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Contagion in the EMU – The Role of Eurobonds with OMTs

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Abstract: We find strong evidence of country interdependence in the pricing of default risk, which suggests that a crisis can easily propagate from countries with weak fiscal fundamentals to other fiscally sounder member States. Interest rate interdependence differs between countries with high interest rates – high yielders – and countries with low interest rates – low yielders –. The former countries are linked through global spreads; i. e. they are exposed to the interest rate spreads (over Germany) of other troubled countries to a degree which increases with fiscal proximity. Low yielders with sounder fiscal fundamentals are partially immune from the high interest rates of fiscally weak member States but are still exposed to the risk of a euro break-up that is priced in Quanto CDS. This "euro risk" factor is a main driver of the interest rate spreads of low yielders until August 2012. More importantly, our case study of Italy shows that the impact of the global spread variable is dominated by changes in market sentiment, a sign that the Italian 2011–2012 crisis had the characteristics of a debt run more than a crisis of fundamentals. This evidence suggests that Eurobonds would be justified as an instrument for crisis prevention in the absence of a "lender of last resort". With the announcement of OMTs, the ECB seems to have taken such role upon itself, mainly as a response to the risk of a euro break-up. We show that OMTs led to a significant fall in the impact effect of the global spread variable in the Italian case. The ECB's ability to buy member States' bonds reduces the risk of a self-fulfilling debt run but also deprives Eurobonds of their role in crisis prevention. Proposals to introduce Eurobonds to finance investment projects and expenditures related to the security and refugee crisis appear more realistic.

Keywords: Eurobonds, global VAR, bond spreads in the euro-area, default premium, liquidity premium, Euro break-up, ESM, OMTs
JEL Classification: C51, C58

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1 Introduction

After reaching a peak in November 2011 and again in the spring of 2012, interest rate differentials, i. e. yield spreads, between government bonds in the euro area have finally narrowed back to pre-crisis levels, marking the end of the European sovereign debt crisis. The ESM–ECB framework for financial assistance has been successful in stabilizing investors' expectations and restoring market confidence. In particular, the ECB announcement of Outright Monetary Transactions (OMTs) in August 2012 seems to have played a key role in reducing the Italian and Spanish yield spreads over German Bunds.

Eurobond proposals during the European debt crisis of 2010–2012 focused on their potential role in preventing a self-fulfilling liquidity crisis not justified by fiscal fundamentals and its spreading to the whole euro area. These proposals were based on the idea that Eurobonds jointly guaranteed by all member States would ensure continuous market access to countries facing a liquidity crisis. Although it is always difficult to distinguish whether a crisis is one of solvency or liquidity, as both aspects are usually present at the same time, in this paper we report evidence that, starting in the second half of 2011, the Italian yield spread over Germany was significantly affected by changes in market sentiment. We extend Favero and Missale (2012) to consider a common "euro risk" factor reflecting euro devaluation risk, and possibly the risk of a euro break-up, that we measure through the average Quanto CDS of euro-area countries. We focus on the period of the European sovereign debt crisis from November 2009 to November 2015 and split this sample into two sub-periods, before and after August 2012, in order to assess the impact of the ECB announcement of OMTs.

We find strong evidence of country interdependence in the pricing of default risk, which suggests that a crisis can easily propagate from countries with weak fiscal fundamentals to other fiscally sounder member States. However, interest rate interdependence differs between countries with high interest rates – high yielders – and countries with low interest rates – low yielders-, and over time. The former countries are linked through global spreads; i. e. they are exposed to the yield spreads of other troubled countries to a degree which increases with fiscal proximity. Low yielders with sounder fiscal fundamentals are partially immune from the high yield spreads of fiscally weak member States but are still exposed to the risk of a devaluation or break-up of the euro that is priced in Quanto CDS. This "euro risk" factor is the main driver of the yield spreads of low yielders until August 2012, which suggests that a broader crisis of the euro area is the channel through which a debt default in a country with weak fundamentals can propagate to safer member States. More importantly, our case study of Italy shows that the impact of the global spread variable is dominated by changes in market sentiment – a sign that the Italian 2011–2012 crisis had the characteristics of a debt run more than a crisis of fundamentals. This evidence suggests that the introduction of Eurobonds as an instrument for crisis prevention would be economically justified. Eurobonds would be in the interest not only of States with financing difficulties but also of States with stronger fundamentals in that a debt default of, say, Italy or Spain would rapidly propagate to the whole Monetary Union.

The other rationale for Eurobonds is the absence of a "lender of last resort" who can prevent a debt run.[1] With the announcement of OMTs, the ECB seems to have taken such role upon itself, mainly as a response to the risk of a euro break-up. This has led to a steady decline in Quanto CDSs and to a significant fall in the yield spreads of Italy and Spain over Germany. The stabilizing effect that the ECB announcement had on market expectations is well evidenced in our econometric analysis by the reduction in the impact effect of the global spread variable in the Italian case. As the ECB's decision to buy government bonds of member States receiving financial assistance from the ESM reduces the risk of a self-fulfilling debt run, it also weakens the case for using Eurobonds as a crisis prevention instrument.[2]

The ESM–ECB framework for crisis prevention has stabilized investors' expectations and, most likely, eliminated the need for Eurobonds even if the ECB cannot act as a genuine lender of last resort.[3] More importantly, the introduction of Eurobonds for crisis prevention faces strong political opposition because it raises moral hazard issues and entails economic costs that safer member States are not willing to pay. By contrast, proposals to issue

1 The ECB cannot act as a genuine lender of last resort as Art. 123(1) TFEU prohibits the ECB from providing any type of credit facility to governments or other public authorities, and from directly purchasing their debt instruments. In fact, OMTs have been justified as secondary market bond purchases in the context of the ECB's open market operations (Art. 18 of 'Protocol No.4 on the Statute of the European System of Central Banks and the European Central Bank) with the aim of "safeguarding an appropriate monetary policy transmission and the singleness of the monetary policy" (ECB, 2012).

2 The fulfillment of this expectation also hinges on compliance with Art. 123(1) TFEU and the jurisprudence of national constitutional courts.

3 The ECB is not allowed to buy government bonds directly from member States (Art. 123(1) TFEU), and "a necessary condition for OMTs is strict and effective conditionality attached to an appropriate ESM programme" (ECB, 2012).

Eurobonds for expenditures that provide clear benefits to all member States may gain political consensus. This would be the case of investment projects and of extraordinary expenditures to deal with security concerns and the refugee crisis. As these problems are common to all member States and the expenditures incurred by each member State have clear positive externalities, Eurobonds seem the appropriate instruments to share the cost and the credit risk associated with their financing.

The rest of this paper is organized as follows. After this Introduction, Section 2 discusses the potential roles and proposals of Eurobonds. In Section 3 we report a graphical decomposition of interest rate spreads between euro-area government bonds and German bonds into their default and non-default components, and we explore their behavior and determinants. Section 3 presents the estimation results of the Global VAR model of euro-area sovereign spreads introduced by Favero and Missale (2012) and Favero (2013). This section also addresses the issue of contagion using a multi GARCH model, and reports an estimate of the effect of the ECB announcement of OMTs on the Italian yield spread. Section 5 discusses the implications for the role of Eurobonds of OMTs and, more generally, of the ESM–ECB scheme of financial assistance. Section 6 concludes the analysis with a proposal for introducing Eurobonds.

2 What use for Eurobonds?

Considering alternative objectives that Eurobonds backed by (several and) joint guarantees can help to achieve is a better starting point than stating their benefits and costs because, depending on these objectives, Eurobonds should have different characteristics, be issued in different amounts, and possibly will have different costs.

Eurobonds can be used to achieve different policy goals. In this paper we focus on three main objectives: (i) to promote further integration of euro area bond markets; (ii) to halt a debt crisis not justified by fundamentals, i. e. a self-fulfilling “debt run”; (iii) to finance EU-wide projects such as infrastructure or extraordinary spending needs. We review each of them in turn.

2.1 Bond market integration

Promoting further integration of euro area financial markets (perhaps, together with greater fiscal coordination) was the “classic” objective in the original proposal of Eurobonds by the Giovannini Group Report (2000), later followed by the Monti Report (2010). Apart from lower segmentation and better functioning of euro financial markets, the proposal hinges on the idea that a fully integrated market would deliver liquidity gains to all and, possibly, boost the role of the euro as a reserve currency. In particular, small issuers (representing a tiny fraction of the euro bond market) paying a high liquidity premium would mostly benefit from a jointly guaranteed Eurobond, but even Germany would benefit from having its bonds traded in a market potentially as thick and liquid as the US market. Evidence of a sizeable, say, 40 basis-point liquidity premium in favor of US Treasuries over German Bunds was taken as the potential reduction in borrowing costs that would derive from greater liquidity. Summing up, this argument for Eurobonds focuses on secondary markets and its relevance is strictly related to the importance of liquidity premia in bond yields. Two important points must be made at this stage. First, since a large market size is a necessary (but not sufficient) condition to reap liquidity gains, the outstanding amount of Eurobonds should be large, say, comparable to US Treasuries. This cannot be done overnight, unless through redenomination, which however raises a number of economic and legal issues. The second important point is that, unlike crisis prevention, market integration offers a rationale for German participation. As credit risk mutualisation penalizes safe borrowers, liquidity is the only reason why Germany might reduce its borrowing costs and directly benefit from the issuance of Eurobonds.

