Sovereign and corporate credit risk: Evidence from the Eurozone

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Abstract. We study the impact of sovereign risk on the credit risk of the non-financial corporate sector in the Eurozone using credit default swap data. We show that an increase in sovereign credit spreads is associated with a statistically and economically significant increase in corporate spreads and, hence, firms' borrowing costs. A deterioration in a country's credit quality affects more adversely firms that are more likely to benefit from government aid, those whose sales are more concentrated in the domestic market, and those that rely more heavily on bank financing. Our findings suggest that government guarantees, domestic demand, and credit markets are important credit risk transmission mechanisms.

Keywords: sovereign risk, corporate credit risk, credit default swaps, Eurozone.
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1. Introduction

The European debt crisis that followed the 2007–2009 financial crisis raised a number of concerns regarding the steadily growing level of sovereign risk and its consequences for the real economy. In recent years academics, as well as market participants and regulators, have devoted great efforts to identifying the determinants of sovereign risk.[1] In this paper we focus instead on how variations in sovereign creditworthiness have affected the credit risk of the non-financial corporate sector in the Eurozone. This issue bears important consequences on firms' access to financial markets and, in turn, on corporate borrowing costs.

The rationale behind the spillover from sovereign to corporate credit risk is the so-called "transfer risk": A government in financial distress is likely to shift the debt burden onto the corporate sector by increasing corporate taxation, imposing foreign exchange controls, and, under extreme circumstances, expropriating private investments. A rich empirical literature documents the presence of transfer risk in emerging economies, where concerns about sovereign creditworthiness have traditionally been more pressing.[2] However, a significant linkage between sovereign risk and corporate credit risk is not granted a priori for developed countries. This is especially true in the context of the Eurozone, where two channels through which sovereign risk is commonly transferred (i.e., currency controls and the expropriation of private investments) are ruled out.

Following the recent wave of sovereign downgrades in developed economies, the investigation of transfer risk has extended beyond emerging markets. Special attention has been devoted to the financial sector where the sovereign-corporate link is expected to be tight: Banks benefit

[1] Caceres, Guzzo, and Segoviano (2010), Longstaff et al. (2011), Dieckmann and Plank (2012) break down sovereign risk into systemic and country-specific components. Altman and Rijken (2011) develop a fundamental-based vulnerability indicator that predicts sovereign distress.

[2] Durbin and Ng (2005) and Peter and Grandes (2005) find that sovereign risk is a significant component of corporate bond yields; Arteta and Hale (2008) show that sovereign debt restructurings worsen the private sector access to capital markets; Dittmar and Yuan (2008) document that information flows from sovereign to corporate bonds.

from government bailouts and hold large amounts of government bonds in their portfolios.[3] The credit risk spillover to the non-financial sector in developed markets remains, instead, fairly unexplored, as most studies look at joint samples of advanced and emerging economies. Borensztein, Cowan and Valenzuela (2013) document that sovereign ratings significantly affect corporate ratings, especially in countries with capital restrictions and high political risk. Almeida et al. (2013) show that, following a sovereign downgrade, firms at the sovereign rating bound reduce investment and leverage more than other firms. Lee, Naranjo and Sirmans (2013) explore the role of country-level property rights institutions and disclosure requirements in explaining sovereign ceiling violations. Similarly, Bai and Wei (2012) and Augustin et al. (2014) find that strong country-level property rights institutions weaken the connection between sovereign and corporate credit risk.

Our goal is to quantify transfer risk in a sample of developed economies and identify what firm attributes render companies vulnerable or resilient to sovereign risk transmission. Our analysis hence differs from the previous literature under several aspects. First, we concentrate on the credit risk transmission to non-financial firms in Eurozone countries, and, hence, our inferences are not confounded by the inclusion of financial institutions and/or emerging markets. Second, we propose and test firm-specific credit risk transmission channels: We believe these to be more relevant than country-level channels given that the countries in our sample enjoy very similar characteristics in terms of property rights, creditor rights and disclosure requirements.

To assess the sovereign-to-corporate spillover, we exploit the European sovereign debt crisis. This led to a sizable increase in sovereign risk for many countries thereby questioning the plausibility of the common belief that government debt in developed economies is risk free. It is

[3] Adelino and Ferreira (2014) find that sovereign downgrades adversely affect bank lending by reducing loan amounts and increasing loan spreads. Using CDS data on European banks, Ejsing and Lemke (2011) and Acharya, Drechsler, and Schnabl (2014) document a significant credit risk transfer from the banking sector to the government during bailouts, and in the opposite direction in the post-bailout period.

precisely under these circumstances that we are interested in quantifying transfer risk and identifying the mechanisms through which it operates. We measure credit risk by using credit default swap (CDS) data on 118 non-financial companies headquartered in eight Eurozone countries (Belgium, Finland, France, Germany, Italy, the Netherlands, Portugal and Spain) between January 2008 and December 2011.

Our main findings on the sovereign-to-corporate spillover are as follows. First, we show that an increase in sovereign spreads leads to a significant increase in credit spreads (and, hence, borrowing costs) of non-financial firms. Our estimates indicate that a 10% increase in sovereign spreads translates into a 0.5%–0.8% increase in corporate spreads. Second, we take advantage of the cross-sectional variation in firm characteristics to shed light on the mechanisms through which transfer risk operates. We find evidence that the sovereign-to-corporate spillover is stronger for firms that are more likely to benefit from government aid, those whose sales are concentrated in the domestic market, and those that rely on bank financing. Our estimates indicate that a 10% increase in sovereign spreads leads to a 0.7%–1.2% increase in corporate spreads for those firms. In order to interpret our results in terms of causation instead of pure association, throughout the analysis we use a dynamic panel specification as well as an instrumental variable approach to limit endogeneity concerns.

Our findings are innovative and not trivial: Evidence of cross-sectional differences in the sovereign-to-corporate spillover may have been somehow unexpected in our sample of CDS reference entities. CDSs can only be traded on the debt of companies that issue rated, publicly traded bonds, which act as reference assets in the CDS contract. These companies are typically more internationally oriented, less financially constrained, and less dependent on bank lending than other firms.[4] As a result, we believe that our findings may, in fact, underestimate the

[4] Ashcraft and Santos (2009) find that the introduction of CDSs leads to an improvement in borrowing terms for safe and transparent firms. Oehmke and Zawadowski (2013) report that large firms with more

impact of an increase in sovereign risk on corporate borrowing costs for the average firm. Indeed, using survey data on access to finance of SMEs in the euro area, Holton, Lawless and McCann (2014) show that the sovereign crisis spilled over into the real economy through tighter credit conditions: SMEs witnessed an increase in loan rejections and interest rates.

The paper is organized as follows. Section 2 illustrates the steps we undertake to construct the data set. Section 3 provides preliminary evidence of the causal impact of sovereign credit quality on corporate CDS spreads. Section 4 investigates the common factors driving sovereign and corporate CDS spreads. Section 5 presents the empirical findings on the credit risk spillover from the sovereign to the corporate segment. Section 6 investigates the transmission mechanisms, while Section 7 provides additional results. Section 8 concludes the paper.

2. Sample construction and summary statistics

We use CDS spreads as a market measure of credit risk. A CDS contract essentially represents an insurance against the risk that an entity (sovereign or firm) defaults on its debt. The key advantage to using CDS spreads instead of bond spreads is that they provide a more accurate measure of the issuer's creditworthiness (Longstaff, Mithal, and Neis (2005), Pan and Singleton (2008), Longstaff et al. (2011)), given that bond spreads are driven by a multitude of other factors, among which liquidity premia play a prominent role. While illiquidity is unlikely to be of concern for sovereign bonds, which are actively traded on the secondary market, it is a significant component of non-financial corporate bond spreads. Both the sovereign and corporate segments of the CDS market enjoy, instead, comparable liquidity.

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debt outstanding (mainly in the form of bonds) are more likely to become reference entities in the CDS market.

We obtain CDS spreads on sovereign and non-financial entities from the MarkIt Group, a standard provider of CDS data, largely employed by academics and practitioners.[5] To ensure liquidity, we consider only the five-year maturity, which is the reference expiry in the corporate CDS segment. We select CDS quotes for senior unsecured debt with the modified-modified restructuring clause for firms and the cumulative restructuring clause for sovereigns, which represent the conventional (and, hence, most liquid) terms for CDS contracts on European reference entities. We consider euro-denominated CDS contracts, since the euro is the standard reference currency for most CDSs on European corporate reference entities. For consistency, we also use euro-denominated CDSs on sovereigns, even though the most liquid contracts in this segment are in U.S. dollars. This is unlikely to introduce a bias, given that the correlation between weekly changes in euro CDS spreads and weekly changes in U.S. dollar CDS spreads on the sovereign entities in the sample is equal to 94.4%. Our sample only covers members of the euro area that adopted the euro by 2001, given the scarcity of firms located in the new Member States (Cyprus, Estonia, Malta, Slovakia, and Slovenia) with CDSs traded on their debt. Focusing on (companies located in) the euro area makes it easier to control for common shocks that affect corporate and sovereign risk in our sample. We do not consider Luxembourg because its sovereign CDS is not available from MarkIt. Finally, we exclude the Eurozone subsidiaries of companies headquartered elsewhere. At this stage we have CDS data on 240 companies and 11 sovereigns.

Our data set includes daily CDS premia (in bps) between January 2008 and December 2011. To reduce the measurement error that may contaminate daily spreads we carry out our analyses at the weekly level, and derive weekly CDS spreads as simple averages of the daily spreads in

[5] MarkIt provides composite prices based on quotes contributed by more than 30 major market participants on a daily basis. The quotes are filtered to remove outliers and stale observations and a daily composite spread is computed only if two or more contributors report a valid quote.

the week. We limit the sample to firms that have publicly traded equity in order to compute a set of market-based control variables at the firm-level (as detailed in Section 5).

