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Research Paper

Sovereign risk and the pricing of corporate credit default swaps

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ABSTRACT

Based on an empirical analysis of European corporations, we investigate the impact of sovereign risk on the pricing of corporate credit risk. In our paper, we show that sovereign credit default swaps (CDSs) are positively correlated with corresponding corporate CDS spreads and are a significant factor in corporate CDS pricing models. We also find that this impact increases throughout the sovereign debt crisis of 2010–11, and it is more distinctive for eurozone countries that were more exposed to the sovereign debt crisis than others. We further observe that this effect is particularly pronounced for corporations with a high dependency on their domestic market.

Keywords: credit default swaps; pricing; sovereign risk; debt crisis; corporate credit risk.

1 INTRODUCTION

During the European sovereign debt crisis of 2010–11, governments found that, once again, investors focused their attentions on sovereign counterparty risk. Interest rate levels for so-called peripheral countries of the eurozone (eg, Spain) increased steadily,

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whereas more stable European economies (eg, Germany) benefited from an opposing trend (eg, lower borrowing costs). Against this background, we investigate to what extent the creditworthiness of a country, measured by its underlying sovereign credit default swap (CDS) spread, spills over into the credit risk of its local companies. The first empirical results show that the interest rates of new bank loans (both corporate and household loans) increased during the financial crisis in the peripheral countries of the eurozone, whereas the core eurozone countries actually benefited from decreased interest rates. For example, between December 2010 and July 2012, interest rates for corporate loans decreased in Germany by 55bps on average. However, during the same time period, in Italy, interest rates for corporate loans increased by 80bps, adding up to an absolute Delta of 1.35% (International Monetary Fund 2012).

Set against the background of the European sovereign crisis, the aim of our paper is to introduce sovereign risk (via sovereign CDS spreads) to the pricing model of corporate CDS contracts. We also control for whether the potential impact of sovereign risk is driven by operational or refinancing activities on a company level. The literature on CDS pricing so far has covered a wide range of potential pricing factors, including, for example, company specific factors such as leverage, liquidity or equity volatility (eg, Ericsson *et al* 2009; Zhang *et al* 2008). Other studies have focussed on the relationship between stock, bond or CDS markets and the corresponding interlinkages (eg, Blanco *et al* 2005) or the impact of counterparty risk on CDS pricing (Morkoetter *et al* 2012). Acharya *et al* (2013), Alter and Schueler (2012), Demirgüç-Kunt and Huizinga (2013) and De Bruyckere *et al* (2013), among others, focussed on the pricing of bank CDSs and reported a positive correlation between sovereign and bank CDS levels.

Throughout the empirical part of our paper, we argue that an increase in sovereign CDS spreads is positively correlated with the CDS spreads of corporates headquartered in the same country. Our argument is as follows: due to a weak economic outlook, the creditworthiness of a government might decrease, which, in turn, might be accompanied by higher sovereign CDS spread levels. From the perspective of corporates headquartered in a country with relatively low creditworthiness, the operational business activities might be negatively affected (eg, lower sales in their domestic market due to a weak economy). In contrast, companies domiciled in a country with a sound credit rating, and therefore a strong economy, should benefit from such a stable environment. If our argument holds, we expect that a strong home bias toward the local market should, depending on the underlying sovereign risk, have a negative (bad underlying sovereign risk) or positive (sound underlying sovereign risk) effect on the observed corporate risk levels.

A good geographical region and time frame in which to study the pricing power of sovereign CDS spreads on corporate risk levels is the eurozone throughout the recent sovereign debt crisis. High levels of volatility were observed for sovereign

CDS spreads during this period, combined with a diverging pattern between the different countries (depending on the creditworthiness of the individual country). In our empirical analysis, we focus on CDS spreads of 107 European corporates from ten different countries for the time period January 2009–December 2011. Controlling for a range of different control variables (eg, leverage), we regress the sovereign CDS spreads (according to the location of the company's headquarters) on the individual corporate CDS spread. In addition, we collect the respective company-specific variables with regard to the ratio of domestic market sales and bank debt over total debt from the respective annual reports.

