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No. 567

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The European Sovereign Debt Crisis:
What Have We Learned?

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The European Sovereign Debt Crisis: What Have We Learned?

Abstract

This paper sets the background for the Special Issue of the Journal of Empirical Finance on the European Sovereign Debt Crisis. It identifies the channel through which risks in the financial industry leaked into the public sector. It discusses the role of the bank rescues in igniting the sovereign debt crisis and reviews approaches to detect early warning signals to anticipate the buildup of crises. It concludes with a discussion of potential implications of sovereign distress for financial markets.

1 Introduction

The interconnectedness between markets is acutely revealed during times of crisis when the transmission of shocks from one market to another is amplified by often extreme market reactions. The clustering of crises since 2007 has presented a unique field to uncover such interconnectedness. The subprime mortgage market in the U.S. ignited the 2008 banking crisis, which turned into a global recession. A series of financial sector bailouts in 2008 sparked a full-blown sovereign debt crisis in Europe. Sovereign credit risk, which was virtually non-existent in developed economies prior to 2007, became a major concern.

What was the channel through which risks in the financial industry leaked into the public sector? Were the bank rescues responsible for igniting the sovereign debt crisis? Can we detect early warning signals to anticipate the buildup of crises? And, in turn, what are the implications of sovereign distress for financial markets? These are the questions that we will address.

The literature on the sources of systemic risk can be broadly divided into two camps. On the one hand, researchers attribute the roots of systemic risk to common macroeconomic shocks to fundamentals (see Gorton 1988; Calomiris and Gorton 1991; Calomiris and Mason 2003; Reinhart and Rogoff 2009, 2011). Another strand of literature focuses on the role of the global financial system in contributing to the rise of systemic risk (see Diamond and Dybvig 1983; Allen and Gale 2000; Kodres and Pritsker 2002; Brunnermeier and Pedersen 2009; Ang and Longstaff 2013). In the context of these studies, systemic risk arises through liquidity shocks, capital flows, funding availability and global risk premia.

In the framework of Duffie and Singleton (2003), systemic credit risk arises because of a shared vulnerability to an adverse shock. Taken in the context of the European sovereign debt crisis, the trigger event may be related to the large-scale rescues of the banking system (see Acharya et al. 2014). Systemic risk constitutes approximately one-third of the total credit risk of Eurozone countries (Ang and Longstaff 2013). It is strongly related to financial sector variables, such as stock market returns or corporate credit risk. The roots of this high interconnectedness with financial markets to some extent lie in the fact that large amounts of Eurozone sovereign debt are concentrated in large banks (Blundell-Wignall 2012), so that interactions within the banking system have direct

repercussions on sovereign credit risk. In addition, the implicit guarantee that the sovereign may provide to the local banking system constitutes a major transmission mechanism through which credit risk propagates from the private to the public sector (see Acharya et al. 2014; Kallestrup et al. 2016, in this issue). In addition, an important source of systemic risk is the funding needs of major investors in the sovereign debt market (see Longstaff et al. 2011). The increase in bank fragility and the role of the banking sector through a contagion channel² has also been shown to be central in the transmission of shocks (see Ballester et al. 2016, in this issue).

While systemic sovereign credit risk is strongly related to financial market variables and may arise largely through the global financial system, it can in turn feed back into the financial sector through the diminished value of government guarantees and the bank holdings of sovereign debt (Acharya et al. 2014). Furthermore, sovereign debt crisis events such as credit rating changes, ECB actions and announcements related to troubled Eurozone countries have a substantial effect on the common currency and materially increase the crash risk of the euro (Ehrmann et al. 2014; Kräussl et al. 2016, in this issue). The credit spreads of vulnerable Eurozone countries are also shown to be a major determinant of euro crash risk (Bekkour et al. 2015).

The European sovereign debt crisis has had major repercussions on the integration of financial markets. Market fragmentation has been deepened both in the equity and in the corporate bond market in Europe, jeopardizing the euro project itself (see Chou et al. 2014; Pieterse-Bloem et al. 2016, in this issue). The roots of financial market fragmentation can be traced back to the intra-euro area capital flight of investors during the European sovereign debt crisis, shifting their holdings of debt securities from stressed to non-stressed euro countries (Beck et al. 2016, in this issue).

Turning to the pressing issue of identifying early warning signals for the build-up of a crisis, Nucera et al. (2016, in this issue) provide a methodology based on systemic risk rankings of firms in the financial sector. An increased discrepancy between price-based and fundamentals-based risk rankings can be used as a warning signal that imbalances are developing in the market.

²Contagion can be defined as the propensity of bank-specific risks to propagate to other banks and spill over to the rest of the economy, see Allen and Gale (2000).

2 Commonality in Sovereign Credit Spreads during the European Sovereign Debt Crisis

2.1 Stylized Facts of Sovereign Credit Default Swap (CDS) Spreads

To gain insight into what drives sovereign credit risk, in this section, we review stylized facts about the dynamics of sovereign credit spreads and their commonality. We use weekly data for 5-year sovereign credit default swaps (CDS) of 11 Eurozone countries obtained from the Bloomberg system. The sample spans between March 7, 2003, and February 19, 2016.