To avoid bias due to missing or stale data, we apply a number of filters in line with the existing literature (Berndt and Obreja (2010), Schneider, Sögner, and Veza (2010)). First, we exclude CDS series where 1) the percentage of missing spreads exceeds 15% of the overall period –that is, more than 31 missing weekly spreads– and 2) the length of the longest series of consecutive missing spreads is more than two weeks. Second, we exclude stale observations with zero changes in corporate or sovereign CDS premia. Finally, we require valid data on a minimum of four companies per country and thus remove countries with infrequent CDS transactions. Following such restrictions, Austria, Greece, and Ireland are excluded because they do not have a sufficient number of companies that meet our data quality thresholds. The final sample includes 118 companies headquartered in eight countries.

Table 1–Panel A reports the sample breakdown by country. France and Germany are the most represented countries, each one comprising about 25%-30% of the sample, in line with the composition of widely traded CDS indexes, such as the iTraxx Europe index for non-financial firms. According to the summary statistics of sovereign CDS spreads, countries can be split into two groups. The first is formed by countries characterized by a relatively low level of credit risk (Finland, France, Germany, and the Netherlands): Sovereign CDS spreads are, on average, about 50 bps or less and fairly stable. The countries in the second group (Belgium, Italy, Portugal, and Spain) are riskier, as confirmed by average sovereign CDS spreads close to 100 bps or higher and a much larger variation than that observed in countries of the first group. Corporate CDSs reflect medium credit quality, with median values (computed at country-level) of firm ratings ranging from BBB for Finland and Portugal to A- for Belgium, the Netherlands, and Spain. A number of reference entities (21 out of 118) are assigned a sub-investment grade rating at some point during the sample period. These firms are unevenly distributed across

countries, as they represent 10% of the corporate sample in Spain, 18% in Italy, 21% in France, 23% in Germany, and 38% in Finland.

Figure 1 depicts the evolution of sovereign (solid line) and corporate (dashed line) CDS spreads. The graphs suggest two important considerations. First, sovereign credit risk is sizable over the sample period in all countries. Sovereign CDS spreads are essentially nil for the first three quarters of 2008 and ramp up after September 2008 as a result of the financial crisis and the bank bailout measures adopted by most governments. After a tightening in the second half of 2009, sovereign spreads steadily increase again in countries facing fiscal strains following the Greek crisis. Sovereign CDS spreads also rise in fiscally virtuous economies during the second half of 2011. Second, sovereign and corporate credit risk tend to co-move. This evidence is also corroborated by Figure 2, where we plot the rolling correlation –computed over 52 weeks– between median changes in log weekly corporate CDS spreads and changes in log weekly sovereign CDSs, together with 90% confidence intervals. The plots document a fairly high correlation with average values ranging from 36% in Belgium to 64% in Italy over the sample period.

3. Sovereign-to-corporate spillover: Preliminary evidence from shocks to sovereign risk

In order to gain preliminary insights on the causal impact of sovereign risk on corporate credit quality, we investigate the response of corporate spreads to two shocks to sovereign creditworthiness: Sovereign rating changes and the ECB Securities Markets Programme (SMP).

First, we analyze the reaction of both sovereign and corporate CDS spreads to sovereign rating changes. We retrieve from Bloomberg issuers' rating announcements (upgrades and downgrades) from Standard & Poor's, Fitch and Moody's. When a sovereign experiences multiple rating changes within a 15-day period, we retain the earliest rating action only –which

typically is more informative. Within our sample period, four countries (Belgium, Italy, Portugal and Spain) account for 19 downgrades in total. We follow an event study methodology and compute log weekly CDS spreads as log averages of daily CDS spreads before (day -5 to day -1) and after (day +1 to day +5) the rating change (day 0) for the four sovereigns and the companies headquartered in those countries.[6] Our variable of interest is the abnormal CDS change, which we measure as the difference between log weekly changes in CDS spreads and log weekly changes in a benchmark index around the event. We use the iTraxx Europe index as the benchmark for corporate entities and, for each country *j*, the average sovereign CDS spread of all Eurozone countries *excluding* country *j*. Table 2-Columns (1-2) report the cross-sectional average of abnormal CDS changes: Following a sovereign downgrade, CDS spreads increase not only for sovereign entities, but also for the non-financial companies headquartered in the downgraded countries. This evidence suggests that the direction of causality is likely to go from the sovereign to the corporate sector. Should the spillover go in the opposite direction, we would expect to find that corporate rating changes affect sovereign credit spreads. Hence, we replicate the event study around corporate rating changes. We exclude corporate rating actions when a change in the sovereign rating takes place within a 15-day period. This leaves us with a sample of 188 downgrades and 70 upgrades for 87 unique firms. Table 3 reports the cross-sectional average of abnormal CDS changes, separately for upgrades and downgrades. We find that corporate rating changes significantly affect corporate credit spreads with the expected sign: Downgrades (upgrades) produce a widening (tightening) of corporate CDS spreads. Importantly, sovereign spreads are instead unaffected. We interpret these findings as evidence against credit risk transmission from the corporate to the sovereign segment.

[6] To avoid contamination, we exclude firms that experience a corporate rating change within a 15-day period from the sovereign downgrade. This filter removes one company, FIAT S.p.A, which was downgraded by Moody's on September 21, 2011 –two days after the downgrade of Italy.

We then focus on the ECB SMP as another example of a shock to sovereign credit quality. By means of the SMP, the ECB purchased government debt securities of selected countries (Greece, Ireland, Italy, Portugal, and Spain) to address tensions in financial markets. The largest purchases followed the introduction of the SMP on May 10, 2010 and its reactivation on August 8, 2011 (see Barclays Capital (2012)). Eser and Schwaab (2013) document a statistically significant and economically large reduction in yield spreads of the countries involved in the large scale asset purchase programme, thereby suggesting that the SMP was unanticipated. We replicate the event study for Italy, Portugal and Spain and the companies located in these countries around the two SMP announcement dates and report results in Table 2-Columns (3-4). We observe a decrease in sovereign risk, in line with the evidence provided by Eser and Schwaab (2013), and further find that corporate CDS spreads decrease as well.

We take these event studies as preliminary evidence of a credit risk transfer from the sovereign to the non-financial sector (but not viceversa). In what follows we quantify the sovereign-to-corporate spillover making use of our entire sample within a more general framework.

4. Commonalities in sovereign and corporate credit spreads

We explore whether changes in sovereign and corporate credit risk are driven by common factors to gain insights on the choice of control variables for our empirical model.

We first look at the correlation matrices of weekly changes in sovereign and corporate CDS spreads, respectively. In line with Longstaff et al. (2011), we find large co-movements in sovereign spreads, with an average pairwise correlation of about 63% over the sample period. Instead, the corresponding average pairwise correlation in weekly spread changes of the non-financial firms in the sample is only about 43%. These numbers suggest that sovereign CDS

spreads are more influenced by global factors than corporate CDS spreads, where other variables (country- and firm-specific) play a more prominent role.

To better understand the sources of commonality in sovereign and corporate spreads, we conduct a principal component analysis (PCA) of the changes in sovereign CDS spreads and compare the results with those for the PCA of the changes in corporate CDS spreads. The PCAs are performed on the correlation matrices of weekly spread changes. The results are presented in Table 4. The first principal component (PC) explains 69% of sample variation in sovereign spreads, whereas the first five components explain 95%. This is in line with findings from previous studies (Longstaff et al. (2011), Dieckmann and Plank (2012)) that indicate a large degree of commonality in the dynamics of sovereign CDS spreads in the euro area. When looking at the PCA on corporate spread changes, we observe instead a much lower degree of commonality. The first PC explains about 47% of sample variation, and the first five components explain a little more than 60%. The correlation between the time series of the first PC extracted from sovereign and corporate CDS changes is 52.21%, which suggest that the main source of variation across both sovereign and corporate spreads is related to global Eurozone factors.

Figure 3 plots the loadings of the first PC for sovereigns (left panel), as well as the histogram of the loadings of the first PC for corporate reference entities (right panel). The weighting of the common component is essentially the same (about 0.35) for all sovereigns except Portugal, which suffered repeated credit downgrades over the period under investigation. The factor loadings of the first component are instead much smaller and more heterogeneous for non-financial firms: The histogram shows a relevant dispersion around the median weighting of 0.10.

The PCA reveals that variables common to the euro area seem to have a strong and uniform impact on the dynamics of sovereign credit spreads, while their effect on corporate spread

changes is much more limited and mixed. Therefore other variables (country- and firm-specific) should be accounted for when attempting to explain such changes.

5. Relation between sovereign and corporate credit spreads

To formally investigate the effect of variations in sovereign risk on corporate credit risk we regress changes in log weekly corporate CDS spreads on changes in log weekly sovereign CDS spreads. Following Acharya, Drechsler and Schnabl (2014), we use log CDS spreads –instead of CDS spreads– to reduce the effect of outliers and enhance comparability across sovereigns, firms and time periods with dissimilar CDS levels. We use log changes in CDS spreads –instead of log CDS spreads– because we are interested in the impact of *variations* in sovereign credit risk on corporate credit risk.[7]

The commonalities in the dynamics of corporate and sovereign CDS spreads, documented in Figures 1 and 2 and by the PCA, suggest that global factors account for an important share of the variation in credit risk within the Eurozone. We include time (week) fixed effects to capture these market-wide changes in macroeconomic fundamentals that directly affect both corporate and sovereign credit risk. We opt for time fixed effects, in lieu of a set of indicators of macroeconomic fundamentals (e.g. Eurozone stock market index returns and volatility, treasury yield term structure), to better control for omitted variables. As discussed in Section 4, both country- and firm-specific factors are likely to play a significant role in explaining changes in corporate CDS spreads and, as such, should be added to our control variables. The inclusion of country-level factors contributes to further mitigate omitted variable concerns, since it enables

[7] Additionally, CDS spreads are non-stationary, over the period under investigation, for most firms in the sample. According to unreported Dickey-Fuller tests with time trend and intercept, the null hypothesis of unit root in log CDS levels is rejected only for 13 firms out of 118 at the 5% significance level, while log changes in CDS spreads are always stationary.

us to isolate the impact of changes in sovereign creditworthiness over and above those country-level shocks that affect both sovereign and corporate CDS spreads.