We present three main results. First, our results indicate that sovereign CDS spreads are indeed significantly linked to the underlying corporate CDS spread. Second, we observe that the effect of sovereign credit risk actually increases with an intensifying sovereign crisis between 2010 and 2011. Third, for corporations headquartered in one of the distressed eurozone countries (eg, Spain), the underlying link between domestic sovereign risk and corporate CDS spreads is significantly stronger when compared with corporates domiciled in a nondistressed eurozone country (eg, Germany). We interpret the results as empirical proof that sovereign risk matters and has a direct impact on corporate credit risk.

Our paper also focuses on the reasoning behind the documented impact of sovereign risk on the pricing of underlying corporate CDS spreads. Is this linkage actually reasonable from a corporate perspective? Does it make sense that an Italian manufacturer ultimately has to pay higher interest rates in contrast with his German peer who is producing the very same products? Following this argument, we first control for domestic market activity. For most companies, the domestic market (where the company is headquartered) is a very important one. Against this background, we argue that the impact of sovereign risk on corporate credit risk levels is justified. Thus, a negative outlook for the domestic economy is ultimately linked to decreasing sales, which, in turn, will trigger a lower level of profitability and lower creditworthiness in the corporations. Second, on the refinancing side, companies may also be affected by the conditions of the corresponding sovereign risk. During the European sovereign debt crisis, banks in distressed countries experienced difficulties refinancing themselves. This shortage of capital supply drove up the banks' refinancing costs. Under the assumption that borrowing from banks is predominantly a domestic business, we could argue that a greater dependency on (local) bank debt should lead to sovereign counterparty risk having a greater impact on corporate CDS spreads. The application of interaction terms between "domestic market dependency" and "sovereign CDS spread" provides empirical proof that a greater dependency on the domestic market (measured in percentage of annual sales volume) leads to the corresponding sovereign CDS level having a greater impact. However, with regard to the second hypothesis, we do not find any empirical proof that a higher ratio of bank debt (in percentage of

total debt) is associated with a greater weight on sovereign counterparty risk when pricing CDS spread levels.

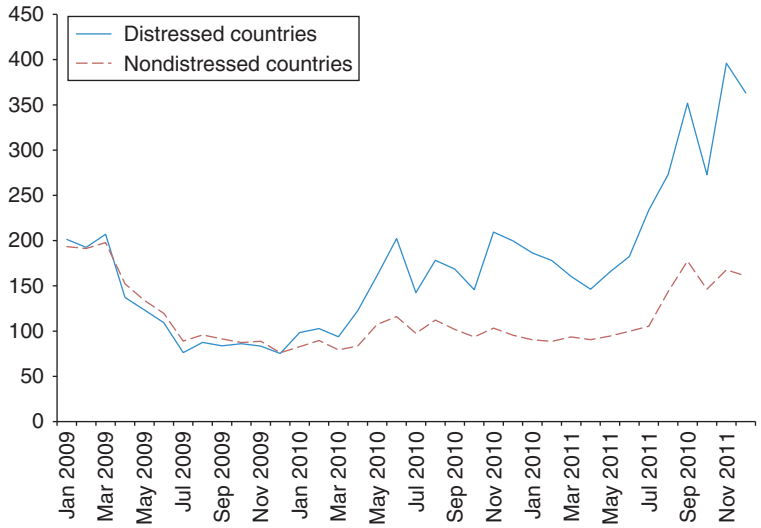
The remainder of the paper is organized as follows. In Section 2 we briefly discuss the sovereign debt crisis in Europe, which motivates our paper. Section 3 provides an overview of the relevant literature covering both pricing factors of CDS spreads and sovereign risk in general. Section 4 presents the data, and Section 5 explains the methodology. Section 6 displays the empirical results. Finally, Section 7 concludes the paper.