Prior to the financial crisis of 2007-08, credit risk in the Eurozone countries was virtually nonexistent. The low levels of sovereign CDS spreads and their low volatility in the period up to 2007 illustrate that fact (see Table 1). Since the onset of the financial crisis, the price of credit protection in the euro area has increased substantially and systemic risks have grown more prominent. During the period of the sovereign debt crisis and especially during its most acute phase in 2010-2012, sovereign credit spreads peaked sharply and have remained volatile and at elevated levels.

Public indebtedness has also increased during the sovereign debt crisis. The average debt-to-GDP ratio across the Eurozone countries rose from 72% in 2006 to 119.5% in 2014. Evidence in Acharya et al. (2014) also suggests the emergence of a relationship between public debt and sovereign credit risk following the bank bailouts in the fall of 2008.

In Table 2, we summarize the dependence features of sovereign credit spread changes. There is substantial heterogeneity in the pairwise correlations of CDS spread changes. Over the whole period, the highest correlation is between Italy and Spain (88%), while the lowest is between Greece and the Netherlands (-8%). The average pairwise correlation over all countries is 52%, considerably lower than the average equity market correlation. This evidence is in contrast to the relative magnitude of equity and credit spread correlations outside of the Eurozone reported in Longstaff et al. (2011). It suggests that global factors might have a lower impact on sovereign credit risk than on the equity market in the euro area. In addition, the dependence of credit spread changes is not symmetric on the upside and on the downside – spreads co-move more strongly when there are large increases in

spreads than when spreads fall.

Similar to Longstaff et al. (2011), we perform principal component analysis of the correlation matrix of the weekly CDS spread changes and equity index returns of the 11 sovereigns. The results indicate that there is strong commonality in CDS spreads, comparable to that on the equity market (see Table 1, Panel B). The first principal component (PC) explains 61% of the variation over the whole sample period, while the first three PCs jointly explain more than 80% of the variation. Figure 1 plots the loadings on the first three PCs across the 11 countries. The first PC exhibits an essentially uniform weighting for all countries but Greece and could be interpreted as a factor capturing parallel shifts in credit spreads. The second PC could be viewed as a spread between Greece, Ireland, Italy, Portugal and Spain on the one hand and the rest of the Eurozone countries on the other, supported by the relatively high positive weights on the GIIPS countries compared to the rest. The third PC places a heavy weight on Greece whose credit spread soared unprecedentedly during the peak of the Eurozone sovereign debt crisis.

The strong factor structure in sovereign credit spreads mirrors that on the equity market, where the first three PCs explain approximately 87% of the variation in equity index returns. In addition, the equity market plays a substantial role in driving the co-movement in credit spreads: the correlation of the first PC with the German stock market return is -50%.

To appreciate the dynamics of the co-movement of sovereign credit spreads, in Figure 2, we plot the evolution over time of the contribution of the first PC against the total variation explained by the first three PCs. Before the fall of 2008, the first PC contributes to less than 50% of the variation in credit spreads. At the wake of the European sovereign debt crisis, however, there is a sharp increase in commonality in the sovereign credit market, as the proportion of credit spread variability explained by a single factor reaches above 90%.

Wang and Moore (2012) argue that the sovereign CDS markets have become much more integrated after the Lehman shock. For the Eurozone countries, it seems that the commonality in the sovereign CDS market has soared after the large-scale bank bail-outs following October 2008.

We also report the evolution of correlations of CDS spread changes, computed on a rolling 52-week basis (see Figure 3). While correlations are rather low on average in the years before the global financial crisis (the cross-

sectional average of rolling correlations is approximately 20% throughout that period), in 2008, correlations jump to over 60%. During that period, however, there is a substantial heterogeneity in pairwise correlations, which is also confirmed by the relatively low contribution of a single factor in explaining the spread variability. The fall of 2008 brings a distinct jump in correlation levels to above 80% with very little cross-sectional variability, consistent with the PCA results reported earlier.

To gain further insights into the degree and the dynamics of the cross-sectional variability in the co-movement of sovereign credit spreads, we calculate a measure of cross-sectional dispersion of CDS spread correlations (see Mueller et al. 2016, for a similar treatment of foreign exchange correlations). We sort correlation pairs in quintiles based on conditional correlation levels each week. To construct the cross-sectional dispersion measure, we subtract the average conditional correlation in the bottom quintile from the one in the top quintile. We plot the evolution of CDS spread correlation dispersion on Figure 4, where we also superimpose the equivalent measure for the country equity index returns. There is substantial time variation in correlation dispersion in the sovereign CDS market. In the run-up to the European sovereign debt crisis, dispersion steadily increases, reaching levels above 1 towards the end of 2008. Equity markets, on the other hand, seem to move much more in tandem throughout the period. And while disparity grows among sovereigns in the credit market, country equity index returns become increasingly dependent during the global financial crisis, reflecting the well-documented fact of increasing stock market co-movement in bad times. The sovereign debt crisis brings both markets closer together: both country equity indices and sovereign CDS spreads co-move tightly throughout the period between 2009 and 2012.