To keep the model parsimonious, we retain a limited number of country- and firm-level explanatory variables suggested by the existing literature on the determinants of corporate credit spreads (Collin-Dufresne, Goldstein, and Martin (2001), and Campbell and Taksler (2003)) and sovereign credit spreads (Longstaff et al. (2011), and Dieckmann and Plank (2012)). Table A1 in the Appendix details the construction of these variables and Table 1–Panel B shows descriptive statistics.

Local/country variables. The state of the local economy is an important determinant of sovereign and corporate credit quality alike: An improvement in a country's business climate is expected to positively affect firms' creditworthiness. We proxy the state of a country's economy with two variables: Local excess returns, i.e. the difference between log returns on the domestic Dow Jones Total Market index and log returns on the EuroStoxx 50 index, and local excess volatility, measured by weekly changes in the standard deviation of local excess returns.

Idiosyncratic/firm variables. Firm-specific equity returns and risk affect a firm's probability of default over and above what can be ascribed to more general movements in equity market returns and volatility. In particular, corporate CDS spreads should be negatively (positively) correlated with idiosyncratic equity returns (volatility). We use firm excess returns, relative to the domestic Dow Jones Total Market index, as a measure of idiosyncratic equity returns,[8] and proxy variations in idiosyncratic volatility with changes in the standard deviation of firm excess returns.

Given the choice of control variables, we estimate the following pooled OLS regression:

$$\Delta \log(CCDS_{ijt}) = \alpha_i + \beta \Delta \log(SCDS_{jt}) + \gamma \Delta X_{ijt} + \delta_t + \varepsilon_{ijt} \quad (1)$$

[8] Equity returns have also been used in studies of yield changes to proxy for changes in (market) leverage, given that variations in book leverage are only available at very low frequency.

where $\Delta \log(CCDS_{ijt})$ is the change in the log CDS spread (in bps) of firm i headquartered in country j from week t-1 to week t, $\Delta \log(SCDS_{jt})$ is the change in the log CDS spread (in bps) of country j from week t-1 to week t, ΔX_{ijt} are the changes from week t-1 to week t in the local and idiosyncratic variables, and α_i and δ_t are firm and time (week) fixed effects. Although specification (1) includes a number of aggregate and firm-specific factors, the regression residuals may still be correlated across firms, countries, and weeks. We then follow Petersen (2009) and Thompson (2011) and compute two-way clustered standard errors by country and time (week). We choose to cluster at the country, instead of firm, level to control for within-country residual correlation.

Column 1 of Table 5 presents regression results. The estimate for β indicates that a 10% increase in sovereign credit spreads is associated with a 0.5% increase in corporate credit spreads. The economic magnitude of this correlation may seem limited. However, we argue that the effect is still substantial, as it corresponds to about one third of the estimated impact of an increase in sovereign CDS spreads on the credit risk of financial institutions in the aftermath of the 2008 bailouts (see Table 8 in Acharya, Drechsler, and Schnabl (2014)), and banks are more directly and heavily exposed to sovereign risk than non-financial firms through their holdings of sovereign bonds.

Specification (1) may suffer from reverse causality when corporate credit risk feeds back into sovereign risk. We address endogeneity concerns in two ways.

First, we enrich model (1) by adding the lagged value of the dependent variable, $\Delta \log(CCDS_{ijt-1})$, to our regressors. Dynamic panel models are widely used in finance to control for endogeneity arising from the dynamic nature of the relation between dependent and independent variables (see, among others, Wintoki, Linck and Netter (2012)). In this respect, using a dynamic panel helps us control for the possibility that current changes in sovereign CDS

spreads may depend on past changes in corporate CDS spreads. It is well known that when the number of cross-sectional units in the dynamic panel is very large compared to its time dimension, the least-squares estimates are biased (Nickell (1981), Flannery and Watson-Hankins (2013)) and alternative techniques, such as GMM, are to be preferred. The dimension of our panel (118 firms by 208 weeks) makes this bias negligible and we estimate the dynamic model using the standard least-squares dependent variable (LSDV) approach. Regression results are reported in Table 5-Column 2. Past changes in corporate CDS spreads are indeed a significant determinant of current spread changes.[9] However, we document a significant spillover from sovereign to corporate credit risk and, in fact, the estimate for β is larger than the one obtained with pooled OLS.

Second, we estimate specification (1) by means of instrumental variables (IV). We instrument $\Delta \log(SCDS_{jt})$ with $\Delta \log(\overline{SCDS}_{-jt})$, i.e. log changes in the average sovereign CDS spreads of all Eurozone countries excluding country *j*.

We argue that our instrument is strong because variations in sovereign credit risk are highly correlated across Eurozone countries during the sample period. The first-stage F test for significance of the instrument equals 11.382: It is above the "rule of thumb" threshold of 10, which confirms that the instrument is not weak. For the instrument to be valid, we need variations in the credit quality of other Eurozone countries to be uncorrelated with changes in the credit risk of domestic firms after taking into account domestic sovereign risk and other control variables. This may not be the case for firms whose features render them particularly sensitive to other Eurozone countries' sovereign risk –for instance companies that predominantly export to these markets. To investigate time variation in such characteristics, we measure a firm's exposure to other Eurozone countries as one minus the fraction (out of total sales) of

[9] In unreported (but available upon request) analyses we test that one lag is sufficient to capture all information from the past.

domestic sales plus sales in non-EU countries. Figure 4 depicts the cross-sectional distribution of firm-average Eurozone sales together with the maximum and minimum of firm-level yearly values. The cross-sectional mean (median) value of the firm-level difference between the maximum and minimum firm's exposure to other Eurozone markets over the years is 8.3% (3.8%). This indicates that, at the firm level, sales to other Eurozone countries are fairly stable across time: Firm fixed effects therefore take care of cross-sectional differences in foreign exposures.

Column 3 of Table 5 reports the estimates from the second-stage IV regression, and shows that (instrumented) changes in sovereign credit risk positively and significantly affect changes in corporate CDS spreads. The coefficient on instrumented $\Delta \log(SCDS_{jt})$ is nearly twice as large as the one estimated with pooled OLS: This, together with the dynamic panel estimate for β, suggests that, if anything, correcting for endogeneity unveils an even stronger positive relation between sovereign and corporate credit risk.

6. Channels of transmission

We now focus on firm-specific mechanisms that affect the response of corporate credit spreads to variations in sovereign credit spreads. The empirical methodology we follow is common to all mechanisms and we detail it here. We consider three distinct channels: Government guarantees, sales concentration in the domestic market, and reliance on bank financing. For each channel we create an indicator variable (D_i) that takes a value of one if the firm benefits from government guarantees, places its output predominantly on the domestic market, or relies heavily on bank

debt. We then enrich specification (1) with the interaction terms between D_i and our main variable of interest, $\Delta \log(SCDS_{jt})$, as well as between D_i and the controls, ΔX_{ijt} and δ_t:[10]

$$\Delta \log(CCDS_{ijt}) = \alpha_i + \beta \Delta \log(SCDS_{jt}) + \lambda D_i \Delta \log(SCDS_{jt}) + \gamma \Delta X_{ijt} + \mu D_i \Delta X_{ijt} + \delta_t + \delta_t D_i + \varepsilon_{ijt} \quad (2)$$

In specification (2), λ encapsulates the extra-sensitivity to changes in sovereign credit quality for firms with government guarantees, sales concentration in the domestic market, or reliance on bank financing. In line with the analysis in Section 5, we estimate specification (2) with pooled OLS, dynamic panel, and IV. Again, the main goal of the dynamic panel and the IV is to ensure that our results can be interpreted in terms of causation rather than simple association.

When estimating model (2) with IV, we have two endogenous regressors, $\Delta \log(SCDS_{jt})$ and $D_i \Delta \log(SCDS_{jt})$, which we instrument with $\Delta \log(\overline{SCDS}_{-jt})$ and $D_i \Delta \log(\overline{SCDS}_{-jt})$, respectively. Instrument strength cannot be assessed using the first-stage F test because we have more than one endogenous regressor. We therefore provide two first-stage diagnostic tools: The Kleinbergen-Paap LM statistic for underidentification and the Kleinbergen-Paap Wald statistic for weak identification.[11] We anticipate that, for all channels, we can reject the null hypothesis of weak instruments at standard significance levels.

6.1. Government aid

Government-controlled firms enjoy both deep credit lines and debt guarantees from the state. Faccio, Masulis, and McConnell (2006) study 450 firms from 35 countries and document that

[10] The indicator variable, D_i, is a time-invariant firm characteristic, hence the main effect of D_i is already captured by the firm fixed effect, α_i.

[11] Given that our model is just-identified, we work with t-test size for weak identification. The usual approach in the applied literature is to conclude that instruments are not weak if the K-P Wald statistic is above the Stock and Yogo (2005) critical values. Based on these critical values we report the p-values for the t-test size at 10% and at 25% following the approach in Bazzi and Clemens (2013).

politically connected firms are more likely to be bailed out than similar unconnected firms. Borisova and Megginson (2011) find that, as a result of privatization, a 1% decrease in government ownership is associated with a 0.75 bps increase in a firm's credit spread. However, when concerns about the solvency of the government arise, government guarantees quickly lose value, thus eroding the creditworthiness of government-controlled companies. In addition, these firms are usually more likely to be the target of *ad hoc* measures should the government need to raise funds in the face of budget concerns. As a result, we expect firms under governmental influence to be relatively more affected by changes in sovereign credit risk.