2 SOVEREIGN DEBT CRISIS IN EUROPE (2009–11)

Following the Lehman Brothers default in September 2008, the worldwide financial crisis hit the banking sector particularly hard in 2008–9. However, from a European perspective, this was only half of the story. Starting in 2009, bond yields and CDS spread levels of sovereign debt in selected European countries increased significantly (Hui and Chang 2011). This group of countries is often referred to as the so-called peripheral eurozone and includes, for example, Greece, Spain and Italy. The main reason for investors' increased risk awareness and risk premiums being in greater demand were high debt levels, high budget deficits and, subsequently, weak national economies. The crisis evolved in early 2009, with Ireland announcing several measures to tighten the national budget. In October 2009, Greece stated its severe fiscal problems, and a budget deficit of 12.7% of the gross domestic product for 2009 was revealed shortly afterwards (see De Santis 2012). As a consequence, the creditworthiness of countries with less solid fiscal fundamentals came under pressure, and this led to increased spread levels (Figure 1 on the facing page). Rating agencies reacted accordingly and downgraded the affected countries, which put further pressure on these countries. With increasing refinancing costs and widening budget deficits, it became more and more difficult for these peripheral eurozone countries to borrow from capital markets. In 2010, Ireland and Greece had no access to the bond markets and could only refinance themselves via repeated bailouts coordinated by the European Union and the International Monetary Fund. Other countries subsequently followed suit. Spain also required a limited form of external help from the European Union in order to capitalize its banking sector. Eurozone members voted to set up a temporary European Financial Stability Facility (EFSF), which, based on guarantees from all eurozone member states, could issue bonds in order to provide funding to member countries suffering refinancing difficulties. Later on, the European Stability Mechanism (ESM) was introduced as a permanent alternative to the EFSF (see, for example, Lane 2012).

The difficulties these countries were facing in 2009–10 can, to some degree, be related to their membership of the eurozone. Countries with a sound fiscal setup were

FIGURE 1 Development of CDS spreads in distressed and nondistressed countries.



Monthly average spread (in bps) of the countries in our sample. Source: Bloomberg 2014, own calculations.

not supporting any initiatives that might lay the groundwork for higher inflation or a devaluation of the currency: a common measure applied by distressed countries in the past. Yet, prior to the sovereign debt crisis, the peripheral countries nevertheless benefited from low interest rates and a high supply of capital.

3 LITERATURE REVIEW

Our findings relate to research focusing on the impact of sovereign risk on debt-related financial products in general and to the wide range of literature determining pricing factors on CDS spreads, with the latter being divided into micro- and macroeconomic factors.

Based on weekly CDS spread data for European banks, Ejsing and Lemke (2011) investigated to what extent risk was actually transferred from banks to the government during the financial crisis. They showed that, after the announcement of government rescue packages, the CDS spreads of banks decreased, while sovereign CDS spreads increased. In addition, the level of sensitivity with regard to a worsening of the financial crisis increased for government debt and decreased for bank debts. This risk transfer from the private to the public sector was also documented by Dieckmann and Plank (2012). Their paper shows that the condition of a country's financial system, as well as

the state of the worldwide financial system, is a significant pricing factor for sovereign CDS spreads.

Set against the financial crisis between 2007 and 2010, Alter and Schueler (2012) focussed on the relationship between sovereign CDS spreads and banks' CDS spread levels. They showed that sovereign CDS spreads are an important pricing factor for bank CDS spreads, particularly prior to a bank bailout, and found that the interdependence between banks and their home countries is rather heterogeneous between countries, but homogenous within countries.

Carr and Wu (2007) documented a positive correlation between sovereign risk (measured by sovereign CDS spreads) and currency-implied return volatilities. They observed that sovereign CDS spreads actually covary with both the currency option implied volatilities and the slope of the implied volatility curve in moneyness.

Ismailescu and Kazemi (2010) investigated the interaction between sovereign credit rating announcements and sovereign CDS spreads. They showed that positive rating events (eg, upgrades) have a strong and positive impact on CDS markets (eg, lower spreads), whereas CDS markets actually anticipate negative rating events, which leads to no impact in the case of, for example, a downgrade (see also Finnerty *et al* 2013). In addition, De Bruyckere *et al* (2013) focussed on contagion between bank risk and sovereign risk. They showed that contagion between bank risk and sovereign default risk exists (as measured by the correlation of CDS spreads), and that it is more present in banks dependent on short-term funding and less focused on traditional banking activities. They also proved empirically that the link between bank and sovereign default risk becomes stronger the more debt the bank accumulates from that respective country on its balance sheet. Acharya *et al* (2013) confirmed the link between bank risk and country risk. They showed that post-bailout changes in sovereign CDSs have a significant impact on bank CDS levels. Demirgüç-Kunt and Huizinga (2013) showed that bank CDS spreads actually decrease with stronger public finances: the better the underlying sovereign risk, the lower the premiums paid for CDS contracts.

