU membership plus Greece, except Luxembourg.

The S&P Index of US stock volatility (VOL) is a proxy for the “market sentiment”.

We use both the European Commission's forecast of the public debt/GDP ratio and the real effective exchange rate (REER) because these are the variables more likely conveying the influence of each country's macroeconomic fundamentals on the propagation of the rise in the risk premium on sovereign bonds.

The path followed by the public debt/GDP ratio represents the market evaluation of fiscal sustainability of the country, i.e. the “credit risk” , the creditworthiness of the country's perspective public finances⁹.

As to the other macroeconomic fundamental, a country's REER path deviating from the path followed by its most proximate market competitors signals a wage rate dynamics increasingly exceeding the labour productivity dynamics, that is a competitiveness loss stemming from the country's real appreciation. The clear downward path exhibited by the Peripheral countries' intra-EMU exports, highlighting the importance of the loss of the exchange rate policy instrument previously often used to counter a negative shock, suggests that the plunging competitiveness hitting Peripheral countries contributed to the widening of their sovereign spreads (Belke and Dreger, 2011). In fact, market operators could become afraid of a prolonged deflation negatively impinging upon the fiscal revenues needed for the fiscal retrenchment. Hence, the steeper the rising path followed by the REER, the larger will be the risk premium imposed by financial markets.

Our Global Spread variable is built up by a weighted average of the yield spreads in Eurozone countries. The weights are time-varying, related to changes of fiscal fundamentals, and make global spread more dependent on the spreads of those countries that are more similar in terms of fiscal fundamentals. The global variables are included through their lags. To consider the contemporaneous global variables would be problematic, as it is likely that the conditions for exogeneity would be violated (Pesaran et al., 2004). In our model, the contemporaneous global spreads will be endogenous for the estimation of the parameters.

⁹ For the reasons exposed in note 3, we decided to waive the “liquidity risk” and focus on the “credit risk”.

Estimation of the GVAR panel model is implemented by a GLS panel, including country fixed effects. The method allows for heteroskedastic and correlated error structure and, furthermore, uses a panel-specific ar(1) autocorrelation structure. We made these choices after the appropriate tests.

5 Results

Table 1 shows the effects on spreads of the market sentiment (volatility), fiscal fundamentals (public debt), competitiveness (REER) and Global Spreads. The model has been estimated over the euro regime for the sample 2000m1-2014m7, and includes the sub-prime crisis.

Results entirely support the above proposed view whereby the rising path of sovereign spreads after the burst of financial crisis finds explanation in the rising international risk aversion only in the case of Core countries, as also shown by the very disproportional values for the Periphery's spreads vis-à-vis the Core spreads (Figure 1).

The Periphery estimate in Table 1 shows that the (high) spread of Peripheral countries actually depend on fiscal fundamentals, competitiveness, market sentiment and Global Spreads. Table 1 highlights that, in the period 2000-2014, the spreads of Core countries have been negatively influenced by the market sentiment, while they were by no means affected by competitiveness and fiscal fundamentals. The Global Spread variable witnesses a contagion developing within the Eurozone. Moreover, the coefficient of the Global Spread (contagion) results to be greater and more significant in Periphery than in Core.

Table 2 presents estimates for two different periods - before and after the second quarter of 2007 - taken as the starting quarter of the crisis, as shown in Figure 1.

A positive correlation between the spreads and the public debt/GDP shows up in both groups of countries (Table 2). Since it occurs in the first period in the Core, it expresses the rapid decline of spreads in countries in which the macroeconomic fundamentals are sound. Since it occurs in the second period in the Periphery, it expresses the rising and significant impact on the spreads of worsening values of the public debt/GDP ratio. Similarly, the significant coefficients of the REER witness the loss of competitiveness of Periphery Countries after the crisis.

The rise in the volatility was reflected by the Core countries' spreads only during the period of high spreads prompting the "flight to quality" (Table 2). Volatility is nil in the first period and becomes significant in the second period. In particular, from the summer of 2007 the spreads of Core countries are magnified by a worsening of the market sentiment (VOL, systemic risk), while the spreads of Peripheral countries rise due to higher debt to GDP ratio, lower competitiveness and volatility/market sentiment.