An obvious candidate for the identification of government-controlled firms would be the proportion of equity owned by the government, either directly or indirectly. However, this measure does not provide a realistic representation of the influence exercised by the government on a firm: By examining a sample of firms that underwent privatization, Bortolotti and Faccio (2009) document that governments tend to retain substantial power in formerly state-owned enterprises in a number of ways.[12] Privatizations of state-owned firms often witness the sale of equity without a proportional transfer of control. Consequently, government ownership underestimates the actual involvement of governments in firms. We therefore resort to the FEEM–KPMG Privatization Barometer (PB)[13] database to identify firms that have been entirely or partially privatized by the state and which may still be *de facto* under the government's influence through one of the mechanisms discussed above. We create the indicator variable $Govt_i$, which, for firm i, equals one if the firm is listed in the PB in any year between 1977 and

[12] For instance, a government can adopt ownership-leveraging devices (pyramiding and dual-class shares) and remain the largest ultimate shareholder of a firm even without owning a majority of its equity. Alternatively, governments can hold golden shares, which enable them to outvote all other shareholders and significantly affect corporate decisions. Over the past decade, the European Court of Justice has in several instances declared the holding of golden shares by France, Germany, the Netherlands, Italy, Portugal and Spain illegal.

[13] The PB is a monthly updated database containing privatization transactions for 25 European countries from 1977 to the present. The database provides information on the percentage of direct retained government ownership and the dates of privatization transactions and was used by, among others, Borisova and Megginson (2011).

2011, and zero otherwise.[14] We then use national stock exchanges' and regulatory bodies' websites (see the data appendix in Bortolotti and Faccio (2009) for a list of data sources) to augment the indicator $Govt_i$ for those cases where a firm is state controlled but has never been privatized (and, hence, is not included in the PB database). One firm out of three is under governmental influence (Table 1-Panel C).

To empirically assess the relevance of the government guarantees channel, we use $Govt_i$ as the indicator variable D_i in specification (2). Regression results are reported in Table 6. Consistently with our conjecture, we observe a significantly stronger sovereign-to-corporate credit risk transfer for firms under government influence with all the different estimation methods: Following an increase in sovereign risk, government-controlled firms experience an increase in CDS spreads which is two to three times higher than other firms.

As an alternative proxy for the likelihood to receive government aid, we consider a firm's strategic relevance to a country. Strategic firms typically contribute to a large fraction of a country's economic output and employ a significant share of a country's workforce: As such, they are more likely to benefit from government aid in case of financial distress.[15] If sovereign risk increases, the value of such an "option" to access state aid for these strategic companies decreases and their creditworthiness might, in turn, be negatively affected.

To test whether strategic firms are more exposed to sovereign risk than other firms, we measure the relevance of a firm with the ratio between the firm's market capitalization and the total market capitalization of the country ($MktCap_{it}$), both recorded on the closing date of the

[14] Although in principle the value of $Govt_i$ could change over time for a given firm, none of our firms were privatized between 2008 and 2011. Therefore $Govt_i$ is effectively a firm (rather than firm-year) indicator.
[15] The European Community Treaty generally prohibits state aid unless it is justified by reasons of general economic development. Recent examples of government aid include various measures adopted to support the automotive industry in the Eurozone.

annual report.[16] The market capitalization of firms (in million of euros) and the closing dates of the annual reports are obtained from the Bureau Van Dijk's Orbis database and the market capitalization of individual countries (in millions of euros) is from Bloomberg. Orbis variables are available at annual frequency and we match CDS quotes in a given year t with $MktCap_{it-1}$, i.e. relative market capitalization at year-end t-1. We compute, for each firm, $MktCap_i$ as the average value of $MktCap_{it}$ over the sample period. The cross-sectional distribution of $MktCap_i$ is depicted in Figure 5. Relative market capitalization is, on average, about 3% (Table 1-Panel C) with values ranging from 0.1% (Dyckerhoff) to 30% (Nokia). We then sort firms into those with "Low strategic relevance" ($HMktCap_i = 0$) and "High strategic relevance" ($HMktCap_i = 1$) depending on whether $MktCap_i$ is below or above the sample median.[17] We use $HMktCap_i$ as the indicator variable in specification (2) and estimate it with pooled OLS, dynamic panel and IV. The findings, reported in Table 7, confirm that the credit risk of strategic firms is significantly more affected by changes in sovereign credit quality. To sum up, the joint evidence from Tables 6 and 7 documents that the sovereign-to-corporate spillover is indeed more relevant for companies that may enjoy government aid.

6.2. Domestic demand

Following an increase in sovereign risk, governments may decide to adopt restrictive monetary or fiscal measures aimed at restoring creditworthiness, which can lead to a significant

[16] Alternative measures of strategic importance may be based on firm assets or the number of employees. However, such measures could overestimate a firm's contribution to the domestic economy when it operates internationally. Given that the proportions of domestic assets and of the workforce employed domestically are rarely available from the consolidated financial statements, we opt for market capitalization as a proxy for a firm's strategic relevance.

[17] We are interested in studying the role of several firm attributes (government aid, sales concentration in the domestic market, and reliance on bank debt) in mitigating or worsening the impact of sovereign risk on corporate credit risk. Inferences may be confounded if variation in these firm attributes is endogenous to unobserved variation in corporate CDS changes. Our results are essentially unchanged if we use firm characteristics measured at the beginning of our sample period, i.e. December 2007.

contraction in domestic demand. This, in turn, can increase default risk for those firms whose business relies heavily on the domestic market: Non-exporting firms are more likely to experience a decline in profits and net worth and, thus, to face tighter borrowing constraints (Arteta and Hale (2008)). Consistently with this channel, Borensztein, Cowan, and Valenzuela (2013) document a larger impact of sovereign credit ratings on corporate credit ratings for firms in the non-tradable sector relative to those in the tradable sector.

We retrieve information from Orbis on geographic segmentation of sales and use the proportion of domestic sales ($Sales_{it}$), computed as the ratio of sales in the country where the company is headquartered to total sales, as a measure of exposure to the domestic market. Similarly to what we have done for the government aid channel,[18] we split the sample of firms into two groups –"Low domestic sales" ($HSales_i = 0$) and "High domestic sales" ($HSales_i = 1$)–, based on whether $Sales_i$, i.e. the firm-average value of $Sales_{it}$, is below or above the median value in the cross-section. As Figure 5 reveals, domestic market concentration shows substantial cross-sectional variation: About 10% of our sample firms place less than 10% of their output in the domestic market, while another 10% –mostly companies operating in the utilities and infrastructure sector– cater exclusively to home-country customers. We then replace D_i with $HSales_i$ in model (2) to assess the incremental effect of variations in sovereign risk on firms that rely more heavily on domestic demand. The findings, presented in Table 8, indicate that, in fact, it is only the firms whose sales are more concentrated in the domestic market that are significantly affected by changes in the sovereign creditworthiness. This confirms the relevance of the domestic demand channel.

[18] There may be concerns that firms previously classified as government influenced also predominantly cater to the domestic market (e.g., utilities). The firm-level correlation coefficient between $Sales_i$ and $Govt_i$ is 0.282 and that between $Sales_i$ and $MktCap_i$ is 0.004, suggesting that this is not the case.

6.3. Credit squeeze

Recent theoretical models (e.g., Gennaioli, Martin, and Rossi (2014)) argue that sovereign defaults lead to severe disruption in domestic credit markets. Such theoretical arguments find support in the empirical literature. Evidence by Borensztein and Panizza (2008) confirms that, indeed, sovereign defaults are frequently accompanied by domestic banking crises that further depress investment and output. In the context of the pre and post 2007–2009 crisis, Ejsing and Lemke (2011) and Acharya, Drechsler, and Schnabl (2014) document a significant increase in bank CDS spreads following an increase in sovereign CDS spreads. The transmission of sovereign to corporate credit risk (for financial and non-financial firms) goes as follows. First, the government provides a series of implicit and explicit guarantees to the financial system that become at risk as the sovereign creditworthiness deteriorates. Second, banks typically hold large amounts of government bonds in their portfolios that lose value as sovereign credit risk widens. As a result, banks' funding costs sharpen and fears of bank runs heighten. Third, the deleveraging of banks' balance sheets has an immediate impact on non-financial firms in terms of reduced bank lending. Recent evidence by Acharya et al. (2014), Becker and Ivashina (2014), Popov and van Horen (2014) suggests that after the start of the Eurozone debt crisis, increased government bond holdings generated a crowding out of corporate lending. Hence, we expect the cost of funding for companies that rely more heavily on bank financing to be more severely affected by an increase in sovereign spreads.

We retrieve from Orbis the proportion of bank debt ($Bank_{it}$), computed as the ratio of bank loans to total debt (i.e., the sum of long-term debt plus long-term debt in current liabilities), which is our proxy for the firm's exposure to the banking sector.

To test the relevance of the credit squeeze channel, we replicate the methodological steps outlined in Sections 6.1 and 6.2 for the other transmission channels. We use $HBank_i$ in lieu of D_i

where $HBank_i = 0$ if $Bank_i$, the firm-average value of $Bank_{it}$, falls below the cross-sectional median value of $Bank_i$, and $HBank_i = 1$ otherwise. Bank financing represents about 40% of total debt, on average, for our sample firms (Table 1–Panel C) with substantial cross-sectional variation (Figure 5). Results for the three estimation methods are reported in Table 9. We observe that changes in sovereign creditworthiness mainly affect bank-dependent firms, thus confirming a spillover from sovereign to corporate risk through the financial intermediation channel.

A potential concern with this finding is that we may be erroneously ascribing the effect to bank deleveraging while, in fact, it may be operating via debt rollover risk. To illustrate this point, suppose a firm's financing needs can be met by (possibly a mix of) bank and other (e.g., bond) financing and that bank financing is short term while bond financing is long term. Under these circumstances, funding sources are directly related to corporate debt maturity: Firms borrowing predominantly from banks are also characterized by shorter maturity debt and face higher refinancing risk than those tapping the bond market. If this were the case, the greater sensitivity to sovereign risk that we uncover for firms that rely on bank financing could be the byproduct of shorter debt maturities.[19] To test whether firms with shorter debt maturities are more exposed to changes in sovereign risk, we use the fraction of current to total debt as a proxy for refinancing risk ($Current_{it}$) and classify firms as "High refinancing risk" ($HCurrent_i = 1$) when $Current_i$, their firm-average value of $Current_{it}$, is above the cross-sectional median value. Table 10 reports regression results for specification (2) using $HCurrent_i$ as the firm indicator D_i. Changes in corporate CDSs are significantly and positively associated with changes in sovereign CDSs, but firms with shorter debt maturities are not more sensitive to variations in sovereign risk –indeed we find some evidence that these firms are less sensitive. We conclude that bank

[19] Almeida et al. (2012) find that firms whose long-term debt was largely maturing right after the onset of the August 2007 credit crisis cut their investment more than otherwise similar firms whose debt was scheduled to mature after 2008.

debt rather than, more generally, short-term debt, significantly affects the spillover from sovereign to corporate credit risk.