2.2 Determinants of Sovereign CDS Spreads

What are the factors that drive sovereign credit risk? The academic literature is broadly divided between country-specific fundamentals and global risk factors. Pan and Singleton (2008) show that the U.S. stock market volatility as measured by the VIX index is tightly related to the credit spreads of Korea, Turkey and Mexico. Longstaff et al. (2011) investigate a broad cross-section of sovereign CDS spreads and find that global financial variables, global risk premia, and global investment flows drive sovereign credit risk. This evidence agrees with the idea that global investors play a predominant role in the sovereign credit market. The tight link between sov-

ereign CDS spreads and global macroeconomic factors can be largely attributed to the default component of the spreads. Ang and Longstaff (2013) study the systemic risk component in sovereign credit spreads by drawing a parallel between the CDSs issued by U.S. states and those issued within the Eurozone. They find that the systemic component, much larger among Eurozone sovereigns, is largely influenced by global financial variables rather than macroeconomic fundamentals.

Remolona et al. (2008) study emerging market sovereign CDS spreads and decompose them into a market-based measure of expected loss and a risk premium. They find that global risk aversion is a major determinant of the sovereign risk premium, while country-specific fundamentals matter more for sovereign risk. Caceres et al. (2010) argue that the relative importance of global risk aversion and country-specific risks is changing over time. Earlier in the financial crisis, it was primarily shifts in global risk aversion that lied behind the dynamics of sovereign spreads, while later country-specific fundamentals become predominant. Whether local or global factors prevail depends on the state of the economy. Augustin (2012) argues that global factors prevail in good times and that local ones matter more in bad times (when the term structure is downward sloping; see also Arghyrou and Kontonikas (2012)).

The European sovereign debt crisis has refocused attention on the importance of domestic factors through the role of the local banking system in transferring credit risk from the private to the public sector (see Dieckmann and Plank 2012; Ejsing and Lemke 2011; Acharya et al. 2014).

3 Transmission Mechanisms of Sovereign Credit Risk

3.1 The Role of the Local Banking System

The bank bailouts at the onset of the European sovereign debt crisis intensified the link between sovereign credit risk and the health of the financial sector. There is a growing consensus in the current literature that these government bailouts played a crucial role in the transmission of risks from the financial sector to the sovereign and were thus instrumental in raising sovereign credit risk.

A growing body of literature considers the implicit guarantees that governments give to the domestic financial system to represent a transmission mechanism for private-to-public risk transfer. In the fall of 2008, several Euro-

pean countries extended guarantees and announced rescue packages to the local banking sectors. Consequently, for a short period, financial sector CDS spreads declined at the expense of increased sovereign CDS spreads. This divergence in credit spreads has been widely considered as evidence for a credit risk transfer from the banking sector to the sovereign. However, later, both bank and sovereign CDS spreads picked up again and started to co-move substantially (see Ejsing and Lemke (2011), who document an increased sensitivity of sovereign debt to a common global risk factor in the post-bailout period). Alter and Schüler (2012) report similar findings. Specifically, they document that during the period before the government interventions in the local financial system, default risk spills from the banking sector into the sovereign CDS market. In the period after the bank bailouts, their findings indicate that sovereign CDS spreads lead in the price discovery mechanism of banks' CDS.

Dieckmann and Plank (2012) also explore the economic channel for the transfer of credit risk “through which investors incorporate their expectations about bailouts in the financial sector”. They base their analysis on the co-movement between sovereign CDS spreads and the stock market performance of the financial sector. They find that the states of both the country-level and the world financial system have a significant explanatory power for the sovereign CDS spreads of that country. The magnitude of the public-to-private risk transfer depends on the relative importance of the country's financial system pre-crisis. Their findings also bring forward the role of a supra-national monetary authority in magnifying the impact of the credit risk transfer: member countries of the Economic and Monetary Union exhibit higher sensitivities to shocks in the local and global financial system.

Gennaioli et al. (2014) provide a theoretical model that rationalizes the transmission channel of credit risk from the sovereign to the domestic banking system and the real economy through the banks' holdings of sovereign debt. Using a large cross-section of developed and emerging countries, they document substantial reductions in the financial activity in countries following government defaults. Further empirical evidence in that direction is presented by Acharya and Steffen (2015), who argue that the roots of the European sovereign debt crisis can in part be found in banks engaging in a carry-trade behavior through their long exposures in peripheral sovereign bonds funded in short-term wholesale markets. Evidence in support of the asset holdings channel is also found in De Bruyckere et al. (2013). They also document evidence on the role of collateral that banks hold in the form of sovereign debt and the explicit and implicit government guarantees as alternative transmission channels through

which credit risk propagates to the financial sector.

Acharya et al. (2014) develop a two-way feedback model between the financial sector and sovereign credit risk. Costly government bailouts can have a detrimental effect on the creditworthiness of the sovereign. This gives rise to an increase in government's credit risk, which in turn brings down the value of the government guarantees that benefit the financial sector. In addition, through collateral damage on banks' government bond holdings that decrease in value, the risk of default of the financial sector increases. Thus, increased sovereign credit risk feeds back into the financial sector and weakens it further. As a consequence, government and financial sector credit risks co-move substantially, once the government has committed to a bank bailout, even though a bailout seeks to reduce financial sector's risk of default as an immediate effect.

Consistent with their model, Acharya et al. (2014) document a substantial rise in bank CDS spreads in the run up to the European sovereign debt crisis, while at the same time sovereign CDS remain low across all countries. After the first bank bailouts announced in the fall of 2008, financial sector CDS are substantially lowered, while sovereign CDS rise sharply, which is suggestive of the transfer of credit risk from the financial sector to the sovereign. Significant co-movement between bank and sovereign spreads, however, becomes prevalent in the long run.