Badaoui *et al* (2013) aimed to gain an understanding of what drives sovereign CDS spreads. Their research revealed that sovereign CDS spreads are driven in large part by liquidity; this is in contrast to sovereign bonds, for which liquidity is of less importance. Badaoui *et al* (2013) also explained that the increase in sovereign risk throughout the recent financial crisis was due to liquidity risk and, as expected, higher default intensity.

White and Hull (2000,2001) were the first to introduce the framework of counterparty risk into the pricing process of CDS contracts. They defined counterparty risk as the default risk of the protection buyer or the protection seller, respectively, and extended their framework (White and Hull 2001) by estimating the default correlation between these two parties.

Galil *et al* (2014) have provided a recent analysis of a wide range of CDS pricing factors. They found that, in particular, stock return, the change in stock return volatility, the change in the median CDS spread in the rating class and ratings are important pricing determinants. Their research confirmed previous studies on pricing factors of CDS contracts (eg, Blanco *et al* 2005; Byström 2005; Zhang *et al* 2008; Skinner and Townend 2002). Ericsson *et al* (2009) provided empirical proof that leverage also counts as an important pricing factor. Further, Fabozzi *et al* (2007) showed that liquidity matters and documented a negative correlation between liquidity and the CDS pricing level, which was also confirmed by Tang and Yan (2007).

Our paper complements the existing literature in two ways. First, it introduces sovereign risk to the literature on the pricing of corporate CDS spreads. Second, it adds to the understanding of the risk transfer between private and public debt. In addition to sovereign risk, we will apply a range of the abovementioned generally accepted pricing factors as control variables for our regression analysis.

4 DATA SAMPLE

In our empirical analysis, we focus on corporations from the European market stemming from ten different countries. The Markit iTraxx Europe Index Series 17 comprises 125 CDS contracts on senior unsecured debt with a maturity of five years on investment grade entities. This approach helps us to rule out any kind of selection bias or distortions that might come from a lack of trading volume or insufficient company size. We cover a time period of three years, starting in January 2009. Further, we focus on the underlying CDS contracts' standard maturity of five years, as this approach is in accordance with the finance literature in this field.

In line with earlier empirical studies working with CDS data, we also use last-quoted monthly data for the performed panel analysis in order to reduce distortions from autocorrelation (Zhang *et al* 2008). We excluded all reference entities that were not publicly listed (because information on equity returns and their respective volatility is needed for our set of control variables), had CDS spreads quoted for less than thirty-six months or had missing values. We also excluded the reference entities that are headquartered in countries where sovereign CDS quotes were not available for the whole observation period. To complete our data set, we had to combine various sources of data: from the Bloomberg trading platform, we retrieved the CDS spreads of reference entities and countries; from Thomson Reuters Datastream, we extracted equity prices, equity index levels, interest rates and balance sheet data, if publicly available; and, from the Standard and Poor's (S&P's) Capital IQ database, we collected data to determine the ratio of bank debt over total debt. Finally, we had to analyze the individual annual reports of the corporations in order to obtain the ratio of revenue in their home countries over their total revenue.

TABLE 1 Overview of mean CDS spreads across rating categories.

	Aaa–Aa3	A1–A3	Baa1–Ba1
2009–11	128.79	104.27	131.89
2009	99.26	108.73	155.2
2010	112.62	88.48	110.46
2011	174.47	115.88	130.16
Nondistressed country	115.33	97.62	128.21
Distressed country	165.31	176.76	183.65
Nonfinancial	70.12	98.05	131.89
Financials	142.75	153.59	N/A

Average CDS spreads of the respective index constituents for the three rating clusters: Aaa–Aa3, A1–A3 and Baa1–Ba1.