7. Additional results

In this section we provide a number of additional results for the sovereign-to-corporate spillover. First, we show that the link between sovereign and corporate credit risk is not confined to the most represented countries in our sample, France and Germany, but rather truly general to the Eurozone. Second, we investigate the transmission channels using different sorts for our sample firms. For the sake of conciseness, we report estimates from the IV specification only.

7.1. Country representativeness

One potential issue with the above results is that the estimate of the spillover effects may be driven by firms headquartered in France and Germany, which jointly account for about 60% of the observations. To assess this potential bias, we first create the indicator variable $Small_i$ which equals one for firms located in Belgium, Finland, Italy, the Netherlands, Portugal or Spain. We then augment specification (1) with the interaction between $Small_i$ and $\Delta \log(SCDS_{jt})$. The coefficient on $\Delta \log(SCDS_{jt})$ measures the spillover in France and Germany, while the sum of this term and the coefficient on $Small_i \cdot \Delta \log(SCDS_{jt})$ captures the effect in all other countries. Table 11-Column 1 reports IV second-stage regression results for this specification. We estimate a significant spillover of 0.051 in France and Germany. In other countries, the spillover is nearly double and significant.

Turning to the transmission channels, we include in specification (2) the interaction between $Small_i$ and $\Delta \log(SCDS_{jt})$ as well as the triple interaction among $Small_i$, $\Delta \log(SCDS_{jt})$ and D_i:

$$\Delta \log(CCDS_{ijt}) = \beta \Delta \log(SCDS_{jt}) + \lambda D_i \Delta \log(SCDS_{jt}) + \eta Small_i \Delta \log(SCDS_{jt}) + \theta Small_i D_i \Delta \log(SCDS_{jt}) + Controls + \varepsilon_{ijt} \quad (3)$$

where *Controls* include all other variables from specification (2). We are interested in $\beta + \lambda$ and $\beta + \lambda + \eta + \theta$, which measure the magnitude of each transmission channel in France and Germany, and in other countries, respectively. We report IV estimates in Table 11-columns (2) to (6).[20] The p-values for the Wald test confirm that $Govt_i$, $HMktCap_i$, $HSales_i$, and $HBank_i$ significantly affect the strength of the sovereign-to-corporate spillover for both France/Germany and smaller countries.

7.2. Alternative sorting

So far we have used time-invariant indicator variables D_i to classify firms according to the characteristics we believe may affect the transmission from sovereign to corporate credit risk. This choice is valid as long as such firm characteristics remain fairly stable through time. In some instances, however, this assumption may be restrictive. During recession times, for example, some firms may attempt to re-orient themselves away from the domestic economy and/or re-balance their debt structure. If this is the case, then it would be more appropriate to sort firms by means of a time-varying indicator. We therefore define a binary variable D_{it} which equals one if, in year t, firm i characteristic (relative market capitalization, domestic to total sales, bank loans to total debt, current to total debt) is above the cross-sectional median *in that year*, and estimate:

[20] Since we have four endogenous variables and four instruments in specification (3), we cannot make use of Stock and Yogo (2005) critical values for the weak identification test. We therefore report the K-P LM statistic for underidentification only. We reject the null of underidentification at standard significance levels.

$$\Delta \log(CCDS_{ijt}) = \alpha_i + D_{it} + \beta \Delta \log(SCDS_{jt}) + \lambda D_{it} \Delta \log(SCDS_{jt}) + \gamma \Delta X_{ijt} + \mu D_{it} \Delta X_{ijt} + \delta_t +$$
$$+ \delta_t D_{it} + \varepsilon_{ijt} \quad (4)$$

Second-stage IV regression results are reported in Table 12, and are in line with our previous findings: Firms that are more strategically relevant, those with high domestic sales, and those that rely more on bank debt are significantly more sensitive to changes in sovereign risk –while firms with more current debt are not.

8. Conclusions

We explore the effect of changes in the creditworthiness of developed sovereign entities on the credit risk of domestic non-financial firms. We measure credit risk with CDS spreads on both sovereigns and corporates from January 2008 to December 2011 for eight countries in the Eurozone. We report the following findings. First, an increase in sovereign risk translates into a significant increase in corporate credit risk, after controlling for a set of global as well as country- and firm-specific variables. Second, the spillover effect is significantly higher for firms that enjoy government guarantees, place most of their output on the domestic market, or rely heavily on bank financing.

Our findings suggest that investors' concerns of a country's debt problems translate into higher funding costs for domestic non-financial corporate issuers. In this respect, strict fiscal discipline has both direct and indirect benefits for a country: It not only improves sovereign creditworthiness, but also reduces firms' borrowing costs, which, in turn, can foster economic growth. Additionally, loosening the links that exacerbate the sovereign-to-corporate spillover may help stabilize corporate funding costs.

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Table A1. Control variables

This table provides a detailed description of the control variables included in the model specifications and their source.

Variable	Description	Source
	Local	
$Local\ exc\ ret_{jt}$	Log return in the domestic Dow Jones Total Market index in excess of the log return in the EuroStoxx 50 index	Bloomberg, Datastream
$\Delta\ Local\ vol_{jt}$	Change in the domestic (annualized) volatility, computed as rolling standard deviation of the local excess stock returns over the past 180 days	Bloomberg, Datastream
	Idiosyncratic	
$Idiosyncratic\ exc\ ret_{it}$	Firm's stock log return in excess of the log return in the domestic Dow Jones Total Market index	Bloomberg, Datastream
$\Delta\ Idiosyncratic\ vol_{it}$	Change in the firm's (annualized) idiosyncratic volatility, computed as rolling standard deviation of the firm's excess stock returns over the past 180 days	Bloomberg, Datastream

Table 1. Summary statistics

This table shows summary statistics of CDS spreads, control variables, and firm-characteristics. Panel A contains summary statistics of weekly CDS spreads of reference entities headquartered in Eurozone countries from January 2008 to December 2011. For each country, the table contains the number of firm-week observations, the number of firms, and the mean, median, and standard deviation of corporate as well as sovereign CDS spreads (bps). The last column reports the median long-term Standard and Poor's rating of firms in each country. Panel B reports summary statistics, multiplied by 100, of the weekly control variables (local and idiosyncratic) defined in Table A1. Panel C contains summary statistics of firm characteristics, computed as firm-level averages of yearly values. $Govt_i$ equals one if the firm is state controlled or it has been entirely or partially privatized. $MktCap_i$ is the ratio between the firm's market capitalization and the total market capitalization of the country. $Sales_i$ is the fraction of sales in the country where the company is headquartered to total sales. $Bank_i$ is the fraction of bank loans to total debt. $Current_i$ is the fraction of current to total debt.

Panel A: CDS

Country			*Corporate CDS*			*Sovereign CDS*			*Corp.*
	Obs.	*Firms*	*Mean*	*Median*	*Std.dev.*	*Mean*	*Median*	*Std.dev.*	*rating*
Belgium	773	5	115.1	85.0	74.5	94.2	88.8	63.3	A-
Finland	1,511	8	344.2	152.0	622.8	32.1	27.2	18.6	BBB
France	7,613	39	190.7	126.0	192.1	54.2	50.8	37.3	BBB+
Germany	5,864	31	230.1	121.4	375.1	34.2	32.4	18.1	BBB+
Italy	1,774	11	231.4	167.7	214.6	140.4	116.3	100.8	BBB+
Netherlands	1,838	10	88.7	77.6	49.2	45.0	38.6	27.8	A-
Portugal	790	4	243.9	186.0	196.8	306.4	136.6	337.3	BBB
Spain	1,675	10	190.4	147.0	146.6	138.1	114.4	89.5	A-
Overall	21,838	118	205.8	122.2	296.3	70.5	44.6	98.7	

Panel B: Control variables

Local (N=208 observations)			
	Mean	*Median*	*Std.dev.*
$Local\ exc\ ret_{jt}$			
Belgium	0.121	0.202	1.710
Finland	-0.142	0.067	2.077
France	0.032	0.075	0.616
Germany	0.062	0.106	0.946
Italy	-0.166	-0.078	1.205
Netherlands	0.018	0.037	1.365
Portugal	-0.135	-0.105	1.959
Spain	0.005	-0.080	1.345
$\Delta\ Local\ vol_{jt}$			
Belgium	0.041	0.025	0.517
Finland	0.009	-0.002	0.533
France	0.008	-0.002	0.251
Germany	0.017	0.007	0.681
Italy	0.031	0.007	0.464
Netherlands	0.018	-0.004	0.446
Portugal	0.032	-0.006	0.470
Spain	0.009	0.007	0.442

(Table 1-Panel B cont.)