2.2 Debt crisis prevention

The objective to avoid a debt crisis not justified by fiscal fundamentals and its propagation to safer member States has been at the center stage of Eurobond proposals during the European sovereign debt crisis of 2010–2012. The idea is that Eurobonds guaranteed by all member States would ensure continuous market access for countries with weaker fiscal fundamentals and thus more exposed to changes in market sentiment. The possibility to rely on Eurobonds would be especially valuable to countries hit by a roll-over crisis when the demand for new bonds dries up because of each investor's fears that other investors will shy away in a panic equilibrium reminiscent of a self-fulling bank run. Absent a central bank acting as a lender of last resort, a self-fulfilling debt run is possible and Eurobonds may provide an alternative to central bank intervention in stabilizing investors' expectations and preventing a panic equilibrium. To the extent that a debt crisis widens interest rate spread on Bunds, impairs borrowing conditions in the euro area, and propagates to safe member

States, Eurobonds may clearly benefit more countries than just those experiencing a debt run. The insurance that Eurobonds would provide to States with weaker fundamentals, like Italy and Spain, would also work as insurance for others. Although it is always difficult to distinguish between solvency and liquidity crises, as solvency is inherently difficult to evaluate and both aspects are usually present at the same time, Favero and Missale (2012) report evidence on Italian and Spanish interest rate spreads over Germany that points to a significant component of such spreads due to changes in market sentiment since the summer of 2011.

Interestingly, crisis prevention arguments focus on the primary market and are not concerned with achieving a large market size. In principle, Eurobonds might not even need to be issued since what matters (as in the case of OMTs) is the reassuring effect on investors' expectations of endowing countries with an instrument for market access of last resort. However, it is worth noting that risk mutualisation would not be without costs for safer member States; even in the case that Eurobonds would not be issued by a country with financing difficulties, the option to do it would increase the expected liabilities of other member States. For this reason, Eurobonds jointly guaranteed by all member States may possibly raise the borrowing costs on all type of bonds.

The establishment of the European Stability Mechanism (ESM) and the ESM–ECB framework for financial assistance have likely deprived Eurobonds of their role in crisis prevention, in that a country experiencing a liquidity crisis can now rely on ESM financial assistance, i. e. a credit line to be used for bond purchases on the primary market, and on OMTs, i. e. ECB bond purchases on the secondary market.

2.3 EU-wide project financing

The third argument for Eurobonds is that they are the appropriate instruments to finance projects and/or expenditures that provide benefits to all member States (in proportions that cannot be assessed) also because of spillover effects and/or externalities. This is clearly the case for infrastructure such as roads and railways connecting two or more member States that facilitate mobility within the EU. However, a similar argument can be made for any investment project that, independently of location, increases output across the EU through spillover effects. More recently, it has been argued that extraordinary expenditures to deal with the refugee crisis and expenditures for security following terrorist attacks should be financed with Eurobonds. As these problems are common to all member States and the expenditures incurred by each member State have clear positive externalities to other States, sharing the cost and the credit risk associated with their financing is economically justified. A potential advantage of Eurobond financing would be to create fiscal space in national budgets without lengthy negotiations on budget flexibility.

It is worth noting that a Eurobond program for specific projects would be limited in the amount of bonds outstanding so that a liquidity premium will have to be paid. Nevertheless, the introduction of Eurobonds backed by (several and) joint guarantees would represent an important first experiment to test investors' demand and borrowing costs. In fact, bonds issued by the ESM or the European Investment Bank are guaranteed by the capital that member States have provided to such institutions; they are, therefore, similar to bonds backed by several but not joint guarantees. Finally, the announcement of a common program would enhance the credibility of EU institutions by signaling a political will for greater fiscal unity and cooperation, thus paving the way for a deeper reform of EU fiscal governance.

3 Default versus non-default component

In this section we examine evidence on long-term interest rate differentials between euro-area government bonds and German bonds for the period 2007–2015 in order to identify their determinants. In particular, we aim to disentangle interest differentials into their main components: a default premium and a non-default premium reflecting liquidity risk and factors related to expected variations in the exchange rate.[4] Assessing the relative importance of such components is crucial to understand the role that Eurobonds can play.

Long-term interest rate differentials between 10-year euro-area government bonds and German Bunds co-move with an unstable pattern over time. Interest spreads over Germany converged significantly with the introduction of the euro, narrowing from highs in excess of 300 basis points in the pre-EMU period to less than 30 basis points about one year after the introduction of the euro. Yet, bonds issued by euro-area member States have never been regarded as perfect substitutes by market participants. Interest rate differentials co-moved synchro-

4 Bernoth et al. (2012), Di Cesare et al. (2012) and Calvori et al. (2016) also consider an "excessive fear" related component.

nously at a very low level between the start of the EMU and the subprime loan crisis. Differentials became sizeable during 2008 and 2009 with some separation in co-movement between high-debt and low-debt countries. The European sovereign debt crisis from the end of 2009 onwards produced interest differentials of the same or even greater magnitude than those of the pre-EMU era, and more heterogeneity in co-movement. Interest rates have progressively returned to a convergence pattern after the announcement by the ECB of OMTs in August 2012.

3.1 Default premium, liquidity risk and devaluation risk

Interest rate differentials, i. e. yield spreads, between government bonds of euro-area countries should price three factors: default risk, liquidity risk and expected devaluation, say, because of currency redenomination. The latter factor may emerge, for example, because of a euro break-up following a major credit event or a German exit from the Eurozone.

Sovereign issuers that are perceived as having a greater solvency risk must pay investors a default premium. Liquidity risk is the risk of having to sell (or buy) a bond in a thin market and, thus, at a loss of value and/or higher transaction costs. Small issuers with low volumes of bonds outstanding and thus small markets must compensate investors with a liquidity premium. The introduction of the euro in January 1999 initially eliminated the expectations of exchange rate variations, but the general surge in the debt-to-GDP ratio of euro-area countries after 2009 has led markets to reconsider the possibility of some member States' exit from the euro and even the collapse of the common currency.

Favero and Missale (2010, 2012) show that default risk is the main driver of yield spreads, with non-default risk playing a role only in the case of small issuers and, more generally, during the global financial crisis. The non-default premium, indeed, appears to be very small with the exception of Finland, the Netherlands, and France in 2008 and 2009. This component is clearly time-varying and fluctuates between around 10 basis points in calm periods and around 50 basis points during crises. The risk of devaluation of euro-denominated assets in case of a major credit event, possibly leading to a break-up of the euro, is not considered in Favero and Missale (2012) as their sample period ends in August 2011, when such risk only began to be perceived. In what follows, we extend the analysis to consider the impact of a proxy for euro devaluation risk.

3.2 Default, liquidity and devaluation risk: the evidence

We extend the original framework in Favero and Missale (2012) by keeping the same measure of default risk and by introducing a proxy for euro devaluation risk. We use data associated with 10-year benchmark government bonds issued by ten European countries, namely, Austria, Belgium, Finland, France, Germany, Ireland, Italy, Portugal, Spain, and the Netherlands which are the most frequently traded bonds in local and Euro MTS markets. Bond yields, i. e. interest rates, are taken from Datastream.

Figure 1 graphs the 10-year maturity bond yields of the countries under analysis. The graph suggests that the European sovereign bond market has experienced three different phases. Until to 2009, bond yields tend to co-move strongly and their variation is fairly low. From the start of the European sovereign debt crisis in late 2009, the bond yields start to diverge. The gap between yields across member States increased throughout 2011. Beginning in 2012, the European sovereign bond market showed clear signs of segmentation. Bonds could be classified into high yielders (Ireland, Italy, Spain and Portugal) and low yielders (Germany, Austria, Belgium, Finland, France, and the Netherlands). This segmentation is very important in explaining the dynamics of yield spreads with respect to their driving factors.

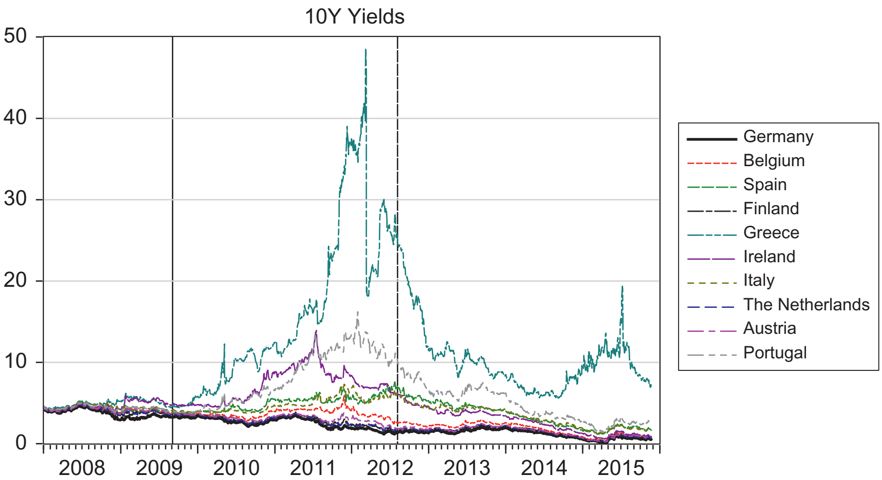

Figure 1: 10-Y Government bond yield in the Euro area.
Note: Yields in % annual terms
Source: Datastream/Thomson Financial.