Table 1 Spreads on Bunds, monthly data, 2000m1-2014m7

	panel all countries	panel core	panel periphery
$(Y_{t-1}^i - Y_{t-1}^G)$	-0.056*** (0.008)	-0.092*** (0.015)	-0.062*** (0.012)
VOL_{t-1}	0.002*** (0.001)	0.002*** (0.000)	0.005** (0.002)
ΔVOL_t	0.002 (0.001)	0.001** (0.000)	0.011*** (0.003)
$(b_t^i - b_t^G)$	0.001** (0.000)	0.000 (0.000)	0.002** (0.001)
$(reer_t^i - reer_t^G)$	0.004** (0.002)	0.002 (0.001)	0.012*** (0.004)
$(Y_{t-1}^i - Y_{t-1}^G)^{E,b}$	0.004 (0.004)	0.009** (0.004)	0.024*** (0.007)
Wald χ^2	50.61	46.31	42.96
$p > \chi^2$	0.000	0.000	0.000
n	1700	850	850

Notes: Robust standard errors in parenthesis

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Country fixed effects included

Table 2 Spreads on Bunds, monthly data, 2000m1-2014m7

	panel core 2000m1-2007m7	panel core 2007m8-2014m7	panel periphery 2000m1-2007m7	panel periphery 2007m8-2014m7
$(Y_{t-1}^i - Y_{t-1}^G)$	-0.180*** (0.028)	-0.119*** (0.024)	-0.112*** (0.014)	-0.088*** (0.021)
VOL_{t-1}	0.000 (0.000)	0.003*** (0.001)	-0.000 (0.000)	0.005 (0.005)
ΔVOL_t	0.000 (0.000)	0.003** (0.001)	0.001 (0.001)	0.014** (0.006)
$(b_t^i - b_t^G)$	0.001*** (0.000)	0.002 (0.001)	0.000 (0.000)	0.004** (0.002)
$(reer_t^i - reer_t^G)$	0.001 (0.001)	0.003 (0.003)	-0.001 (0.001)	0.046** (0.018)
$(Y_{t-1}^i - Y_{t-1}^G)^{E,b}$	0.075*** (0.026)	0.005 (0.007)	0.050* (0.026)	0.030* (0.017)
Wald χ^2	41.96	35.77	87.10	26.32
$p > \chi^2$	0.000	0.000	0.000	0.005
n	450	400	450	400

Notes: Robust standard errors in parenthesis

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Country fixed effects included

Until 2007, spreads are low and, hence, the dynamics of the Global Spreads was slowing down. Global Spreads are, in turn, positively correlated with the spreads (column 1 and 3 of table 2). In this first period the dynamics of the Global Spreads was slowing down thus contributing to stabilize the spreads both of the Core and Periphery countries. After 2007 spreads rise and Global Spreads are high. In this second period, the rising Global Spreads prompt the spreads of Periphery countries, but do not affect those in the Core¹⁰ In the second period, the contagion effect rising from growing spreads seems to be limited to the countries of Periphery.

The positive and significant correlation of the sovereign spreads with the volatility of S&P Index for Core countries, and with a deterioration in competitiveness and fiscal fundamentals in Peripheral countries, provides evidence of a contagion essentially developing within the Periphery. The exclusive link of the Periphery's sovereign spreads to worsening macroeconomic fundamentals signals the reinforcing of the country-risk, that is a rising probability of default.

6 Concluding Remarks

Data drawn from banks' portfolios show that the launch of the monetary union prompted a rapid financial integration in the Eurozone, resulting in huge cross-border financial investments which provoked excess exposure of Core countries' banks in the Periphery's financial assets.

Empirical evidence indicates that the paths of sovereign bonds' yields, almost flat in the first years after the adoption of the euro, were upward shifted by the financial crisis. In particular, the Periphery's sovereign bonds' yields exhibited disproportionate increases with respect to interest rate on 10-year German Bund.

The contribution of this paper to the literature on the crisis of the Eurozone consists in an in depth analysis of the Core-Periphery divide, with the application of a GVAR model where each country's spread depends upon all Eurozone countries' spreads. We conduct econometric estimates showing that the rise in the sovereign spreads after the Lehman collapse was mainly determined by a rising international risk aversion in the Core countries, while in Peripheral countries soaring sovereign spreads are mainly driven by their macroeconomic fundamentals, namely the public debt/GDP ratio and REER values increasing with respect to the Eurozone average.

Results also indicate that the financial markets' distrust in the fiscal sustainability of distressed Peripheral countries did stem from the Core-Periphery structural divide, more than from the market evaluation of each government's fiscal solvency.

¹⁰ The lower significance of the Global Spread variable in table 2 with respect to table 1 could stem from the lower number of observations.

Macroeconomic failures in public finances and competitiveness seem to originate the exceptional increases in sovereign spreads of the Periphery, through a contagion effect which is limited to this group of Eurozone countries.

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