Idiosyncratic (N=21,838 observations)			
	Mean	*Median*	*Std.dev.*
$Idiosyncratic\ exc\ ret_{it}$	0.053	0.063	3.482
$\Delta\ Idiosyncratic\ vol_{it}$	0.039	0.009	1.099

Panel C: Firm characteristics

	Firms	*Mean*	*Median*	*Std.dev.*
$Govt_i$	115	0.330	0	0.472
$MktCap_i(\%)$	100	3.368	1.540	4.928
$Sales_i(\%)$	87	45.805	34.384	32.392
$Bank_i(\%)$	83	40.101	19.740	37.811
$Current_i(\%)$	101	9.990	7.865	11.379

Table 2. Sovereign rating changes and the ECB SMP programme

This table reports the effect of sovereign rating downgrades and the ECB Securities Markets Programme (SMP) on corporate and sovereign credit spreads. Sovereign rating changes include 19 downgrades affecting Belgium, Italy, Portugal and Spain, from Standard & Poor's, Moody's and Fitch. For the SMP we consider the two announcement dates of May 10, 2010 (introduction of the asset purchase programme) and August 8, 2011 (reactivation of the asset purchase programme). The countries affected by the SMP in our sample are Italy, Portugal and Spain. Abnormal corporate CDSs are differences between log weekly corporate CDS changes and log weekly Itraxx changes around the rating action. Abnormal sovereign CDSs are differences between log weekly sovereign CDS changes and log weekly changes in average sovereign CDS spreads of all other European countries. t-statistics are given in parenthesis below average abnormal CDSs. ***, **, and * denote significance of the one-sided test at the 1%, 5%, and 10% levels, respectively.

	Sovereign rating downgrades		ECB SMP	
	Abnormal sovereign CDSs	Abnormal corporate CDSs	Abnormal sovereign CDSs	Abnormal corporate CDSs
	(1)	(2)	(3)	(4)
Mean	0.030**	0.038***	-0.100*	-0.043***
t-stat	(-1.894)	(4.121)	(-1.874)	(-2.480)
Obs.	19	119	6	44

Table 3. Corporate rating changes

This table reports the effect of corporate rating changes on corporate and sovereign credit spreads. Corporate rating changes include 188 downgrades and 70 upgrades from Standard & Poor's, Moody's and Fitch. Abnormal corporate CDSs are differences between log weekly corporate CDS changes and log weekly Itraxx changes around the rating action. Abnormal sovereign CDSs are differences between log weekly sovereign CDS changes and log weekly changes in average sovereign CDS spreads of all other European countries around the rating action. t-statistics are given in parenthesis below average abnormal CDSs. ***, **, and * denote significance of the one-sided test at the 1%, 5%, and 10% levels, respectively.

	Rating upgrades		Rating downgrades	
	Abnormal corporate CDSs	Abnormal sovereign CDSs	Abnormal corporate CDSs	Abnormal sovereign CDSs
Mean	-0.028***	-0.001	0.019***	-0.001
t-stat	(-3.999)	(-0.025)	(2.420)	(-0.091)
Obs.	70	67	188	177

Table 4. Principal component analyses

This table reports the percentage of variance explained by the first five components extracted from the principal component analyses of the correlation matrix of weekly changes in sovereign CDS spreads and the correlation matrix of weekly changes in corporate CDS spreads between January 2008 and December 2011.

	Sovereign		Corporate	
Principal Component	Sample Variation Explained (%)	Total	Sample Variation Explained (%)	Total
First	68.69	68.69	46.55	46.55
Second	13.36	82.05	4.26	50.80
Third	5.94	87.99	3.86	54.66
Fourth	3.34	91.33	3.16	57.82
Fifth	3.21	94.54	2.64	60.46

Table 5. Sovereign risk and corporate credit risk

This table shows the effect of changes in sovereign credit risk on corporate credit risk. The dependent variable, $\Delta \log(CCDS_{ijt})$, is the weekly change in log corporate CDS spread. All models include firm fixed effects, time (week) fixed effects and the control variables described in Table A1. Column (2) also adds the lagged value of the dependent variable. Column (3) reports second-stage regression results for specification (1) where changes in country j sovereign credit risk, $\Delta \log(SCDS_{jt})$, are instrumented with changes in average sovereign credit risk of all other European countries, $\Delta \log(\overline{SCDS}_{-jt})$. Standard errors are two-way (country and week) clustered. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Pooled OLS	Dynamic Panel	IV
	(1)	(2)	(3)
$\Delta \log(SCDS_{jt})$	0.049***	0.057***	0.082***
	(0.015)	(0.018)	(0.023)
$\Delta \log(CCDS_{ijt-1})$		0.241***	
		(0.020)	
Firm FE	Y	Y	Y
Week FE	Y	Y	Y
Controls	Y	Y	Y
Observations	21,838	20,570	21,838
Adj. R-squared	0.495	0.535	0.495
Firms	118	118	118

Table 6. Sovereign risk and corporate credit risk: Government guarantees

This table shows the effect of government guarantees on the spillover from sovereign risk to corporate credit risk. The dependent variable, $\Delta \log(CCDS_{ijt})$, is the weekly change in log corporate CDS spread. $Govt_i$ equals one if the firm is state controlled or it has been entirely or partially privatized. All models include firm fixed effects, time (week) fixed effects and the control variables described in Table A1. Interaction terms are between control variables and $Govt_i$ as well as between time fixed effects and $Govt_i$. Column (2) also adds the lagged value of the dependent variable and its interaction with $Govt_i$. Column (3) reports second-stage regression results for specification (2) where changes in country j sovereign credit risk, $\Delta \log(SCDS_{jt})$, are instrumented with changes in average sovereign credit risk of all other European countries, $\Delta \log(\overline{SCDS}_{-jt})$. Standard errors are two-way (country and week) clustered. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Pooled OLS	Dynamic Panel	IV
	(1)	(2)	(3)
(β) $\Delta \log(SCDS_{jt})$	0.037**	0.038***	0.040***
	(0.015)	(0.008)	(0.007)
(λ) $\Delta \log(SCDS_{jt}) \cdot Govt_i$	0.034***	0.043*	0.075**
	(0.012)	(0.022)	(0.031)
$\Delta \log(CCDS_{ijt-1})$		0.213***	
		(0.026)	
β+λ	0.071	0.081	0.115
p-val Wald test β+λ=0	(<0.001)	(0.002)	(<0.001)
Firm FE	Y	Y	Y
Week FE	Y	Y	Y
Controls	Y	Y	Y
Interaction terms	Y	Y	Y
Observations	21,819	20,557	21,819
Adj. R-squared	0.496	0.540	0.500
Firms	115	115	115
First stage diagnostics			
Kleinbergen-Paap LM stat			4.413
p-val			(0.036)
Kleinbergen-Paap Wald stat			7.060
p-val (t-test size>10%)			(0.049)
p-val (t-test size>25%)			(0.003)

Table 7. Sovereign risk and corporate credit risk: Strategic relevance

This table shows effect of a firm's strategic relevance on the spillover from sovereign risk to corporate credit risk. The dependent variable, $\Delta \log(CCDS_{ijt})$, is the weekly change in log corporate CDS spread. Firms are considered of high strategic relevance ($HMktCap_i = 1$) if their average value for $MktCap_{it}$ is above the cross-sectional median. $MktCap_{it}$ is the ratio between the firm's market capitalization and the total market capitalization of the country. All models include firm fixed effects, time (week) fixed effects and the control variables described in Table A1. Interaction terms are between control variables and $HMktCap_i$ as well as between time fixed effects and $HMktCap_i$. Column (2) also adds the lagged value of the dependent variable and its interaction with $HMktCap_i$. Column (3) reports second-stage regression results for specification (2) where changes in country j sovereign credit risk, $\Delta \log(SCDS_{jt})$, are instrumented with changes in average sovereign credit risk of all other European countries, $\Delta \log(\overline{SCDS}_{-jt})$. Standard errors are two-way (country and week) clustered. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Pooled OLS	Dynamic Panel	IV
	(1)	(2)	(3)
(β) $\Delta \log(SCDS_{jt})$	0.032**	0.031**	0.042***
	(0.013)	(0.015)	(0.001)
(λ) $\Delta \log(SCDS_{jt}) \cdot HMktCap_i$	0.039**	0.055***	0.066**
	(0.016)	(0.015)	(0.027)
$\Delta \log(CCDS_{ijt-1})$		0.212***	
		(0.014)	
β+λ	0.071	0.086	0.107
p-val Wald test β+λ=0	(<0.001)	(<0.001)	(<0.001)
Firm FE	Y	Y	Y
Week FE	Y	Y	Y
Controls	Y	Y	Y
Interaction terms	Y	Y	Y
Observations	19,289	18,201	19,289
Adj. R-squared	0.506	0.543	0.506
Firms	100	100	100
First stage diagnostics			
Kleinbergen-Paap LM stat			5.037
p-val			(0.025)
Kleinbergen-Paap Wald stat			6.029
p-val (t-test size>10%)			(0.087)
p-val (t-test size>25%)			(0.006)

Table 8. Sovereign risk and corporate credit risk: Domestic demand

This table shows the effect of the concentration of sales in the domestic market on the spillover from sovereign risk to corporate credit risk. The dependent variable, $\Delta \log(CCDS_{ijt})$, is the weekly change in log corporate CDS spread. We define firms as having high domestic sales ($HSales_i = 1$) if their average value for $Sales_{it}$ is above the cross-sectional median. $Sales_{it}$ is the fraction of sales in the country where the company is headquartered to total sales. All models include firm fixed effects, time (week) fixed effects and the control variables described in Table A1. Interaction terms are between control variables and $HSales_i$ as well as between time fixed effects and $HSales_i$. Column (2) also adds the lagged value of the dependent variable and its interaction with $HSales_i$. Column (3) reports second-stage regression results for specification (2) where changes in country j sovereign credit risk, $\Delta \log(SCDS_{jt})$, are instrumented with changes in average sovereign credit risk of all other European countries, $\Delta \log(\overline{SCDS}_{-jt})$. Standard errors are two-way (country and week) clustered. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Pooled OLS	Dynamic Panel	IV
	(1)	(2)	(3)
(β) $\Delta \log(SCDS_{jt})$	0.005	0.007	0.003
	(0.015)	(0.017)	(0.016)
(λ) $\Delta \log(SCDS_{jt}) \cdot HSales_i$	0.071**	0.082**	0.108***
	(0.033)	(0.036)	(0.036)
$\Delta \log(CCDS_{ijt-1})$		0.241***	
		(0.013)	
β+λ	0.076	0.089	0.111
p-val Wald test β+λ=0	(0.004)	(0.002)	(<0.001)
Firm FE	Y	Y	Y
Week FE	Y	Y	Y
Controls	Y	Y	Y
Interaction terms	Y	Y	Y
Observations	16,709	15,767	16,709
Adj. R-squared	0.509	0.548	0.509
Firms	87	87	87
First stage diagnostics			
Kleinbergen-Paap LM stat			4.725
p-val			(0.030)
Kleinbergen-Paap Wald stat			7.008
p-val (t-test size>10%)			(0.051)
p-val (t-test size>25%)			(0.003)