Default risk is measured using CDS spreads. A CDS is a swap contract in which the protection buyer of the CDS makes a series of premium payments to the protection seller and, in exchange, receives a payoff if the bond goes into default. The difference between a CDS on a member State bond and the CDS on the German Bund of the same maturity is a measure of the default risk premium of that State relative to Germany.

To capture the risk of devaluation of euro-denominated assets, which is possibly associated with the risk of a euro break-up, we use the Quanto CDS, a measure introduced by De Santis (2015). The Quanto CDS is defined as the difference between the CDS quotes in US dollar and euros for the same country. That difference between the US dollar – and the euro-denominated CDS spreads represents the premium that market participants are willing to pay to receive protection in US dollars so as to avoid the risk that the euro (or an eventual new legacy currency) depreciates against the dollar after a default in a member State. De Santis shows that the Quanto CDS is equal to the expected (present value) loss from receiving protection in euros instead of dollars in case of default, and it thus depends on the probabilities of default in future periods of the contract multiplied by the payout upon default and the expected rate of depreciation in these future periods. In other words, the Quanto CDS is a "credit-event-probability-weighted" currency premium associated with the payout from default. This measure is available from 2010 onwards. Figure 2 graphs 10-year maturity Quanto CDS rates for the countries under analysis.

The behavior of the Quanto CDS of euro-area countries is characterized by a strong co-movement along a common trend with cross-country differences that vary within a 50 basis point band (with Spain exhibiting wider fluctuations). In fact, Quanto CDS differ across euro-area countries because of different probabilities of default and payouts, but they are characterized by a common trend in that a credit event in one country will affect the Quanto CDS of other countries through expected depreciation, currency risk and default probabilities. Therefore, the common trend displayed in Figure 2 represents the euro devaluation risk that, we think, correlates with the risk of a euro break-up.[5] Having measured the Quanto CDS for each country, we take the simple average across all euro-area countries to eliminate the effect of country-specific factors and outliers. The average Quanto CDS constitutes a common

5 It is worth noting that a credit event does not imply the break-up of the euro area, as in the Greek case in March 2012. Quoting De Santis (2015), "the Quanto CDS measures the risk associated with the depreciation against the US dollar and not the intra-euro area currency risk".

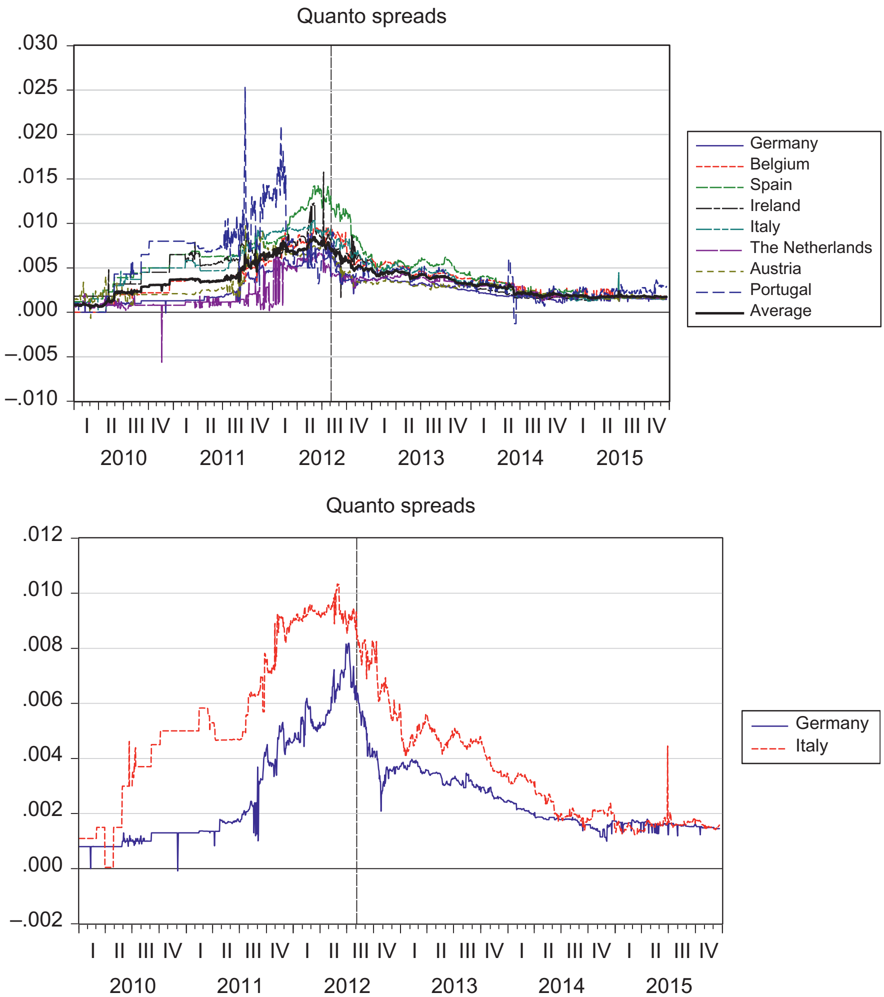

Figure 2: Quanto spreads.
Source: Datastream/Thomson Financial.

risk factor that captures expectations of underperformance of the Euro with respect to the US dollar upon occurrence of a credit event that triggers CDS payments. We call this common factor the "devaluation risk" or "euro risk" factor.

Figure 3(a) and (b) report the yield spreads for euro-area countries relative to Germany, along with their default and non-default components. We group euro-area countries into low yielders in Figure 3(a) and high yielders in Figure 3(b).

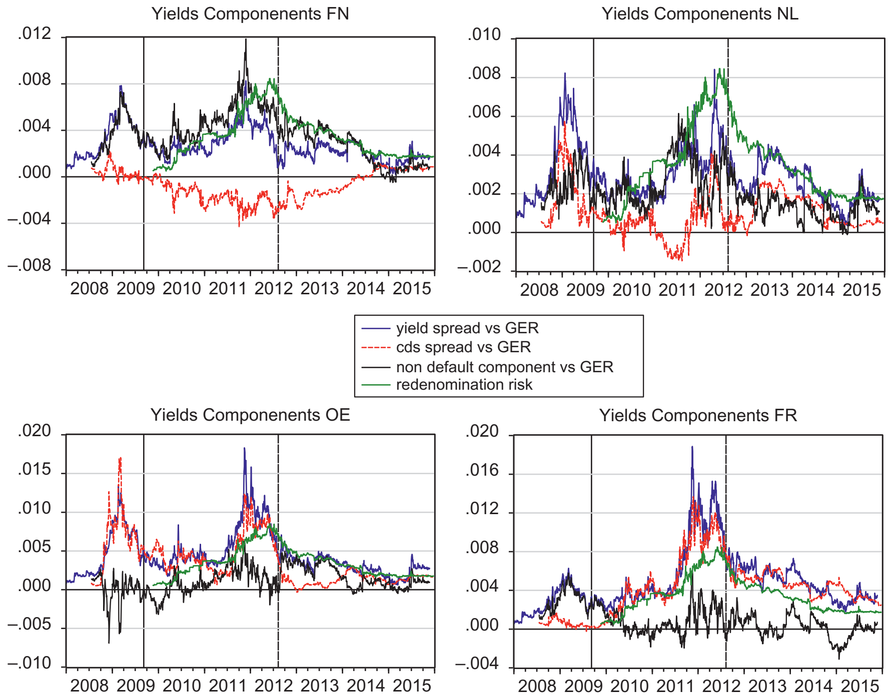

Figure 3a: The default and non-default component in yields spreads – Low Yielders.
Source: Datastream/Thomson Financial.

In particular, we report the yield spreads between 10-year government bonds and German Bunds (blue line) along with: the associated CDS spreads (red line), the residual non-default component (black line), and the "euro risk" factor, i. e. the average Quanto CDS in the euro area (green line).

The following facts emerge from the data:

i. The first important fact about the co-movements of yield spreads in the euro area is that their interdependence is not constant over time, and it differs between countries with high interest rates – high yielders – and countries with low interest rates – low yielders-.

ii. In the case of high yielders, the CDS differential relative to Germany, i. e. the default risk component of the yield spread, accounts for virtually the entire yield differential (and its variability) from the beginning of the sample to the end of 2010. The gap between the yield spread and its default component that emerges between 2010 and 2012 is strongly related to the "euro risk" factor. With the steady decline in the risk of a euro break-up, from August 2012 onward, the non-default component goes back to fluctuating close to zero.

iii. The case of low-yielders is mixed. In Austria and France the default risk component of the yield spread accounts for almost the entire yield differential (and its variability) from 2009 to mid-2011. Then, in the midst of the European debt crisis, a non-default component of about 40 basis points emerges; however, this component bears no close relationship to the "euro risk" factor. By contrast, Finland and the Netherlands exhibit a small, volatile and at times negative CDS differential relative to Germany, with the non-default component accounting for the largest part of the yield differential. It is however difficult to interpret this