Having removed all observations with missing values, our sample of companies sums up to 107 reference entities (see the resulting company list in Table A.1 on page 22). Table A.2 on page 23 shows the distribution of companies across ten countries and a range of industries. The clustering of the latter into five industries is taken from the Markit iTraxx list and contains the following industries: autos and industrials, consumers, energy, financial and technology media telecommunications (TMT).

As the analyzed reference entities originate from different industries, countries and rating classes, we assume that the probability that our results are impacted by a selection bias is fairly small. Rating values are assigned according to Moody's rating classification; if this is not available, S&P's credit rating is used to determine the rating classes. In total, the iTraxx data sample consists of 3745 observations.

Table 1 presents an overview of the yearly mean CDS spreads across different rating categories. The expected negative relationship between quality of rating class (eg, low default probability) and level of CDS spreads is partially confirmed for our data sample, but, surprisingly, only for 2009 and not the total sample. We analyzed this effect further and found that it comes from the years 2010 and 2011, particularly from the nondistressed countries. Therefore, we detect an already well-documented trend of inconsistencies in the CDS spreads with regard to rating due to other influencing factors. (See, for example, Callen *et al* (2009) on the impact of earnings on CDS spreads. See Hull *et al* (2004) on the relationship between rating announcements and CDS spreads.)

Table 2 on the facing page displays summary statistics of the CDS pricing determinants. We list corporate CDS as the dependent variable, sovereign CDS as the major explanatory variable of interest and the control variables. Table A.3 on page 23 provides a list of all variables used in the analysis, including their respective

TABLE 2 Summary statistics.

Variable	Mean	Standard deviation	Minimum	Maximum	Observations
rCDS_Spread	0.0168	0.1810	−0.4917	0.9636	3.745
rCDS_Country	0.0350	0.2249	−0.3883	1.0678	3.745
rCDS_Liq	0.0437	0.4696	−17.1532	7.6550	3.745
rEQFirm	0.0064	0.0989	−0.5547	0.9020	3.745
rEQIndex	0.0049	0.0553	−0.1639	0.1888	3.852
rEQFirm_Vola	−0.0032	0.0628	−0.5213	0.7994	3.745
rLeverage	−0.0023	0.0599	−0.4349	0.9318	3.745
rGovt_2Y	−0.0028	0.2502	−0.7606	1.4286	3.745
rSlope	0.0161	0.4616	−0.8591	10.2675	3.745

definitions. Table A.4 on page 24 shows a correlation matrix that we used to check for multicollinear variables, which are not present.

5 METHODOLOGY

In the following, we will explain our measure for sovereign risk, as well as the main variables of interest and the standard set of control variables we included in our analysis. The empirical identification strategy is rather straightforward: we apply control variables in line with the existing literature to explain CDS spreads, and we add sovereign risk and some additional control variables to further disentangle the effect of sovereign risk on corporate credit risk. In addition, we control for company and time-fixed effects.

5.1 Sovereign risk and corporate credit default swaps

To measure the impact of sovereign risk on corporate CDS spreads, we include the matched maturity sovereign CDS spread (CDS_Country) of the company's home country in our regression analysis. As a first approximation, we show the distribution of the respective sovereign CDS spreads over the relevant time period (2009–11) clustered for distressed and nondistressed countries in Figure 1 on page 5.

What can clearly be seen from Figure 1 is that the CDS spreads for distressed and nondistressed countries start at pretty much the same level, and, during the analyzed time period, the spreads increase for both groups. It becomes obvious, though, that the spreads increase tremendously for the distressed country group.

Aside from the fact that the overall sovereign spread increased and the levels are different for the two groups, we would expect to see an increasing effect of sovereign risk on corporate spreads over time. We expect to see the increasing impact

of sovereign risk on company risk, particularly as our data set focuses on the European sovereign crisis, in which decreasing sovereign creditworthiness became a major issue for peripheral countries of the eurozone. At the same time, the credit spreads for core eurozone countries actually decreased, as investors were rushing into more secure government debt, driving down the corresponding yields. We control for this effect to ensure our analysis is robust with respect to industries and ratings.