Table 9. Sovereign risk and corporate credit risk: Credit squeeze

This table shows the effect of reliance on bank loans on the spillover from sovereign risk to corporate credit risk. The dependent variable, $\Delta \log(CCDS_{ijt})$, is the weekly change in log corporate CDS spread. We define firms as having high bank exposure ($HBank_i = 1$) if their average value for $Bank_{it}$ is above the cross-sectional median. $Bank_{it}$ is the fraction of bank loans to total debt. All models include firm fixed effects, time (week) fixed effects and the control variables described in Table A1. Interaction terms are between control variables and $HBank_i$ as well as between time fixed effects and $HBank_i$. Column (2) also adds the lagged value of the dependent variable and its interaction with $HBank_i$. Column (3) reports second-stage regression results for specification (2) where changes in country j sovereign credit risk, $\Delta \log(SCDS_{jt})$, are instrumented with changes in average sovereign credit risk of all other European countries, $\Delta \log(\overline{SCDS}_{-jt})$. Standard errors are two-way (country and week) clustered. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Pooled OLS	Dynamic Panel	IV
	(1)	(2)	(3)
(β) $\Delta \log(SCDS_{jt})$	0.019	0.030**	0.026*
	(0.014)	(0.014)	(0.015)
(λ) $\Delta \log(SCDS_{jt}) \cdot HBank_i$	0.057**	0.051**	0.085***
	(0.023)	(0.022)	(0.031)
$\Delta \log(CCDS_{ijt-1})$		0.268***	
		(0.023)	
β+λ	0.076	0.081	0.112
p-val Wald test β+λ=0	(<0.001)	(<0.001)	(<0.001)
Firm FE	Y	Y	Y
Week FE	Y	Y	Y
Controls	Y	Y	Y
Interaction terms	Y	Y	Y
Observations	15,934	15,051	15,934
Adj. R-squared	0.504	0.544	0.504
Firms	83	83	83
First stage diagnostics			
Kleinbergen-Paap LM stat			4.555
p-val			(0.033)
Kleinbergen-Paap Wald stat			6.593
p-val (t-test size>10%)			(0.064)
p-val (t-test size>25%)			(0.004)

Table 10. Sovereign risk and corporate credit risk: Refinancing risk

This table shows the effect of refinancing risk on the spillover from sovereign risk to corporate credit risk. The dependent variable, $\Delta \log(CCDS_{ijt})$, is the weekly change in log corporate CDS spread. We define firms as having high refinancing risk ($HCurrent_i = 1$) if their average value for $Current_{it}$ is above the cross-sectional median. $Current_{it}$ is the fraction of current to total debt. All models include firm fixed effects, time (week) fixed effects and the control variables described in Table A1. Interaction terms are between control variables and $HCurrent_i$ as well as between time fixed effects and $HCurrent_i$. Column (2) also adds the lagged value of the dependent variable and its interaction with $HCurrent_i$. Column (3) reports second-stage regression results for specification (2) where changes in country j sovereign credit risk, $\Delta \log(SCDS_{jt})$, are instrumented with changes in average sovereign credit risk of all other European countries, $\Delta \log(\overline{SCDS}_{-jt})$. Standard errors are two-way (country and week) clustered. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Pooled OLS	Dynamic Panel	IV
	(1)	(2)	(3)
(β) $\Delta \log(SCDS_{jt})$	0.059***	0.064***	0.097***
	(0.017)	(0.019)	(0.024)
(λ) $\Delta \log(SCDS_{jt}) \cdot HCurrent_i$	-0.041**	-0.033	-0.075***
	(0.018)	(0.020)	(0.022)
$\Delta \log(CCDS_{ijt-1})$		0.243***	
		(0.023)	
β+λ	0.018	0.031	0.022
p-val Wald test β+λ=0	(0.092)	(0.003)	(0.038)
Firm FE	Y	Y	Y
Week FE	Y	Y	Y
Controls	Y	Y	Y
Interaction terms	Y	Y	Y
Observations	19,374	18,282	19,374
Adj. R-squared	0.502	0.539	0.502
Firms	101	101	101
First stage diagnostics			
Kleinbergen-Paap LM stat			4.521
p-val			(0.034)
Kleinbergen-Paap Wald stat			6.063
p-val (t-test size>10%)			(0.086)
p-val (t-test size>25%)			(0.006)

Table 11. Sovereign risk and corporate credit risk: Small vs large countries

This table shows the effect of changes in sovereign credit risk on corporate credit risk and tests the spillover channels for large and small countries. The dependent variable, $\Delta \log(CCDS_{ijt})$, is the weekly change in log corporate CDS spread. $Small_i$ is an indicator variable that equals one if the firm is headquartered in Belgium, Finland, Italy, the Netherlands, Portugal or Spain. D_i equals $Govt_i$ in column (2), $HMktCap_i$ in column (3), $HSales_i$ in column (4), $HBank_i$ in column (5), and $HCurrent_i$ in column (6). All models include local and idiosyncratic variables from Table A1, firm and time (week) fixed effects. Column (1) includes interaction terms of control variables and time fixed effects with $Small_i$, and columns (2)-(6) include interaction terms with $Small_i$ and D_i. The table reports second-stage regression results where changes in country j sovereign credit risk, $\Delta \log(SCDS_{jt})$, are instrumented with changes in average sovereign credit risk of all other European countries, $\Delta \log(\overline{SCDS}_{-jt})$. Standard errors are two-way (country and week) clustered. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

		Channel (D_i)				
		$Govt_i$	$HMktCap_i$	$HSales_i$	$HBank_i$	$HCurrent_i$
	(1)	(2)	(3)	(4)	(5)	(6)
(β) $\Delta \log(SCDS_{jt})$	0.051***	0.054***	0.081***	0.012*	0.050***	0.077***
	(0.012)	(0.004)	(0.022)	(0.006)	(0.017)	(0.013)
(λ) $\Delta \log(SCDS_{jt}) \cdot D_i$		0.034***	0.009	0.072***	0.032***	-0.038***
		(0.011)	(0.027)	(0.014)	(0.011)	(0.009)
(η) $\Delta \log(SCDS_{jt}) \cdot Small_i$	0.046	-0.033***	-0.119***	-0.029**	-0.068***	0.035**
	(0.035)	(0.007)	(0.013)	(0.014)	(0.010)	(0.015)
(θ) $\Delta \log(SCDS_{jt}) \cdot D_i \cdot Small_i$		0.076***	0.144***	0.071***	0.115***	-0.081***
		(0.011)	(0.015)	(0.021)	(0.020)	(0.017)
β+λ		0.088	0.090	0.084	0.082	0.039
p-val Wald test β+λ=0		(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)
β+η	0.097	0.020	-0.038	-0.017	-0.018	0.112
p-val Wald test β+η=0	(0.004)	(<0.001)	(0.149)	(0.167)	(0.427)	(<0.001)
β+λ+η+θ		0.129	0.115	0.126	0.129	-0.007
p-val Wald test β+λ+η+θ=0		(<0.001)	(<0.001)	(<0.001)	(<0.001)	(0.602)
Firm FE	Y	Y	Y	Y	Y	Y
Week FE	Y	Y	Y	Y	Y	Y
Controls	Y	Y	Y	Y	Y	Y
Interaction terms	Y	Y	Y	Y	Y	Y
Observations	21,838	21,819	19,289	16,709	15,934	19,374
Adj. R-squared	0.501	0.501	0.507	0.510	0.505	0.502
Firms	118	115	100	87	83	101
First stage diagnostics						
Kleinbergen-Paap LM stat	4.548	4.684	5.292	4.954	4.875	4.649
p-val	(0.033)	(0.030)	(0.021)	(0.026)	(0.027)	(0.031)