3.2 Financial Sector Linkages

Kallestrup et al. (2016, in this issue) revisit the public and bank sector linkages debate and offer an alternative mechanism via which credit risk spreads from the financial industry to the public sector. They consider the cross-border public and private exposures of the local banking system and construct a measure that reflects the size and riskiness of the foreign exposures of the major banks in each country. Foreign exposures of banks are non-trivial in size relative to other exposures. For example, the foreign exposure of the Austrian banking system is about half of the total exposure. Thus, it is not surprising to find that bank CDS spreads are affected by these cross-border exposures. What is remarkable, however, is the extent to which the CDS market reflects changes in these exposures. The co-movement between the CDS spread for banks and the country's banks' foreign exposure-weighted CDS spread reveals the extent to which credit risk originates in the domestic or the foreign economy. There is substantial heterogeneity among countries with respect to the extent to which credit risk is channeled in

the country's financial sector via its cross-border exposures.

Kallestrup et al. (2016, in this issue) provide strong evidence that bank risk as measured by CDS premia is substantially affected by banks' foreign exposures. The risk of the banking sector in turn feeds into the sovereign credit risk through the implicit or explicit government guarantees of the local banking system. Remarkably, the authors find that global factors such as the excess return of the U.S. equity market and changes in the yield spreads on investment grade and high yield bonds do not appear to play a role in sovereign credit risk, while the measures for the size of the implicit and explicit guarantees are highly significant. These results provide strong evidence that the risk in the banks spills over to the public sector.

It is worth noting that focusing on bank foreign risk exposures provides an exogenous source of bank credit risk variation, which is not a result of the direct feedback loop from the sovereign back to the domestic bank, as documented by Acharya et al. (2014). Thus, it is possible to appreciate the extent to which credit risk from the local banking system translates into sovereign credit risk.

3.3 The Efficiency of Bank Bailouts

The global financial crisis required a massive government intervention in the banking system. In the U.S., the measures under the initial Troubled Asset Relief Program (TARP) required 700 billion dollars in credit assistance. The Capital Purchase Program (CPP) under TARP disbursed more than 200 billion dollars to 707 U.S. banks between the last quarter of 2008 and the last quarter of 2009. In Europe, there was a vast wave of government bailouts of the local banking system in the fall of 2008. Just one of the Irish banks, Anglo Irish, cost the government 11% of Ireland's Gross Domestic Product (GDP). The total amount of government aid used by financial institutions in the EU over the 2008-2013 period rose to 1.5 trillion euro (see the European Commission State Aid Scoreboard).

The large scale of government interventions has sparked an intense public debate on the need for bank bailouts and their repercussions. Government interventions can attenuate the severity of the recession and prevent a complete meltdown of the financial system. However, ex-ante, anticipated bailouts can lead to excessive risk-taking. They also have the potential to distort price competition. Furthermore, as discussed above, they have opened up the channel for the transmission of risks from the banking system to the public sector.

Croci et al. (2016, in this issue) contribute to that debate by investigating the decisions made by the Treasury during the credit crisis in selecting banks to be supported by the Capital Purchase Program (CPP). Were CPP funds allocated to ex post viable banks? Was CPP funding crucial for the survival of the bailed out banks? It appears that only a few of the banks that were bailed out were eventually resolved by the FDIC. This evidence, together with the fact that the bailout programs officially terminated with a profit³ highlights the success of the Treasury in properly selecting viable banks for its CPP funding. However, a question concerns whether that selection was not overly conservative.

The authors demonstrate that there are no systematic differences at the onset of the crisis between CPP funded banks and those that were resolved by the FDIC. Moreover, CPP funding appears to be instrumental in the survival of funded banks: banks that were not bailed out were almost six times more likely to fail within 5 years than otherwise identical CPP banks. The authors find no evidence to support the decision of the Treasury to limit the provision of CPP funds in order to minimize competitive distortions, or macroeconomic and informational rents associated with the funding. Moreover, the authors show that the costs of failure were higher compared to what the bailout costs would have been for the failed banks. Strikingly, they find that even under the worst-case scenario of non-recoverable government funding, it would have been optimal to bail out at least more than half of the failed banks. Thus, while the authors do not provide arguments on the optimality of bailouts per se, they raise the relevant question of bailout efficiency.

3.4 Contagion in the Banking System

A growing body of literature studies the sovereign contagion among Eurozone countries (see Caceres et al. 2010; Beirne and Fratzscher 2013; Alter and Beyer 2014; Caporin et al. 2013). Cross-border linkages across the financial sector play a crucial role in transmitting risks within the banking sector across countries and from the financial market towards the sovereign. Defining contagion as a situation where events in one bank, country or portfolio spillover to another bank, country or portfolio through banks' cross-border linkages, Ballester et al. (2016, in this issue) provide a novel framework for the evaluation of contagion during periods of prolonged financial distress. This framework distinguishes between systematic contagion (which reflects the spillover effects

³The CPP funds allocated to 707 U.S. banks amounted to \$204.9 billion, and the Treasury recovered \$225.9 billion by July 31, 2014.

due to changes in global factors that affect all banks) and idiosyncratic contagion (which is related to the spillover effects that arise due to changes in bank fundamentals). The authors document a systematic component of contagion that dominates the idiosyncratic one, which suggests the primary role of common factors as triggers for the spillover of risks in the banking sector.