In our further analysis, we want to disentangle the effect for areas of corporate activity; ie, we want to understand if the impact of sovereign risk is more pronounced for companies with a strong bias for asset side activities in their home countries. We measure this effect by the percentage of a company's revenue in their respective home country per year (ie, their revenue home-country ratio (RHC)). This information was hand-collected from the individual annual reports of the companies in our data sample. Thus, we capture not only the cross-sectional impact but also the time-series effect observed throughout the sovereign debt crisis in Europe. All calculations are based on historical euro exchange rates with regard to the markets not denominated in euros. Our hypothesis is that stronger reliance on local operations might increase the exposure to sovereign risk, as local business activity cannot be diversified with international exposure. We assume that, if sovereign risk is increasing, a country's economy becomes worse, putting pressure on domestic sales. Therefore, there should be a strong link between the local embeddedness of the business and the impact of sovereign risk on corporate creditworthiness.

In line with the existing literature (eg, Alter and Schueler 2012), we conjecture that sovereign risk having a large impact on corporate risk might stem from the liability side of the balance sheet, as the dependence on local banks with regard to the financing needs of the corporation might be interpreted as an increased exposure toward the creditworthiness of the sovereign. Greater sovereign risk is associated with higher CDS spreads, which, in turn, increases the refinancing costs for banks (Acharya *et al* 2013; Demirgüç-Kunt and Huizinga 2013). If local banks have to bear higher refinancing costs, interest rates for corporate loans will also go up. Particularly, when the financial intermediation system in the country follows a typical relationship-banking type of business model and the access to international capital markets is not so substantial, this effect might kick in. We therefore operationalize this analysis by looking at the percentage of bank lending over total lending (bank debt (BD)). The hypothesis is that a stronger reliance on local bank lending might increase the impact of sovereign risk on corporate risk. Bank lending is defined as the total amount of bank debt outstanding for each reference entity, including drawn credit lines and loans. It was derived on a quarterly basis from S&P's Capital IQ. Total debt is also based on quarterly figures for the observation period and includes long-term and short-term debt and capital leases for each of the reference entities.

5.2 Control variables

Based on the abovementioned existing literature on the drivers of CDS spreads, we analyzed a large universe of control variables, first on a univariate basis and second after testing for collinearity, by including a selected subset of the original covariates in our multivariate analysis. In the following, economic reasons for including a variable and operationalization and definition of the proxies are explained. Like other finance papers in the field, we follow Das *et al* (2009) and cluster the control variables into market-based, firm-based or trade-specific determinants.

5.2.1 Market-based determinants

Following Benkert (2004), we include the risk-free rate of return as the first market-based determinant in our regression and expect a negative relationship between the risk-free rate of return and the corporate CDS spread. Benkert (2004) argued that decreasing spot rates in recessionary times could be accompanied by higher corporate default rates, which, in turn, manifests as higher CDS spreads. We include the short-term rate by considering the two-year Treasury bond yields of the respective country of the underlying corporation (Govt_2Y).

As a second market-based variable, we include the slope of the term structure in our analysis, even though the empirical prediction of the direction of the impact is not particularly clear. Following Estrella and Mishkin (1996), a higher slope might imply an anticipated improvement of the overall economy, resulting in lower default probabilities and therefore decreasing CDS spreads. In contrast, following Zhang *et al* (2008), the higher slope could trigger increasing inflation rates, which might cause a deterioration in the overall macroeconomic conditions and result in higher CDS premiums. Despite contradicting hypotheses on the direction of the impact, we include the term structure in our analysis and follow Ericsson *et al* (2009). We calculate the slope at the end of each month in our observation period by subtracting the ten-year risk-free interest rate of the respective country from the two-year risk-free interest rates of the respective country. We then calculate the monthly change of the slope (rSlope) based on the difference.

Next, we include the equity index returns of the respective country (rEQIndex), the overall CDS index (Index) and the market volatility of the respective equity index (EQIndex_Vola) in our analysis. For each country of our data sample, we identified a primary blue chip equity index (eg, FTSE 100 for the United Kingdom) and calculated the corresponding monthly returns on the basis of end-of-month values. The overall CDS index returns (rIndex) are based on the iTraxx Investment Grades and include the most liquid 125 European reference entities. Again, the monthly returns (changes) are calculated in percentages based on end-of-month figures.