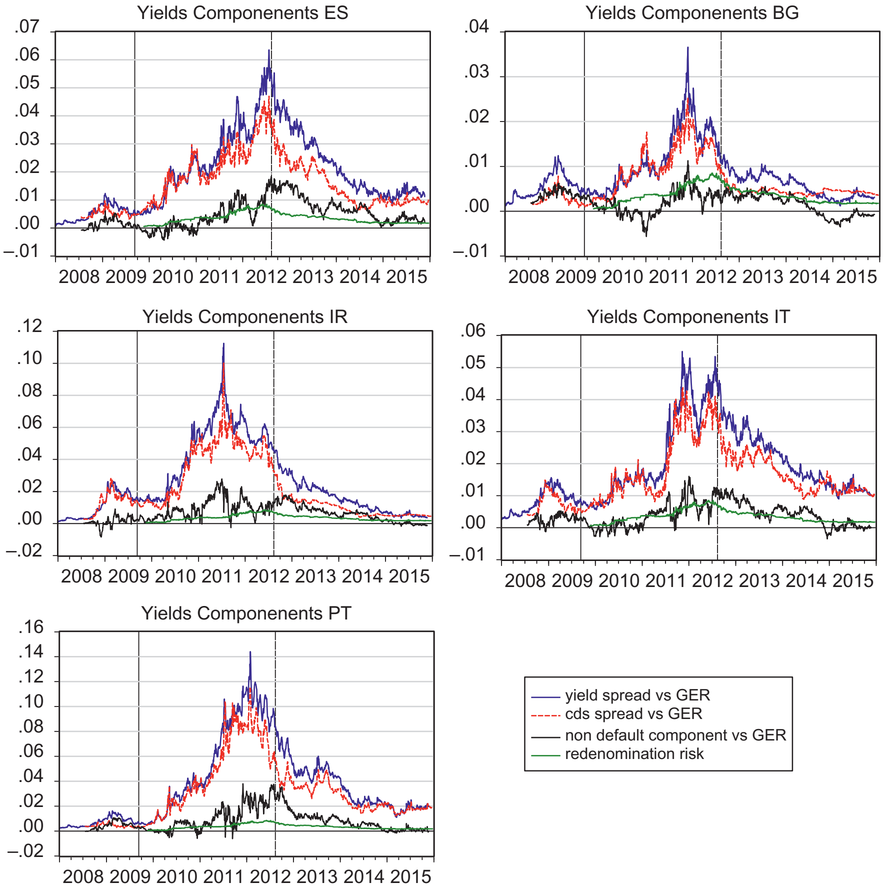

Figure 3b: The default and non-default component in yields spreads – Low Yielders.
Source: Datastream/Thomson Financial.

non-default component as representing a liquidity premium as it correlates with the “euro risk” factor, at least until the beginning of 2012.

iv. Until 2011 the non-default component of the yield spread is small for all member States, not exceeding 50 basis points (except in Finland), but it becomes sizeable in the midst of the European debt crisis, fluctuating around or above 100 basis points in the case of high yielders. The simultaneous increase in the “euro risk” factor suggests that euro devaluation or break-up risk, rather than liquidity risk, is the likely explanation of such large non-default components.

v. For all countries, before 2010 and after 2013, non-default components are unlikely to reflect the risk of devaluation or a break-up of the euro, and thus provide a rough estimate of liquidity premia. During the global financial crisis the non-default component is sizeable in Finland, reaching 70 basis point, and not negligible, around 40–50 basis points, in Belgium, the Netherlands, and France. However, in the aftermath of the European debt crisis, the component of the spread likely due to liquidity problems becomes very small, around 25 basis points in Finland and the Netherlands, and even lower, around 10 basis points, in Austria and France.

Our analysis suggests that the greater liquidity of Eurobonds (if introduced on a large scale) would mostly benefit small issuers with some reduction in their borrowing costs. However, as we have just looked at interest rate differentials relative to Germany, we cannot exclude that liquidity might improve for Germany and the other large issuers as well, thus determining a generalized reduction in the level of interest rates. On the other hand, we are skeptical that any such reduction would be significant for at least two reasons. First, it is hard to imagine a further reduction in interest rates below their currently negative levels. Second, as shown by Favero and Missale (2012), the liquidity premium of about 40 basis points that German Bunds historically paid on US Treasuries, has reversed in favor of Germany after the global financial crisis. To conclude, reductions in borrowing costs from a potentially larger and more liquid market for Eurobonds are likely to be small and mostly appealing to small issuers. Arguments for Eurobonds based on liquidity enhancements and, consequently, lower costs appear weak, although they cannot be completely dismissed.

4 Fiscal fundamentals, global risk and contagion

Having shown that default risk is the main driver of yield spreads with some additional role for euro devaluation and break-up risk, in this section we examine the relative importance of fiscal fundamentals, global risk factors and contagion. The analysis follows Favero and Missale (2012) where we find strong evidence that changes in market sentiment significantly affect yield spreads in the Euro area and have an important role in propagating the debt crisis.

We focus on the default premium component of yield spreads, and model it as a linear function of local fiscal fundamentals, i. e. the expected debt-to-GDP and deficit-to-GDP ratios, the "euro risk" factor, and a global risk factor that we call the "global spread", which interacts the spreads of the other member States with local fiscal fundamentals to capture the global risk that a country faces. The global spread variable is country-specific and is obtained as the weighted average of other countries' spreads with weights reflecting fiscal proximity, that is, the distance of their debt and deficit ratios to the same variables of the country considered; the closer the debt and the deficit of the country considered to those of another country, the greater the weight assigned to the yield spread of that country. This makes the exposure of each country to the spreads of the other countries in the euro area depend on the "distance" between their fiscal fundamentals. The main novelty relative to Favero and Missale (2012) is the introduction of a common "euro risk" factor, i. e. the average Quanto CDS, to consider the risk of a euro break-up.[6] Finally, we split our sample into two sub-periods, before and after August 2012, in order to assess the impact on the estimated coefficients of the ECB announcement on August 2 of OMTs, i. e. secondary market purchases of government bonds of member States receiving financial assistance from the ESM.

4.1 A GVAR model of yield spreads

We estimate by Seemingly Unrelated Regressions (SUR) the following 10-equations (countries) Global VAR (GVAR) for the 10-year yield spreads on German Bunds for Austria, Belgium, Finland, France, Greece, Ireland, Italy, the Netherlands, Portugal and Spain, using daily data over the period November 2009 to November 2015:

6 We restrict our analysis to the euro debt crisis period and use daily data, while Favero and Missale (2012) used weekly data over the period June 2006–August 2011. As a result, we do not include in our specification global factors such as the US Baa-Aaa bond spread, which is very stable over the restricted sample period.

$$\begin{aligned}(Y_t^i - Y_t^G) &= \beta_0 + \beta_1 (Y_{t-1}^i - Y_{t-1}^G) + \beta_2 (b_t^i - b_t^G) + \beta_3 (d_t^i - d_t^G) + \\ &+ \beta_4 ER_t + \beta_5 ER_{t-1} + \beta_6 GS_t^i + \beta_7 GS_{t-1}^i + u_t^i\end{aligned} \qquad [1]$$

$$GS_t^i = \sum_{j \neq i} w_t^{ij} \left(Y_t^j - Y_t^G \right)$$

$$dist_t^{ij} = 0.5 \left(b_t^i - b_t^j \right) / 60 + 0.5 \left(d_t^i - d_t^j \right) / 3$$

$$q_t^{ij} = \frac{1}{dist_t^{ij}} \text{ if} \left| dist_t^{ij} \right| < 1; 0 \text{ otherwise}$$

$$w_t^{ij} = q_t^{ij} \Big/ \sum\nolimits_{j \neq i} q_t^{ij}$$

The model relates yield spreads, i. e. the difference between the yield Y_t^i of a country i and the German yield Y_t^G, to the difference in debt- and deficit-to-GDP ratios, $b_t^i - b_t^G$ and $d_t^i - d_t^G$, the common 'euro risk' factor, ER_t, and the global spread GS_t^i.

Following Attinasi et al. (2010), for fiscal fundamentals we consider the average for a 2-year period of the expected deficit-to-GDP ratio, d_t^i, and the expected debt-to-GDP ratio, b_t^i. The expected variables are the European Commission Forecasts that are released on a bi-annual basis. We include in the model the difference between each country's forecast and the forecast of the same variables for Germany. The common 'euro risk' factor, ER_t, that captures the euro devaluation risk and possibly the risk of a euro break-up, is obtained as the simple average of the Quanto CDS of the countries under consideration, as explained in Section 3.2. The global spread, GS_t^i, captures the global (euro area) risk that a country faces. It is constructed as a country-specific stochastic trend that is mostly driven by the yield spreads of the countries that have fiscal fundamentals more similar (or less distant) to the country considered. Specifically, the global spread is measured for each country by a weighted average of yield spreads of other countries. Weights, w_t^{ij}, are the inverse of the fiscal distance, $dist_t^{ij}$, which is defined as the absolute value of the difference between the fiscal fundamentals, d_t and b_t, of two countries, i and j (normalized by their 3 and 60 percent limits). Hence, weights are constructed to make the global spread more dependent on the spreads of those countries that are more similar in terms of fiscal fundamentals. The time-varying weights, related to the changing forecasts for fiscal fundamentals, have the potential of explaining the changing correlation of spreads observed in the descriptive analysis of the previous section. The global spread variable is inspired by the construction of global variables in the GVAR modeling approach (see, e.g., Pesaran et al., 2004; Dees et al., 2007), where global macro variables are constructed for each country by using trade weights; we simply replace trade shares with the above measure of fiscal proximity, w_t^{ij}. Using the distance in terms of fiscal fundamentals makes the global spread country-specific and the weights not constant, unlike in standard GVAR based on trade shares. Note that the global spread variables vary at daily frequency only for the fluctuations in the yield spreads, while the low frequency fluctuations depend both on the fluctuations in the yield spreads and on the changes in the weights. As the latter occurs only biannually, no endogeneity problem for the weights should arise.