The authors further investigate the dynamic properties of the two components of contagion. During crisis periods, CDS spreads are driven by the common global component related to the state of the market and thus cannot be fully explained by the credit risk of the bank. The onset of the sub-prime crisis brought forward a high degree of interconnectedness across the bank CDS market with the prevailing role of systematic contagion. A different pattern emerged with the European sovereign debt crisis: although the systematic component still played an important role, idiosyncratic contagion became more pronounced. In addition, during that period, banks in the euro-peripheral countries were net idiosyncratic transmitters, while banks in the euro-core countries were net systematic transmitters of contagion.

Interestingly, the authors find that increases in co-movement of CDS returns precede evidence of contagion in banking markets. This increase in commonality can be used as an early warning signal for the regulator.

4 Early Warning Signals

4.1 Systemic Risk

There has been a considerable effort in the recent literature to develop risk rankings of financial institutions in order to gauge their systemic importance (see Acharya et al. 2012; Acharya and Steffen 2015; Adrian and Brunnermeier 2011; Brownlees and Engle 2015; Benoit et al. 2015, among others). However, currently, only a few are used for regulatory purposes, mainly due to the non-negligible volatility of many of the rankings. In addition, considering them in isolation often provides conflicting evidence on the contribution to systemic risk of a given institution. Thus, aggregating information across rankings has recently been proposed as a promising alternative.

Giglio et al. (2016) assess the ability of a large selection of systemic risk measures to forecast macroeconomic downturns. They develop a systemic risk index and demonstrate that it provides predictive signals for the lower

tail of macroeconomic outcomes.

Nucera et al. (2016, in this issue) exploit the information contained in alternative systemic risk rankings for financial institutions. They provide a principal components-based methodology to combine systemic risk rankings and extract the common information content from their cross section. The rationale behind the aggregation of information lies in the intuition that a risk averse policymaker would consider complementary approaches only if they point in the same direction. On the other hand, if there is a considerable disagreement across risk measures, policymakers could interpret it as a warning signal that markets are dislocated from their fundamentals.

The authors apply their aggregation methodology to companies in the European Union financial sector. This results in a considerably less volatile risk ranking than the separate measures taken in isolation. Furthermore, there is little turnover among companies at the top of the ranking, which is important to consider for targeted banking supervision. The aggregate measure reveals a substantial discrepancy in the loadings of the price-based vs. the book value-based systemic risk rankings at the onset of the 2008 financial crisis. Similar albeit smaller deviations in loadings appear during the European sovereign debt crisis. The authors argue that such discrepancies between market prices and fundamentals can be used by policymakers as early warning signals that imbalances are building up.

4.2 Political Risk

Political risk plays an important role in the government debt market both for emerging economies and developed countries. A substantial proportion of the sovereign credit spread in emerging market government bonds is explained by political risk (see Bekaert et al. 2014). In the U.S., debt-ceiling debates and, most prominently, the 2013 U.S government shutdown have had a sizeable effect on Treasury yields (see Nippani and Smith 2014). Political risk has taken center stage amid the turmoil in government bond yields during the European sovereign debt crisis.

The economic content of political risk is investigated in Erb et al. (1996), who find that world bond markets respond to changes in political risk, but there is no evidence of its predictive power. Duyvesteyn et al. (2016, in this issue) revisit the question of predictability over a time period that includes the European sovereign debt crisis. Contrary to earlier findings, they document that changes in political risk matter for price discovery in the

government bond markets of the Eurozone and emerging market countries. Specifically, while bond markets react to changes in political risk ratings, they are not fully efficient in that they absorb the information contained in these country ratings only with a certain lag. Consequently, changes in political risk ratings contain information about future bond risk premiums: bond returns for countries whose political risk has improved are subsequently higher than those for countries whose political risk has deteriorated. In addition, the predictive power of political risk changes for bond returns improves substantially in bad times. Political risk ratings are also shown to predict credit ratings. Countries whose political risk ratings have improved witness a subsequent improvement in credit ratings and vice versa. The authors argue that changes in political risk ratings constitute a new bond factor whose effect is not subsumed by known risk factors.

5 Implications of the European Sovereign Debt Crisis

5.1 Market Fragmentation

Since the harmonization of fiscal and monetary policies in the early 1990s, Eurozone countries have traditionally been associated with the prevalence of industry over country effects in explaining equity market co-movement (see Rouwenhorst 1999; Flavin 2004; Brooks and Del Negro 2004; Ferreira and Ferreira 2006; Eiling et al. 2011). However, since the onset of the financial crisis and in the run-up to the European sovereign debt crisis, the European equity market has witnessed the rising importance of country effects, and hence, market integration has been set back (see Chou et al. 2014).

However, the corporate bond market paints a different picture of financial integration in Europe. Pieterse-Bloem et al. (2016, in this issue) investigate the relative importance of country vs. industry factors in order to gauge the extent of financial integration in the European corporate bond market. They document that unlike the stock market, in the corporate bond market, country factors unconditionally dominate industry factors in explaining the variance of corporate bond spreads. Moreover, the global financial crisis has led to a significant shift in the country and industry exposures of European corporate bond returns and has deepened financial fragmentation in the Eurozone.