We expect a negative relationship between the equity index and CDS spreads. In line with Zhang *et al* (2008), we also expect market volatility and the CDS index to have a positive impact on the respective CDS spreads.

5.2.2 Firm-specific determinants

In line with the existing literature, we include the corporate rating in our analysis (Daniels and Jensen 2005). Following Cossin and Hricko (2001), the ratings are analyzed by either introducing dummy variables for each rating class or assigning numeric values (Rating) to each rating class, ranging from 1 for the highest rating (AAA or Aaa) to 17 for the lowest rating class (C). We use the Moody's long-term issuer credit rating for each corporation; if this is not available, the S&P's credit rating is used.

Besides rating, we include in our analyses the leverage ratio (Leverage) of the corporation, as the theory based on structural credit models indicates that the distance to default measured by leverage is a strong indicator for future creditworthiness (Merton 1974). Following Ericsson *et al* (2009), the leverage ratio of the reference firm i in month t is operationalized as follows:

$$\text{Leverage}_{it} = \frac{\text{Total debt}_{it} + \text{Preferred equity}_{it}}{\text{Market value (equity)}_{it} + \text{Total debt}_{it} + \text{Preferred equity}_{it}}, \quad (5.1)$$

with total debt and preferred equity being book values quoted on an annual basis. The market value of equity equals the market capitalization, which is defined as the factor of the last equity price and the number of shares outstanding at the end of month t. Following the indication of structural credit models, we also include firm-specific equity returns (rEQFirm) in our analysis, as the positive impact of returns on the equity of the underlying company might reduce the impact of a large leverage on CDS spreads (Zhang *et al* 2008). The same argument holds for equity volatility (EQFirm_Vola), which is defined as the rolling standard deviation σ_t over the twenty-four months prior to time t. Equity volatility is a good proxy for asset volatility, which is commonly used in pricing models for CDS spreads and seems not to be correlated with other explanatory variables (see Cossin and Hricko 2001). The historical market volatility (EQIndex_Vola) is estimated analogously.

5.2.3 Trade-specific determinants

Tang and Yan (2007) documented a pattern for CDS markets where higher liquidity has a negative impact on CDS spreads, which is the reason we include liquidity as an explanatory variable of corporate CDS spreads. Badaoui *et al* (2013) also reported the importance of liquidity risk to the risk premiums of sovereign CDSs, but this impact is already incorporated in the sovereign CDS spreads as our major variable

of interest. We therefore only use relative bid–ask spreads divided by the last price quote of the traded instruments in order to obtain a proxy for the liquidity (CDS_Liq) of the corporate CDS spreads from a transaction costs perspective. The last monthly bid-and-ask quotes are derived for each CDS contract.

6 EMPIRICAL RESULTS

6.1 Baseline regressions

Before we explain the results of our panel regression analysis, we describe briefly a set of tests on the underlying data set. We started with the Lagrange multiplier test for the serial correlation of errors (Wooldridge 2002) and continued by excluding the multicollinearity of the considered variables. With regard to the first step, we followed an established approach in the CDS literature. We applied the first differences approach (absolute change during one month) to cope with serial autocorrelation, but only the return approach (relative change during one month) solved the problem; this is indicated by the prefix "r" that is attached to each variable in our regression model.

With regard to multicollinearity, we had to remove the following variables from our multivariate analysis: CDS index (Index), volatility of the equity index of the respective country (EQIndex_Vola) and rating (Rating). We perform some robustness tests for rating, however.

After controlling for serial autocorrelation and multicollinearity, we specify a fixed-effect model based on a Hausman test and control for entity- and time-fixed effects. Moreover, we also employ a heteroscedasticity-robust variance matrix.[1]

Considering the adjustments discussed above, the general regression model can be described as follows:

$$\begin{aligned} r\text{CDS\_Spread}_{it} = {} & c + \beta_1 r\text{CDS\_Country}_{it} + \beta_2 r\text{CDS\_Liq}_{it} + \beta_3 r\text{EQFirm}_{it} \\ & + \beta_4 r\text{EQIndex}_{it} + \beta_5 r\text{EQFirm\_Vola}_{it} + \beta_6 r\text{Leverage}_{it} \\ & + \beta_7 r\text{Govt\_2Y}_{it} + \beta_8 r\text{Slope}_{it} + a_i + a_t + e_{it}, \end{aligned} \tag{6.1}$$

with a_i and a_t representing entity- and time-fixed effects.