We estimate the model over the full sample and over two subsamples: from November 2009 to 1 August 2012 and from 2 August 2012 to November 2015. The split in subsamples is introduced to assess the impact of the ECB announcement of OMTs on the relation between yield spreads and their determinants; local fiscal fundamentals, global spreads, and the "euro risk" factor.

4.2 The empirical evidence

The results of the estimation, which are reported in Table 1 in the Appendix, can be summarized as follows:

i. All spreads are very persistent. This implies that long-run means are very imprecisely estimated because yield spreads tend to display a stochastic trend that first slopes upward and then downward.
ii. The effect of fiscal fundamentals, when they are not interacted with the yield spreads of other member States, is rarely significant. The debt ratio is significant only in Ireland over the second period, and in the case of low yielders but with the wrong sign. The deficit is significant only in Ireland and Portugal over the first sample period, and in Austria and Spain over the second period.
iii. The common "euro risk" factor (capturing the risk of a euro break-up) is strongly significant for all countries, except for Portugal, before the ECB announcements of OMTs while its decline over the second period significantly reduces the yield spreads of high yielders. Its impact on the yield spread of the high yielders is also stronger and more persistent than on the spread of low yielders.
iv. The global spread variable that makes the exposure to other countries' yield spreads increase with the similarity of their debt and deficit ratios (so as to link more closely the spreads of countries with similarly weak fundamentals) is strongly significant in all member States with different impact coefficients. The impact of the global spread is stronger on the yield spread of high yielders than on the spread of low yielders.

v. The ECB announcement of OMTs is associated with a steady decline of yield spreads and the common "euro risk" factor, and with a change in their relationship that differs across countries. In the case of low yielders, the impact of the "euro risk" factor becomes either negative or not significant whereas it remains significant and gains strength in the case of high yielders.
vi. Panel restrictions cannot be imposed on the system as the coefficients differ importantly across countries.

The evidence in Table 1 shows that global spreads are highly significant for all countries considered while fiscal fundamentals have no effect at any conventional significance level, with the exception of Ireland and Portugal and in only one of the two subsamples. Fiscal fundamentals matter not *per se* but because they determine the exposure of each country's yield spread to the yield spreads of the other member States. Fiscal proximity selects the reference group of countries whose yield spreads determine the global spread to which a country is exposed. Member States with sound fiscal fundamentals are immune to the risk priced in the yield spreads of countries with fiscal problems while member States with weak fundamentals are affected by the yield spreads of troubled countries to the extent that they are fiscally similar. Hence, fiscal fundamentals matter in the pricing of default risk but only as they determine the exposure to other countries' spreads, that is, to the global risk that the market perceives. When global risk factors are muted, fiscal fundamentals have no effect on yield spreads. This evidence suggests that markets do set incentives for fiscal discipline but they do it discontinuously, namely only when global systemic risk is perceived.

The effect of the ECB announcement of OMTs is found by comparing the results of the estimation of the GVAR model over the two subsamples pre and post August 2012. To this end it is worth noting that the period following the ECB announcement is characterized by a steady decline in the "euro risk" factor, as the risk of a euro break-up fell. This downward trend actually starts one week before, on July 26, following Mario Draghi's statement that he would do "whatever it takes" to defend the euro. Furthermore, as shown in Figure 3(a) and (b), the announcement of OMTs on 2 August 2012 marks the turning points in the yield spreads of Italy and Spain, the two countries under greater debt-financing stress at that time. In other member States, borrowing conditions seem instead to have eased earlier, in the first half of 2012.

The ECB announcement of OMTs clearly led to a change in the relationship between the yield spreads and the risk of a euro break-up that differs across countries. In the case of low yielders, the impact of the "euro risk" factor becomes either negative or not significant whereas it remains significant and gains strength in the case of high yielders. We interpret the result for the former countries as evidence that the ECB announcement does not only reduce euro devaluation risk and the probability of a break-up but it also makes the yield spread of countries with sound fiscal fundamentals immune to such risks. By contrast, sensitivity to the "euro risk" factor increases in countries with weaker fiscal fundamentals. As fundamentals are expected to change slowly over time, a lower devaluation risk is the main factor that drives their yield spreads down. In fact, after the ECB announcement, the yield spreads of high yielders with closer fiscal fundamentals decrease at the same pace, leaving the estimated coefficient on the global spread statistically unaffected with the notable exception of Spain, where the yield spread displays some resilience, reflecting the problems of its troubled banking sector. This evidence contrasts with that for low yielders, where the estimated sensitivity to the global spread increases significantly after the ECB announcement of OMTs. As the risk of a euro break-up vanishes, it appears that the yield spreads of countries with sounder fiscal fundamentals tend to co-move more synchronously with each other and with those of weaker member States.

Summing up, there is strong evidence of country interdependence in the pricing of default risk, which suggests that a crisis can easily propagate from countries with weak fiscal fundamentals to fiscally sounder member States. However, the channel of yield interdependence differs between high yielders and low yielders and over the two sub-periods. The former countries are linked through global spreads; i. e. they are exposed to the yield spreads of other troubled countries to a degree which increases with fiscal proximity.[7] Low yielders with sounder fiscal fundamentals are partially immune to the high spreads of fiscally weak countries but are still exposed to the risk of a devaluation or break-up of the euro, as priced in Quanto CDS. This "euro risk" factor is the main driver of the yield spreads of low yielders until August 2012, which suggests that a broader crisis of the euro area is the channel through which a debt default in a country with weak fundamentals can propagate to safer member States.

This evidence suggests that the introduction of Eurobonds would have been in the interest not only of countries with debt-financing difficulties but also of countries with stronger fundamentals in that a debt default of, say, Italy or Spain would rapidly spread across the whole Monetary Union. However, for Eurobonds to be justified as an instrument for crisis prevention, two conditions must be satisfied. The first one concerns the nature of the debt crisis; only in the case of a self-fulfilling liquidity crisis not due to fundamentals, Eurobonds

7 High yielders are also affected by the "euro-risk" over the entire sample period.

would be economically justified and mostly effective at stabilizing investors' expectations, thus avoiding a debt run. Although fiscal fundamentals do not affect yield spreads directly, we have shown that they determine the exposure to other countries' yield spreads, that is, to the global risk that the market perceives. The issue to which we turn in the next section is whether the impact of the global spread variable is constant or dominated by changes in market sentiment. The second condition for Eurobonds is the absence of a "lender of last resort" who might solve a liquidity crisis. With the announcement of OMTs, the ECB seems to have taken such role upon itself, mainly as a response to the increase in the risk of a euro break-up. The strong reaction of the market, leading to a dramatic fall in Quanto CDSs and yield spreads, is itself evidence of the non-fundamental nature of the crisis. On the other hand, the ESM–ECB plan for crisis prevention has most likely eliminated the need for Eurobonds even if the ECB cannot act as a genuine lender of last resort because a necessary condition for OMTs is that a country receives financial assistance from the ESM and has thus committed to an adjustment program with policy conditions attached.[8] We turn to this issue in the last section.

4.3 Contagion in the EMU

Eurobonds are justified as instruments for crisis prevention if market sentiment dominates the pricing of default risk. In fact, evidence of significant changes in market sentiment would provide a good indicator of the likelihood of a debt run, i. e. of a liquidity crisis driven by self-fulfilling expectations. Thus, the relevant issue is whether the market's assessment of sovereign risk in relation to fiscal fundamentals and global risk is constant, and thus reliable, or subject to shifts in sentiment; in other words, whether the impact of the global spread variable is stable or changing over time. To address this issue we look at the structural stability of the coefficient on the global spread variable. This is crucial to assess the presence of contagion. Indeed, time variation in the impact of the global spread variable on domestic yield spreads would imply that shifts in market sentiment dominate the fundamentals-driven interdependence across countries.

8 Moreover, the ECB cannot purchase government bonds in the primary market, i. e. at issuance, as Art. 123(1) TFEU prohibits the ECB from providing any type of credit facility to governments or other public authorities, and from purchasing debt instruments from them directly (see footnote 1 for further details).

To measure the effect of contagion we study the case of Italy, estimating a multivariate GARCH model of two equations for the yield spread and the associated global spread. The estimated reduced form specification of our Global VAR is

$$\begin{bmatrix} \left(Y_t^{IT} - Y_t^{G}\right) \\ GS_t^{IT} \end{bmatrix} = B_0 + B_1 \begin{bmatrix} \left(Y_{t-1}^{IT} - Y_{t-1}^{G}\right) \\ GS_{t-1}^{IT} \end{bmatrix} + B_2 \begin{bmatrix} FF_{t-1}^{IT} \\ GFF_{t-1} \end{bmatrix} + B_3 ER_{t-1} + H_t^{1/2} \begin{bmatrix} \varepsilon_t^{IT} \\ \varepsilon_t^{GS} \end{bmatrix} \quad [2]$$

$$vech(H_t) = M + Avech\left(\varepsilon_{t-1}\varepsilon_{t-1}^{'}\right) + Bvech(H_{t-1})$$

This specification models the joint process of the Italian yield spread and the global spread variable relevant to Italy, GS_t^{IT}, as a persistent process with a mean determined by the expected Italian fiscal fundamentals FF_{t-1}^{IT}. The latter are the same debt and deficit ratios relative to Germany used in system specification (1), while GFF_{t-1} is the weighted average of the fiscal fundamentals relative to Germany of other countries with weights determined by fiscal proximity to Italy as in the global spread variable.