There is substantial heterogeneity in the relative importance of country and industry factors across countries.

The authors document a different path in the return to market fragmentation in the core, periphery, and non-Euro countries. Most notably, two countries in particular, Germany and the Netherlands, appear to be most severely impacted by the crisis, with market fragmentation becoming most pronounced in those countries. The authors explain this fact with a flight-to-safety episode towards the core countries during the European sovereign debt crisis.

5.2 Cross-Border Portfolio Capital Flows

The evidence above suggests that the origins of the fragmentation in the euro area financial markets could be rooted in the substantial shifts in investment flows in debt securities out of stressed and into non-stressed Eurozone countries. Beck et al. (2016, in this issue) investigate the geographical patterns of capital flows to euro countries during the sovereign debt crisis. They document a disproportionate reduction in the holdings of stressed Eurozone countries' debt securities by foreign investors without a commensurate increase in their holdings of non-stressed countries' bonds. Thus, foreign investors shifted investment flows out of the Eurozone countries in the first years since the start of the European sovereign debt crisis. This shift is not driven by valuation effects, as the authors compare the actual portfolio changes to those implied by a standard gravity model of international portfolio choice.

On the other hand, the paper documents evidence of significant and economically important capital flight by stressed countries' investors into non-stressed countries debt markets. The authors argue that this intra-euro capital flight contributed significantly to the excessive volatility of debt flows within the euro area and acted as a major trigger towards fragmentation in the euro area financial markets.

The evidence suggests that the under-investment by foreign investors and the capital flight by stressed country investors was significantly reversed by the policy measures taken by the ECB in 2012 and specifically after the announcement of its Outright Monetary Transactions (OMT) program. Disproportionate portfolio shifts in Eurozone debt market securities essentially ceased in the post-OMT period, attenuating financial market fragmentation.

Contrary to the portfolio rebalancing that took place over the period of the European sovereign debt crisis and that was mostly a domestic phenomenon, the geographic patterns in portfolio shifts during the global financial

crisis paint a different picture. Galstyan and Lane (2013) study the portfolio adjustments that took place between the end of 2007 and the end of 2009 and find that investors from neighboring countries were less likely to disinvest from a given country than investors from more distant countries. In addition, there were smaller capital outflows in the case of common membership in the euro area. Similar geographic patterns were found by De Haas and Van Horen (2013) for bilateral bank lending during the period of the financial crisis: larger drops in lending were associated with greater geographical distance between borrowers and lenders.

Floreani and Habib (2015) study the exposures of global investors to the euro area around the sovereign debt crisis. Consistent with the home bias hypothesis – or the tendency to hold a disproportionate amount of home assets – they find that euro-area investors are overexposed to euro-area securities, while foreign investors are underexposed to euro-area assets. The bias is stronger for investors from low-rating or stressed euro economies. Importantly, foreign investors are found to be rather resilient in their holdings of euro area assets between 2010 and 2012, with the exception of debt securities issued by stressed countries. Together with the evidence brought forward by Beck et al. (2016, in this issue), these findings suggest that the euro crash risk due to a sudden under-investment of foreign investors may have been attenuated.

5.3 Stability of the Euro

During the European sovereign debt crisis, the exchange rate of the euro has shown a remarkable degree of volatility. However, trying to pin down the determinants of changes in the exchange rate or its volatility has proven to be an elusive task. Ehrmann et al. (2014) examine macroeconomic announcements, as well as actions and statements by policymakers about the sovereign debt crisis and conclude that exchange rate developments are much less affected by the public debate than previously feared. However, decisions and actions at the EU level and by the ECB have played a role in explaining the exchange rate and its volatility.

When assessing the stability of the euro, it is crucial to also consider higher moments of the euro FX return distribution. Currency crash risk is usually proxied by the realized skewness of the underlying FX return distribution (e.g., see Brunnermeier et al. 2008; Rafferty 2012) or obtained from the implied risk-neutral distribution of option prices (e.g., see Hui and Chung 2011; Bekkour et al. 2015).

During the European sovereign debt crisis, changes in the creditworthiness of member states are major drivers

of euro crash risk and hence have a significant impact on the stability of the euro. Bekkour et al. (2015) demonstrate that an increase in credit risk in euro area countries triggers a surge in the volatility and the tail risk of the USD/EUR exchange rate. The creditworthiness of member countries is shown to be a major determinant of the euro crash risk as measured by the skewness of the implied risk neutral distribution. A similar result is obtained by Hui and Chung (2011) who use deep out-of-the-money put option prices to measure euro crash risk.

Kräussl et al. (2016, in this issue) reveal a different channel for the emergence of the euro crash risk. The authors analyze the impact of specific announcements related to vulnerable member states, ECB actions and sovereign credit rating downgrades on the crash risk of the euro, proxied by the time varying skewness of the foreign exchange rate distribution. Their findings suggest that news announcements relative to stressed Eurozone countries affect the value of the euro and its crash risk. ECB actions generally result in a short-lived depreciation of the euro with a reversal effect that follows on the day after the announcement. Credit rating downgrades of stressed Eurozone member states lead to depreciation of the euro and to an increase in the euro crash risk.