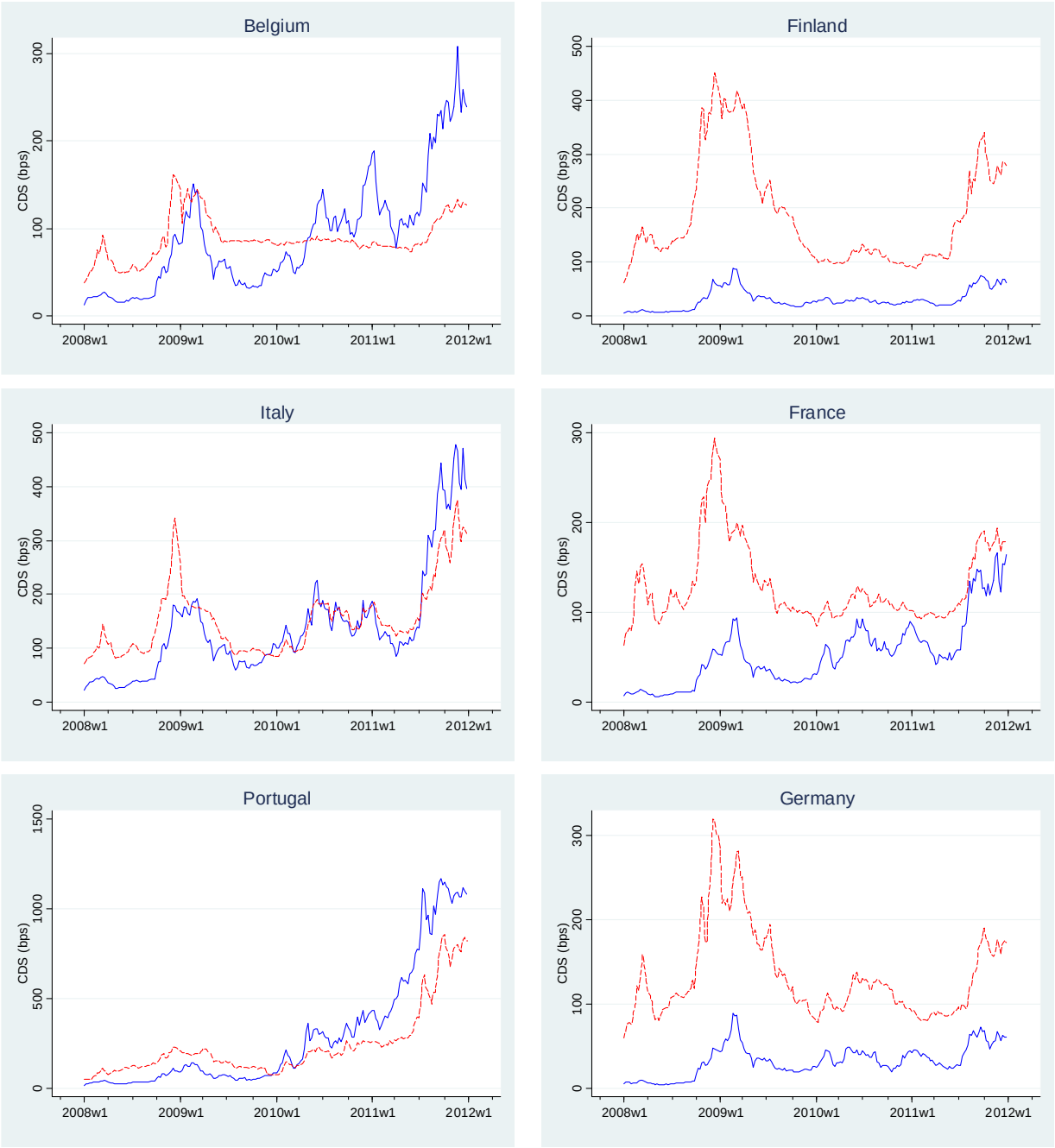
Table 12. Robustness check (time-varying medians)

This table shows the effect of transmission channels on the spillover from sovereign risk to corporate credit risk when firm sorts are based on time-varying medians. The dependent variable, $\Delta \log(CCDS_{ijt})$, is the weekly change in log corporate CDS spread. A firm is considered of high strategic relevance in year t ($HMktCap_{it} = 1$) if its value for $MktCap_{it}$ in year t is above the year t cross-sectional median. $HSales_{it}$, $HBank_{it}$ and $HCurrent_{it}$ are defined similarly. All models include local and idiosyncratic variables from Table A1, firm and time (week) fixed effects, and the direct effect of D_{it}. Interaction terms are between control variables (local and idiosyncratic) and D_{it} as well as between time fixed effects and D_{it}. The table reports second-stage regression results for specification (4) where changes in country j sovereign credit risk, $\Delta \log(SCDS_{jt})$, are instrumented with changes in average sovereign credit risk of all other European countries, $\Delta \log(\overline{SCDS}_{-jt})$. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Channel (D_{it})	$HMktCap_{it}$	$HSales_{it}$	$HBank_{it}$	$HCurrent_{it}$
	(1)	(2)	(3)	(4)
(β) $\Delta \log(SCDS_{jt})$	0.031***	-0.018	0.022***	0.100***
	(0.004)	(0.023)	(0.005)	(0.021)
(λ) $\Delta \log(SCDS_{jt}) \cdot D_{it}$	0.080***	0.154**	0.088***	-0.084***
	(0.029)	(0.071)	(0.028)	(0.021)
β+λ	0.110	0.136	0.110	0.016
p-val Wald test β+λ=0	(<0.001)	(0.006)	(<0.001)	(0.079)
Firm FE	Y	Y	Y	Y
Week FE	Y	Y	Y	Y
Controls	Y	Y	Y	Y
Interaction terms	Y	Y	Y	Y
Observations	19,189	14,847	15,140	19,374
Adj. R-squared	0.509	0.504	0.502	0.503
Firms	100	87	83	101
First stage diagnostics				
Kleinbergen-Paap LM stat	4.987	5.426	4.482	4.644
p-val	(0.026)	(0.020)	(0.034)	(0.031)
Kleinbergen-Paap Wald stat	6.018	4.107	6.663	5.973
p-val (t-test size>10%)	(0.088)	(0.233)	(0.062)	(0.090)
p-val (t-test size>25%)	(0.006)	(0.033)	(0.004)	(0.007)

Figure 1. Sovereign and corporate credit risk

The solid line represents the sovereign CDS spread and the dashed line the median CDS spread computed across non-financial reference entities headquartered in a country.



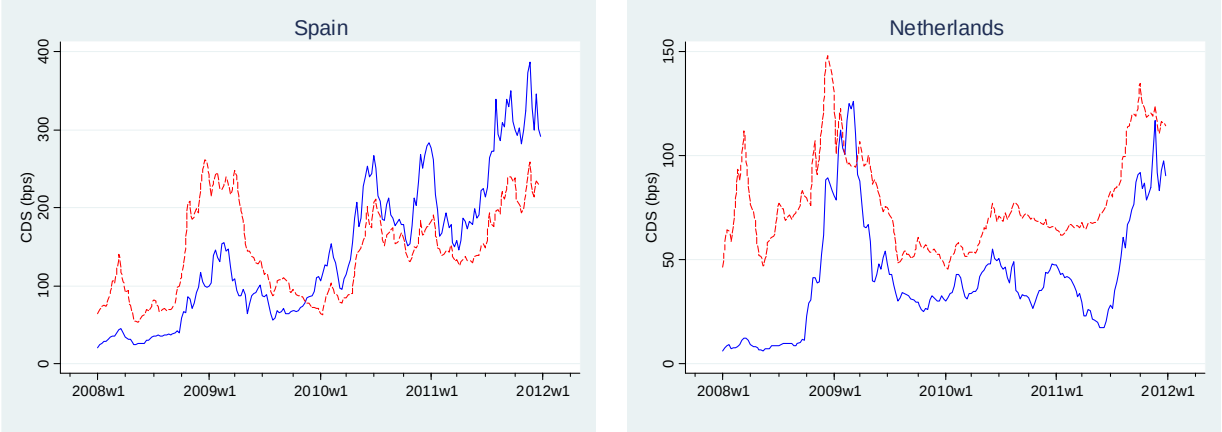


Figure 2. Correlation between sovereign and corporate credit risk

Rolling correlation, computed over 52 weeks, between median log weekly changes in corporate CDS spreads and log weekly changes in sovereign CDS (solid line) with 90% confidence intervals (shaded area).

Figure 3. Principal component analysis: Loadings of first principal component

The left panel shows loadings of the first principal component from the PCA on sovereign CDS spread changes. The right panel is a histogram of loadings of the first principal component from the PCA on corporate CDS spread changes.

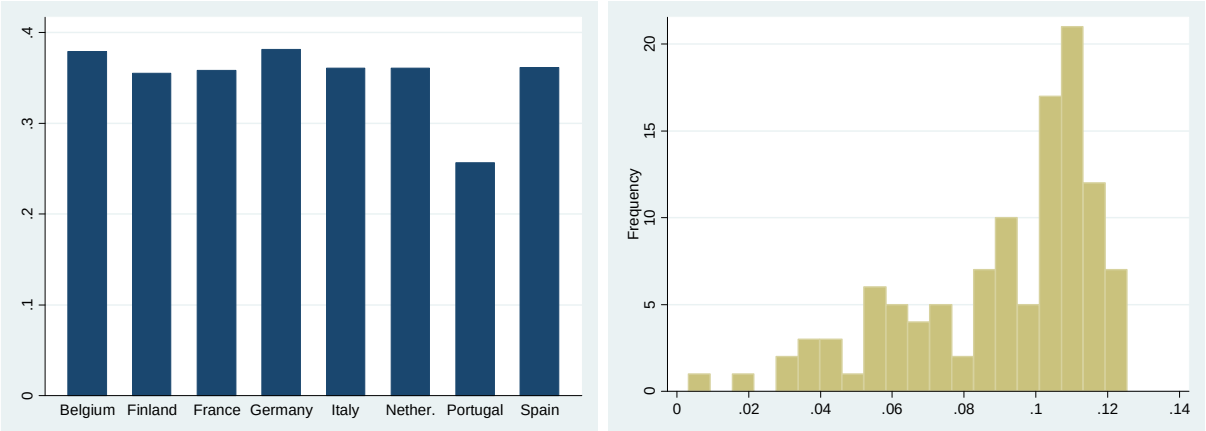


Figure 4. Exposure to Eurozone countries.

We define a firm exposure to other Eurozone countries as one minus the fraction (out of total sales) of domestic sales plus sales in non-EU countries. This figure depicts the cross-sectional distribution of firm-level averages of yearly values, together with the max/min range of yearly values.

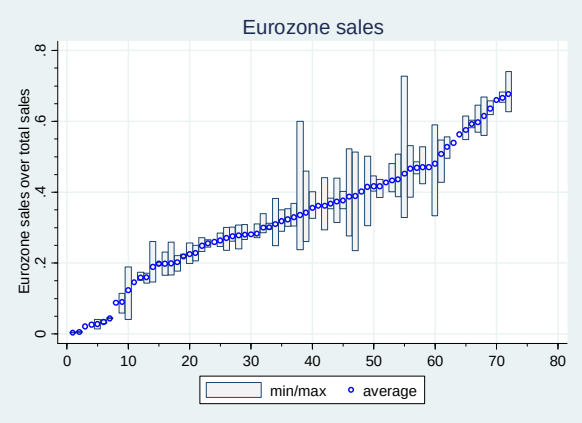


Figure 5. Firm characteristics.

Cross-sectional distribution of firm characteristics, computed as firm-level averages of yearly values. $MktCap_i$ is the ratio between the firm's market capitalization and the total market capitalization of the country. $Sales_i$ is the fraction of sales in the country where the company is headquartered to total sales. $Bank_i$ is the fraction of bank loans to total debt. $Current_i$ is the fraction of current to total debt.