The identification of the structural parameters is achieved by a triangularization of the variance-covariance matrix of the residuals, H_t, based on the assumption that the Italian yield spread is contemporaneously caused by the global spread but not vice-versa. The model in equation (2) allows for a time-varying conditional variance-covariance between the Italian yield spread and the corresponding global spread in that the H_t matrix is updated every period. In particular, the time-varying variance-covariance matrix of the residuals, H_t, is modelled as a diagonal BEKK (Engle and Kroner, 1995) system. This specification can, then, be used to generate a time-varying estimate of the impact of the global spread on the Italian yield spread.

The model provides us with a natural measure of contagion: the dynamic conditional beta in the terminology of Bali and Engle (2010), which is the coefficient γ_t determining the effect of a shock in the global spread on the Italian spread:

$$E\left(\varepsilon_t^{IT} | \varepsilon_t^{GS}\right) = \gamma_t \varepsilon_t^{GS} with \gamma_t = h_{12,t} h_{22,t}^{-1}$$

where the $h_{ij,t}$ *are the estimated elements of the* H_t matrix.

Variations in the coefficient γ_t are reported in Figure 4 along with the estimates of the global spread coefficient obtained by SUR estimation of the GVAR model in equation (1), and displayed as a continuous line for the two subsamples, November 2009–July 2012 and August 2012–November 2015.

The impact of the global spread on the Italian yield spread varies significantly over time, a clear sign of changes in market sentiment. During the

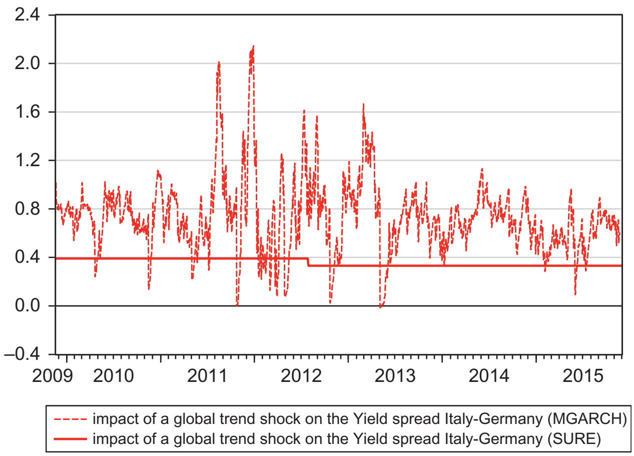

Figure 4: Interdependence and contagion between the yield spread Italy-Germany and the global spread.
Sources: Authors' calculation.

European sovereign debt crisis, the sensitivity of the Italian yield spread to its global spread became much higher than it would have been in the case of a constant market reaction to global risk, as implied by SUR estimation of the GVAR model.

Figure 5 provides an estimate of the effect of contagion as measured by the difference between the impact effect of the global spread as estimated in the multivariate GARCH model and that obtained from the constant parameter SUR

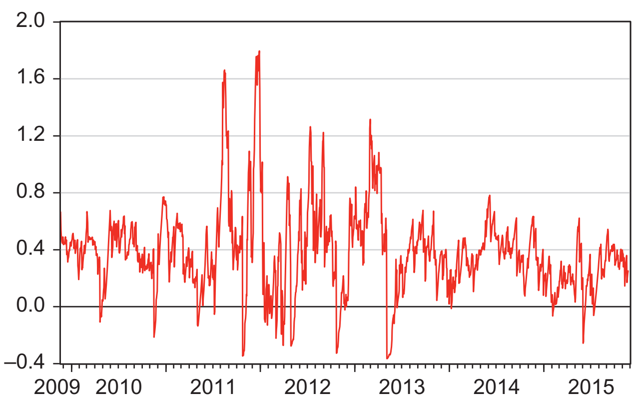

Figure 5: The impact effect of contagion on the yield spread Italy-Germany.
Sources: Authors' calculation.

estimation. Specifically, in Figure 5, we report the difference of the responses (of the yield spread) in the two models to a given increase in the global spread of 100 basis points.

In the second half of 2011, the effect of contagion became sizeable. Figure 5 shows that, because of market sentiment, the estimated impact effect on the Italian yield spread is almost 200 basis points higher. This evidence suggests that in late 2011, the Italian yield spread started to deviate significantly from its fundamentals-driven equilibrium and its fluctuations became increasingly dominated by shifts in market sentiment. Favero and Missale (2012) report similar evidence for Spain. Financial markets not only exert their disciplinary role discontinuously but their overreaction to global risk is itself an important source of instability. In late 2011 and early 2012, market sentiment played a major role in the pricing of default risk in Italy and Spain, a fact which called for “a lender of last resort” to halt the debt run and its spreading to safer member States.

4.4 The ECB announcement of OMTs

On 2 August 2012, the ECB announced the possibility of OMTs, that is, unlimited secondary market purchases of bonds of member States receiving financial assistance from the ESM under a program that includes ESM primary market purchases.

As shown by the GVAR estimation over the two subsamples and discussed in Section 4.2, the ECB announcement of OMTs led to a steady decline in Quanto CDSs and to a significant fall in the yield spreads of Italy and Spain. The strong influence that the ECB announcement had on market expectations is well evidenced by our estimate of the effect of contagion based on the difference between the impact effect of the global spread as estimated in the multivariate GARCH model and in the constant parameter SUR system. Figure 5 shows that the impact effect associated with shifts in market sentiment is significantly lower in the second subsample, pointing to a substantial effect on market expectations of the ECB’s willingness to act as a quasi-lender of last resort. We interpret this finding as further evidence of the non-fundamental nature of the Italian debt crisis in 2011–2012 and the role of self-fulling expectations in making a run equilibrium possible. Quite revealingly of the self-fulfilling nature of the Italian crisis, no bonds have yet been purchased under the OMT program.

The strong effect that the OMT announcement had on investors’ expectations and interest rates shows the importance of a lender of last resort in insuring the market against the risk of a liquidity crisis. However, to the extent that the ECB's ability to buy member States' bonds reduces the risk of a self-fulfilling debt run, it also deprives Eurobonds of a role in crisis prevention. The implications of the ESM–ECB scheme for Eurobonds are discussed in the next section.

5 The crisis-prevention role of Eurobonds with the ESM–ECB scheme

A lender of last resort, prepared to buy unlimited amounts of a member State's bonds if necessary, is the best way to halt a debt run and prevent a propagation of the crisis. If the central bank cannot act as a lender of last resort, the possibility to issue Eurobonds in case of a debt run would ensure market access to a country with financing difficulties and halt a debt crisis that would rapidly propagate to other countries. In particular, the yield on Eurobonds would be immune to the changes in market sentiment observed in our econometric analysis. Eurobonds jointly guaranteed by all member States would ensure the funding needed to roll over the maturing debt at a reasonable cost and give time, and financial breathing space, for fiscal adjustment. To avoid moral hazard, the right to issue Eurobonds could be granted only to member States satisfying ex-ante conditions regarding their debt sustainability. In order to prevent countries with high interest rates from issuing Eurobonds to reduce borrowing costs at the expense of relatively safer States, their use could be limited to crisis situations, say, when the yield spread observed in the secondary market exceeds a pre-specified threshold. Then, the mere right to issue Eurobonds, if credible, would be enough to avoid a debt run, i. e. a panic equilibrium where each investor refuses to roll over the debt for fear that anybody else would do the same. If the crisis were one of liquidity, no Eurobond would have to be issued.

The establishment of the ESM, and the design of the ESM–ECB scheme for financial assistance, have probably made Eurobonds unnecessary as an instrument for crisis prevention. In fact, a country facing a debt run can now rely on the ESM Primary Market Support Facility, i. e. the drawdown of an ESM precautionary credit line for bond purchases on the primary market (up to 50% of the issue amount), and on OMTs, i. e. the ECB's unlimited purchase of bonds with a maturity between 1 and 3 years on the secondary market. If credible, the joint intervention of the ESM in the primary market and the ECB commitment to buy bonds in the secondary market removes the risk of a self-fulfilling debt run.

The most compelling evidence of the insurance that the ECB can provide against a self-fulfilling debt run is the market reaction to the ECB Governing Council's announcement on 2 August 2012 that the ECB would undertake OMTs in the secondary bond market.[9] The announcement gave content to Mario Draghi's statement that he would do "whatever it takes" to defend the euro, and triggered a rapid decline in yield spreads of Italian and Spanish bonds that fell from about 500–300 basis points in less than three months. This dramatic reduction is well captured by the increased sensitivity of yield spreads to the "euro risk" factor and by the effect of improved market sentiment shown in Figure 5. This evidence supports the view of De Grauwe (2011, 2013) that the lack of a lender of last resort was what the market feared the most. Importantly, the announcement of OMTs has so far worked by stabilizing investors' expectations with no need for bond purchases by the ECB.

The strong effect that the OMT announcement had on investors' expectations and interest rates shows the reassurance provided by the Central Bank' ability to buy debt. However, if a lender of last resort is what the market wants to solve the coordination problem and avoid a debt run, it is worth noting that the OMT program does not make the ECB a genuine lender of last resort. For the ECB to intervene with bond purchases on the secondary market, a member States that needs financial assistance must first activate an ESM precautionary program, i. e. a credit line to be used for ESM bond purchases in the primary market under a Primary Market Support Facility. Precautionary assistance from the ESM is subject to the fulfillment of eligibility criteria, i. e. ex-ante conditionality, and the signing of a memorandum of understanding, i. e. ex-post conditionality. Eligibility criteria include a sustainable public debt, a sustainable external position and a sound financial system. Ex-post conditionality refers to specific policy actions, e. g. fiscal adjustment and reforms, to achieve the objectives indicated in the memorandum of understanding.