6 Conclusion

The European sovereign debt crisis brought a number of lasting implications for the financial market in the euro area. First, it led to a major setback in the financial integration goal of the Eurozone. The intra-euro flight of private capital out of stressed countries left deeply fragmented equity and corporate bond markets. Second, the sovereign debt crisis had a deep impact on the value of the common currency, contributing significantly to the euro crash risk and challenging the stability of the monetary union.

The series of unconventional monetary policy actions of the ECB helped attenuate these effects. In particular, the asset repurchases undertaken within the Securities Markets Programme (SMP) in 2010-2011 had a substantial yield reduction impact, larger than the effect of U.S. Treasury repurchases within the Federal Reserve's large-scale asset repurchases programs (LSAPs). They also contributed to lowering bond yield volatility and the extreme tail behavior of yield changes with substantial long-run effects (see Eser and Schwaab 2016). Moreover, because the capital outflows from stressed countries were predominantly a domestic Eurozone phenomenon, the possibility to offset private with public investment flows via target balances contributed to alleviating the market tensions and limiting the potentially devastating effect on market integration. The absence of sharp underinvest-

ment of foreign capital in the euro area economies suggests that the extreme tail risks for the euro exchange rate may have been limited. The Outright Monetary Transactions (OMT) program of the ECB that replaced the SMP in September 2012 had a significant effect in reversing the intra-euro capital flight trend, thus attenuating financial market fragmentation in the Eurozone and the tail risk of a euro-area break-up (see Altavilla et al. 2014; De Santis 2015; Beck et al. 2016, in this issue). However, the long-term implications have yet to be uncovered.

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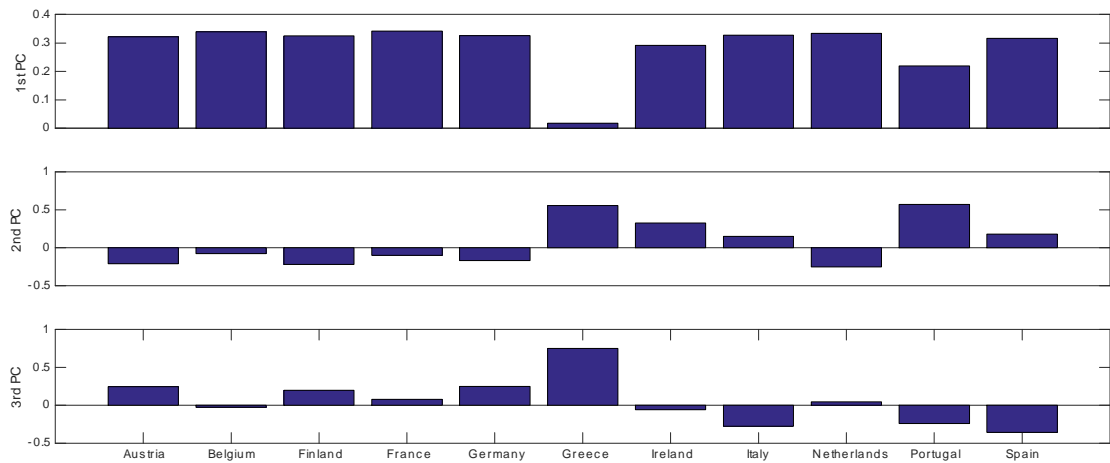


Figure 1
Principal Component Analysis

The figure plots loadings on the first three principal components of weekly changes in CDS spreads. The sample period spans between March 7, 2003, and February 19, 2016.

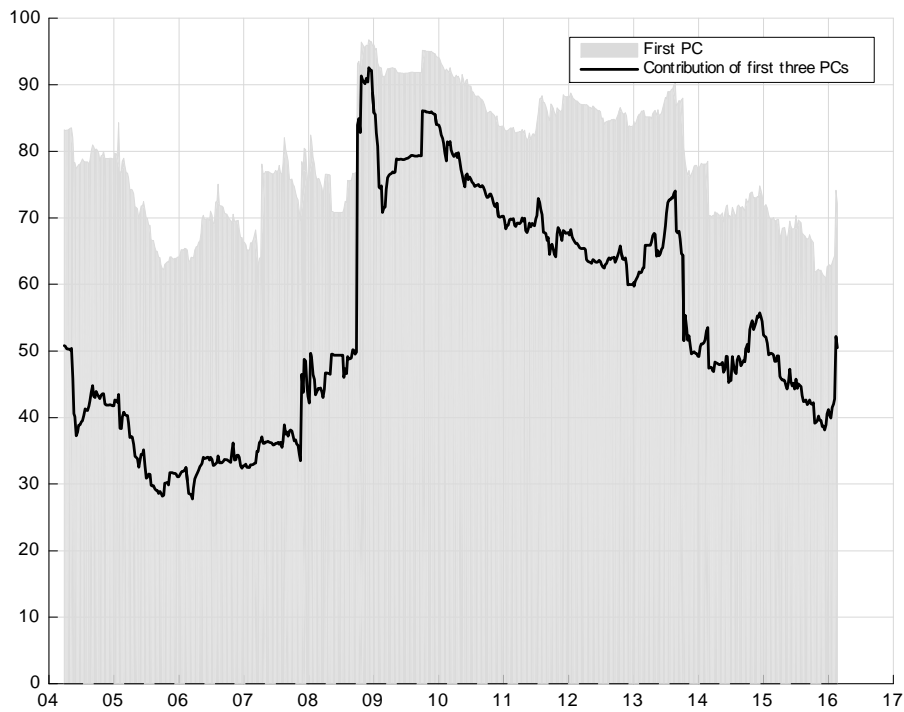


Figure 2

Principal Component Analysis: Explained Variation

The figure plots the evolution over time of the percentage of the variance of weekly changes in sovereign CDS spreads explained by the first three principal components, as well as the contribution of the first principal component. The sample period spans between March 7, 2003, and February 19, 2016.



Figure 3
Rolling Correlations of Sovereign CDS Spread Changes

The figure plots cross-sectional means of rolling estimates of pairwise correlations between CDS spread changes in the 11 sovereigns. Each week, rolling window estimates are obtained using the past 52 weeks. For each pair, weeks with missing observations per pair are discarded. The shaded area corresponds to the 25th and the 75th cross-sectional quintile or pairwise correlation estimates. The sample period spans between March 7, 2003, and February 19, 2016.

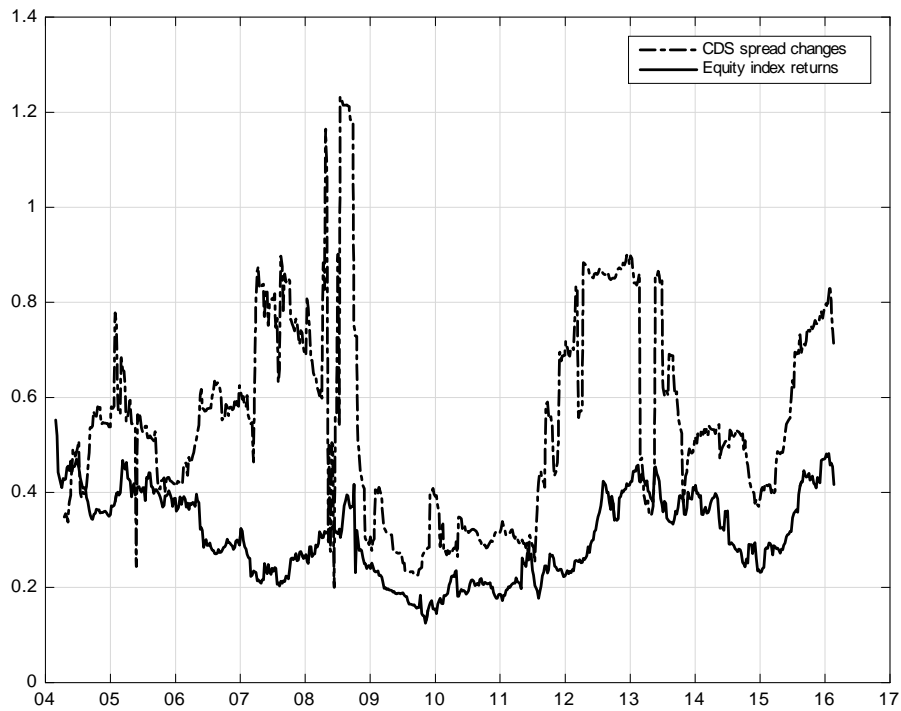


Figure 4

Correlation Dispersion

The figure plots the correlation dispersion obtained for cross-sectional rolling estimates of pairwise correlations between weekly CDS spread changes and equity index returns of the 11 sovereigns. Each week, rolling window estimates are obtained using the past 52 weeks. For each pair, weeks with missing observations per pair are discarded. The sample period spans between March 7, 2003, and February 19, 2016.

Table 1
Descriptive statistics

	Sovereign CDS spread				Debt-to-GDP (%)
	Average mean	Average Std. dev.	Min	Max	Average
Prior to 2007	5.2	1.3	1.5	18.8	72.3
2007-08	23.3	25.7	1.4	257.5	75.6
Post-2008	360.4	445.5	12.4	25,422.8	119.5

The table reports descriptive statistics of weekly sovereign 5-year CDS spreads and the average debt-to-GDP ratio for Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal and Spain for three sub-periods. The debt-to-GDP ratios are reported for the years 2006, 2008 and 2014. The sample period spans between March 7, 2003, and February 19, 2016.

Table 2
Co-movement

	CDS spread changes	Equity index returns
<i>Panel A. Dependence measures</i>		
Average Correlation	0.52	0.78
Average Quantile Dependence		
10th quantile	0.37	0.58
25th quantile	0.52	0.7
75th quantile	0.57	0.61
90th quantile	0.48	0.49
<i>Panel B. Principal Component Analysis: Percentage explained</i>		
First PC	60.9	76.3
Second PC	12	5.8
Third PC	8.5	4.6
Fourth PC	4.7	3.3
Fifth PC	3	2.8

The table reports descriptive statistics of the co-movement of weekly sovereign 5-year CDS changes and country equity index returns of the 11 sovereigns. Panel A reports average correlations and average quantile dependence coefficients for different quantile levels. Panel B reports summary statistics of the principal components analysis of the correlation matrix based on the 11 sovereigns. The sample period spans between March 7, 2003, and February 19, 2016.

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