Introducing ex-post conditionality (in addition to eligibility criteria) was necessary to overcome political resistance against ECB intervention, but it has negative consequences. First, conditioning ECB intervention on fiscal and policy adjustment appears unnecessary when a country already satisfies the eligibility

9 The technical framework of these operations was formulated on 6 September 2012.

requirements of sustainable public debt and a sound financial system. If the ex-ante condition is met, and the crisis is one of liquidity, the requirement of fiscal adjustment can send the wrong signal and impair the ability of the ECB to act as a lender of last resort when this is economically justified. Secondly, and more importantly, because of the stigma implied by the imposition of fiscal measures, a country can be reluctant to ask for assistance even in the midst of a liquidity crisis when timely intervention by the Central Bank is crucial (see, e. g. Vanden Bosh 2012).[10]

Clearly, if the ESM-ECB framework were ever tested and proved to be too restrictive to provide rapid and effective liquidity assistance either because of political delays in the request for assistance or in the design of the adjustment program, then the case for Eurobonds to maintain market access in crisis situations would strongly re-emerge. However, at present, this appears a remote possibility.

6 The role of Eurobonds – concluding remarks

Despite its rigidity, the ESM–ECB scheme for precautionary financial assistance has so far been successful in stabilizing investors' expectations and halting the run on the Italian and Spanish debt. In any case, constraints preventing the ECB from acting rapidly in crisis situations should not be an argument for introducing Eurobonds, but rather an incentive for a reform that makes ESM financial assistance available on the fulfillment of ex-ante conditionality, as in the case of IMF assistance under the Flexible Credit Line.

More importantly, the introduction of Eurobonds as a crisis instrument faces strong political opposition because it raises moral hazard issues, and Eurobonds have economic costs that safer member States are not willing to pay. Giving a member State the option to issue a bond jointly guaranteed by all other States, even if not exercised, is an implicit contingent liability for States with stronger fiscal fundamentals. While such costs are certain and immediate, the gains from increased liquidity will eventually arise only in a distant future, as they require that a market for Eurobonds as large and deep as that of US Treasuries develops. It is then not surprising that Eurobond proposals have faced the strong opposition of safer member States like

10 Other features of the ESM–ECB scheme, such as the limitation of OMTs to bonds in the maturity segment between 1 and 3 years, appear unduly restrictive and may limit the scope of ECB intervention.

Finland, Germany and the Netherlands. As the benefits for the latter countries would arise mainly because of a stronger Monetary Union, Eurobonds will never be used for crisis prevention without the aim for greater fiscal unity. The solidarity, cooperation and political foresight that would be needed for jointly guaranteed EU debt are simply not present in the EU at the moment.

If the opposition to the use of Eurobonds for deficit financing and debt rollover is understandable, the hope for jointly guaranteed EU debt can stay alive if Eurobonds are linked to specific projects or expenditures that provide benefits to all member States. A small scale program for financing investments or expenditures that have positive externalities and spillover effects could gain political consensus and have some chance of success.

The idea is to issue Eurobonds in order to finance projects and/or expenditures that provide benefits to all member States also because of spillover effects and/or externalities. This is clearly the case for EU infrastructure projects, but a similar argument can be made for any public investment that increases output across the EU through spillover effects. More recently, it has been argued that extraordinary expenditures to deal with the refugee crisis and/or to enhance security should be financed with Eurobonds. As these problems are common to all member States and the expenditures incurred by each member State have clear positive externalities to other States, Eurobonds seem the appropriate instruments to share the borrowing cost and credit risk associated with their financing.

Furthermore, issuance of Eurobonds backed by several and joint guarantees would represent an important first experiment to test investors' demand and borrowing costs. A common Eurobond program would enhance the credibility of EU institutions by signaling a political will for greater fiscal unity and cooperation, thus paving the way for a deeper reform of EU fiscal governance.

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Appendix

Table 1: Yield spreads on bunds, seemingly unrelated regression – subsample evidence, daily data. High Yielders: Spain, Greece, Ireland, Italy, Portugal.

	ESP			GRE			IRL			ITA			POR		
Sample	2009:11	2009:11	2012:08	2009:11	2009:11	2009:11	2009:11	2009:11	2012:08	2009:11	2009:11	2012:08	2009:11	2009:11	2012:08
	2015:11	2012:07	2015:11	2015:11	2012:07	2015:11	2015:11	2012:07	2015:11	2015:11	2012:07	2015:11	2015:11	2012:07	2015:11
Constant	3.1E05	−3E05	4.E04	0.0005	0.0002	4.E05	**0.0004**	**0.002**	**−6.E04**	2.E4	0.0008	0.0012	2.E4	**0.003**	4.E05
	(1E04)	(0.0004)	(3.E04)	(0.0019)	(0.001)	(0.001)	**(0.0002)**	**(0.0008)**	**(2:E04)**	(2.E4)	(0.0007)	(0.0008)	(2.E4)	**(0.001)**	(0.001)
$Y^i_{t-1} - Y^G_{t-1}$	**0.980**	**0.970**	**0.960**	**0.994**	**0.971**	**0.977**	**0.998**	**0.993**	**0.965**	**0.988**	**0.984**	**0.922**	**0.998**	**0.993**	**0.977**
	(0.004)	**(0.007)**	**(0.008)**	**(0.003)**	**(0.016)**	**(0.007)**	**(0.002)**	**(0.005)**	**(0.007)**	**(0.004)**	**(0.007)**	**(0.010)**	**(0.003)**	**(0.006)**	**(0.007)**
$b^i_t - b^G_t$	−2.E06	0.0023	−1E04	−4.E04	−0.003	−0.005	**−7.E04**	0.0005	**0.001**	−4.E04	−0.002	−0.002	−4.E04	0.003	−7.E04
	(0.0002)	(0.0013)	(1:E03)	(0.001)	(0.0023)	(0.0053)	**(2.E04)**	(0.0008)	**(0.0005)**	(4.E04)	(0.002)	(0.0013)	(2.E04)	(0.0025)	(0.0001)
$d^i_t - d^G_t$	0.0004	−0.006	**0.008**	0.002	−0.024	−0.017	0.002	**0.019**	0.006	−0.002	0.006	−0.007	0.006	**0.009**	−0.011
	(0.002)	(0.007)	**(0.003)**	(0.009)	(0.016)	(0.021)	(0.002)	**(0.009)**	(0.004)	(0.003)	(0.008)	(0.005)	(0.007)	**(0.003)**	(0.007)
ER_t	**1.207**	**0.856**	**1.86**	**5.527**	**5.997**	−1.314	**0.762**	**0.507**	**1.500**	**0.711**	**0.261**	**2.215**	**0.614**	−0.01	**2.450**
	(0.136)	**(0.195)**	**(0.200)**	**(0.914)**	**(1.12)**	(1.59)	**(0.198)**	**(0.318)**	**(0.180)**	**(0.147)**	**(0.210)**	**(0.22)**	**(0.293)**	(0.447)	**(0.36)**
ER_{t-1}	**−1.114**	**−0.831**	**−1.71**	**−5.492**	**−5.017**	0.136	**−0.756**	**−0.592**	**−1.221**	**−0.701**	**−0.322**	**−1.838**	**−0.742**	−0.327	**−2.284**
	(0.135)	**(0.192)**	**(0.19)**	**(0.910)**	**(1.12)**	(1.58)	**(0.198)**	**(0.318)**	**(0.18)**	**(0.146)**	**(0.208)**	**(0.22)**	**(0.293)**	(0.447)	**(0.36)**
GS^i_t	**0.844**	**0.714**	**1.428**	**0.938**	**0.599**	**3.737**	**0.109**	**0.114**	**0.103**	**0.358**	**0.391**	**0.331**	**0.925**	**0.982**	**0.763**
	(0.030)	**(0.042)**	**(0.044)**	**(0.094)**	**(0.103)**	**(0.237)**	**(0.012)**	**(0.019)**	**(0.012)**	**(0.021)**	**(0.033)**	**(0.024)**	**(0.005)**	**(0.079)**	**(0.055)**
GS^i_{t-1}	**−0.839**	**−0.685**	**−1.387**	**−0.922**	**−0.577**	**−3.632**	**−0.110**	**−0.112**	**−0.100**	**−0.350**	**−0.366**	**−0.325**	**−0.890**	**−0.912**	**−0.757**
	(0.030)	**(0.043)**	**(0.045)**	**(0.095)**	**(0.103)**	**(0.239)**	**(0.012)**	**(0.019)**	**(0.012)**	**(0.021)**	**(0.034)**	**(0.024)**	**(0.005)**	**(0.079)**	**(0.056)**
Adj R-squared	0.99	0.99	0.99	0.95	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Mean Dep. Variable	0.022	0.025	0.022	0.096	0.108	0.086	0.030	0.048	0.0158	0.022	0.023	0.021	0.046	0.059	0.035
SE of Regression	0.0008	0.0009	0.0005	0.004	0.004	0.003	0.001	0.0015	0.0004	0.0008	0.001	0.0006	0.002	0.002	0.0001

(*continued*)

Table 1: (*continued*)

			BEL			FIN			FRA			NL			OE
Sample	2009:11 2015:11	2009:11 2012:07	2012:08 2015:11	2009:11 2015:11	2009:11 2012:07	2012:08 2015:11	2009:11 2015:11	2009:11 2012:07	2012:08 2015:11	2009:11 2015:11	2009:11 2012:07	2012:08 2015:11	2009:11 2015:11	2009:11 2012:07	2012:08 2015:11
Constant	**1.8E04**	**6.6E04**	1.3E05	**5.4E05**	**−2.E04**	4.2E05	2.E06	−1.E04	1.E04	3.E05	−2.E05	6.E05	2.E05	−7.E05	**2.E04**
	(7.5E05)	**(1.9E04)**	(8.8E04)	**(2.2E05)**	**(1.E04)**	(2.8E05)	(5.E05)	(1.E04)	(1.E04)	(2.E05)	(4.E05)	(4.E05)	(2.E05)	(4.E05)	**(8.E05)**
$Y_{t-1}^i - Y_{t-1}^G$	**0.980**	**0.970**	**0.970**	**0.953**	**0.936**	**0.952**	**0.980**	**0.975**	**0.969**	**0.960**	**0.940**	**0.966**	**0.984**	**0.981**	**0.942**
	(0.004)	**(0.007)**	**(0.006)**	**(0.004)**	**(0.011)**	**(0.009)**	**(0.004)**	**(0.007)**	**(0.006)**	**(0.006)**	**(0.01)**	**(0.007)**	**(0.004)**	**(0.007)**	**(0.008)**
$b_t^i - b_t^G$	−5.E04	**−0.003**	0.0003	−2.E05	**−0.001**	−2.E04	8.E05	−8.E04	−4.E05	−2.E04	**−9.E04**	−5.E05	−2.E05	**−0.002**	1.E06
	(0.001)	**(0.0008)**	(0.0002)	(1.E04)	**(0.0004)**	(0.0003)	(0.0002)	(0.064)	(0.0003)	(0.0001)	**(0.0003)**	(0.0003)	(0.004)	**(0.0008)**	(0.0003)
$d_t^i - d_t^G$	−5.E05	−0.002	0.004	−4E04	2.E04	−2.E04	8.E05	−6.E03	0.001	−9.E04	−2.E03	0.001	1.E04	**−0.009**	**0.008**
	(0.001)	(0.004)	(0.003)	(0.0006)	(2.E03)	(7.E04)	(0.02)	(0.004)	(0.001)	(0.0008)	(0.002)	(0.001)	(0.006)	**(0.003)**	**(0.004)**
ER_t	**0.266**	**0.281**	0.142	**0.089**	**0.115**	**−0.207**	**0.232**	**0.238**	0.026	**0.109**	**0.119**	−0.047	**0.183**	**0.217**	**0.200**
	(0.008)	**(0.13)**	(0.084)	**(0.033)**	**(0.04)**	**(0.062)**	**(0.005)**	**(0.08)**	(0.073)	**(0.003)**	**(0.04)**	(0.068)	**(0.005)**	**(0.08)**	**(0.02)**
ER_{t-1}	**−0.286**	**−0.323**	−0.037	**−0.094**	**−0.132**	**0.171**	**−0.213**	**−0.216**	−0.006	**−0.094**	**−0.112**	0.062	**−0.185**	**−0.227**	**−0.204**
	(0.08)	**(0.12)**	(0.084)	**(0.033)**	**(0.04)**	**(0.062)**	**(0.005)**	**(0.08)**	(0.072)	**(0.003)**	**(0.04)**	(0.066)	**(0.005)**	**(0.08)**	**(0.02)**
GS_t^i	**0.228**	**0.211**	**0.285**	**0.095**	**0.078**	**0.347**	**0.111**	**0.097**	**0.248**	**0.100**	**0.088**	**0.187**	**0.211**	**0.200**	**0.281**
	(0.013)	**(0.02)**	**(0.016)**	**(0.008)**	**(0.01)**	**(0.023)**	**(0.008)**	**(0.01)**	**(0.014)**	**(0.008)**	**(0.01)**	**(0.016)**	**(0.012)**	**(0.017)**	**(0.02)**
GS_{t-1}^i	**−0.220**	**−0.199**	**−0.293**	**−0.087**	**−0.064**	**−0.324**	**−0.109**	**−0.096**	**−0.245**	**−0.099**	**−0.086**	**−0.188**	**−0.206**	**−0.204**	**−0.271**
	(0.013)	**(0.02)**	**(0.016)**	**(0.009)**	**(0.01)**	**(0.024)**	**(0.008)**	**(0.01)**	**(0.014)**	**(0.008)**	**(0.01)**	**(0.016)**	**(0.012)**	**(0.017)**	**(0.02)**
Adj R-squared	0.99	0.99	0.99	0.98	0.97	0.95	0.98	0.99	0.98	0.97	0.97	0.97	0.99	0.99	0.97
Mean Dep. Variable	0.0087	0.012	0.006	0.0025	0.0032	0.0019	0.0054	0.0062	0.0047	0.0027	0.0031	0.0025	0.0043	0.0060	0.0030
SE of Regression	0.0004	0.0006	0.0002	0.00025	0.0002	0.0005	0.0003	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0004	0.0002

Note: Coefficients significant at the 5 percent level using the standard t-distribution are reported in bold.

$$(Y_t^i - Y_t^G) = \beta_0 + \beta_1 (Y_{t-1}^i - Y_{t-1}^G) + \beta_2 (b_t^i - b_t^G) + \beta_3 (d_t^i - d_t^G) + \beta_4 ER_t + \beta_5 ER_{t-1} + \beta_6 GS_t^i + \beta_7 GS_{t-1}^i + u_t^i$$

References

Attinasi, M.G., C. Checherita, and C. Nickel. 2010. "What Explains the Surge in Euro Area Sovereign Spreads During the Financial Crisis 2007–2009?," 10 *Public Finance and Management* 595–645.

Bali, T.G., and R.F. Engle. 2010. "Resurrecting the Conditional CAPM with Dynamic Conditional Correlations," SSRN Working Paper, http://papers.ssrn.com/sol3/papers.cfm?abstract_id = 1298633.

Bernoth, K., J. von Hagen, and L. Schuknecht. 2012. "Sovereign Risk Premiums in the Euro Government Bond Market," 31 *Journal of International Money and Finance* 975–995.

Calvori, F., M. Dentella, and G.P. Gallo. 2016. "Sovereign Debt Spreads in the Euro Area: When Fears Become Excess Fears," Working Paper No 3/2016, DISIA Università di Firenze. http://local.disia.unifi.it/wp_disia/2016/wp_disia_2016_03.pdf.

Dees, S., F. Di Mauro, M.H. Pesaran, and L.V. Smith. 2007. "Exploring the International Linkages of the Euro Area: A Global VAR Analysis," 22 *Journal of Applied Econometrics* 1–38.

De Grauwe, P. 2011. "Managing a Fragile Eurozone," 12 *CESifo Forum* 40–45.

De Grauwe, P. 2013. "The European Central Bank as Lender of Last Resort in the Government Bond Markets," 59 *CESifo Economic Studies* 520–535.

De Santis, R.A. 2015. "A Measure of Redenomination Risk," Working Paper Series No. 1785, European Central Bank. https://www.ecb.europa.eu/pub/pdf/scpwps/ecbwp1785.en.pdf.

Di Cesare, A., G. Grande, M. Manna, and M. Taboga. 2012. "Recent Estimates of Sovereign Risk Premia for Euro-Area Countries," Occasional Papers No. 128, Bank of Italy. https://www.bancaditalia.it/pubblicazioni/qef/2012-0128/QEF_128.pdf.

ECB. 2012. "Technical Features of Outright Monetary Transactions," Press Release, September 6, http://www.ecb.europa.eu/press/pr/date/2012/html/pr120906_1.en.html.

Engle, R.F., and K.F. Kroner. 1995. "Multivariate Simultaneous Generalized ARCH," 11 *Econometric Theory* 122–150.

Favero, C.A. 2013. "Modelling and Forecasting Government Bond Spreads in the Euro Area: A GVAR Model," 177 *Journal of Econometrics* 343–356.

Favero, C.A., and A. Missale. 2010. "EU Public Debt Management and Eurobonds," in European Parliament's Committee on Economic and Monetary Affairs, ed. *Euro Area Governance – Ideas for Crisis Management Reforms*. Brussels: European Parliament.

Favero, C.A., and A. Missale. 2012. "Sovereign Spreads in the Euro Area. Which Prospects for a Eurobond?," 27 *Economic Policy* 231–273.

Giovannini Group Report. 2000. "Co-ordinated Public Debt Issuance in the Euro Area." November. http://ec.europa.eu/economy_finance/publications/publication6372_en.pdf.

Monti, M. 2010. "A New Strategy for the Single Market. At the Service of Europe's Economy and Society," Report to the President of the European Commission. http://ec.europa.eu/bepa/pdf/monti_report_final_10_05_2010_en.pdf.

Pesaran, M.H., T. Schuermann, and S.M. Weiner. 2004. "Modelling Regional Interdependencies Using a Global Error-Correcting Macro-Econometric Model," 22(2) *Journal of Business and Economic Statistics* 129–162.

Vanden Bosch, X. 2012. "Preventing the Rise of Sovereign Borrowing Costs in the Eurozone: What Can the ESM and the ECB Achieve?" Egmont Paper No. 56, Royal Institute for International Relations. http://aei.pitt.edu/39375.