If our hypotheses can be confirmed, we would expect sovereign risk and the corresponding measure rCDS_Country to have a significant and economically relevant impact on CDS spreads, with an increase over time and a pronunciation toward

[1] In order to test for heteroscedasticity, a modified Wald test for groupwise heteroscedasticity is performed, whereby the null hypothesis of equal group variances is rejected on high significance levels. In order to control for this effect, a heteroscedasticity-robust error variance matrix is employed (see, for example, White 1980).

countries that were hit more severely by sovereign crisis than others. The multiple regressions results of Table 3 on page 16 all rely on entity- and time-fixed effects.

The results in Table 3 indicate that sovereign CDS spreads are indeed significantly linked ($+0.104^{***}$) to the underlying corporate CDS spreads (column 1), and the explanatory power can be slightly increased by including our sovereign risk measure in the baseline regression (column 1 versus column 2). The control measures show the expected directions, even though it is worth mentioning that for the total sample displayed in column 1 the leverage measure shows insignificant results.

Further, we see that the impact of sovereign credit risk is actually increasing with the aggravation of the sovereign crisis in 2010 (column 3, which covers the time span from January 2009 to April 2010, versus column 4, which covers the time span between May 2010 and December 2011). The coefficient for the impact of sovereign risk on corporate debt more than doubled when compared with the earlier sample (0.128^{***} versus 0.0519^{*}), which is a strong indicator of the effect of increased influence of sovereign risk on corporate risk. At the same time, the explanatory power for this model (column 4) is significantly high compared with the baseline regression run on the total sample.

Besides the overall statistically significant impact of sovereign CDS spreads and an increase of this impact over time, we observe that the link is actually stronger for distressed countries that experienced massive refinancing problems followed by exorbitantly high interest rate levels (column 5 versus column 6): namely Spain and Italy. Out of our group of ten eurozone companies, Spain and Italy were the countries hit hardest by the sovereign debt crisis. However, they were not bailed out by the International Monetary Fund, as Greece was, for example. Both countries experienced significant refinancing problems, and, in the case of Spain, the European Central Bank was forced to provide financing for the local banking sector. The documented result does not come as a surprise, but the size of the impact (0.276^{*} versus 0.104^{***}) is remarkable. These latter results, however, have to be interpreted with care, as the observations in the distressed countries (thirteen companies) are fewer than in the nondistressed country sample (94 companies). Therefore, we performed an additional (unreported) analysis using the median sovereign CDS spread during the sample period, rather than a digital distressed flag. We divided the countries into two groups, with the median as the cutoff point, thereby increasing the number of countries in the group with refinancing problems. This gave us some interesting results: the effect is robust even for this broader definition of distress. The coefficients for distressed countries above the median sovereign spread become 0.186^{***}, compared with 0.276^{***} for the digital definition of distress, and the coefficients for the nondistressed countries are 0.0492^{**} compared with 0.0933^{***} in the narrow definition sample.

6.2 Robustness

As we had to remove the variable rating from our analysis (it dropped off in the multivariate regression), we performed the underlying baseline regression for subsamples of rating categories. This is because we want to know if the effect is stable across ratings.

As can be seen from Table 4 on page 18, the effect of sovereign risk on corporate risk for the full sample is very pronounced for the rating category covering ratings from A1 to A3, which indicates intermediate credit quality (0.119***). For the worst rating categories (Baa1–Ba1), the effect is significant but smaller than for the medium ratings (0.0999***). We do not find a significant effect for the highest rating categories. We interpret these results in the direction that the impact of sovereign risk is rather robust across rating categories, but it is particularly pronounced in the medium- and lower-ratings categories. The better ratings do not show a significant result, which might be interpreted in the sense that, in this category, the sovereign risk does not have an impact on the corporate risk. Since ratings are quite often correlated with company size (eg, the average size of AAA-rated companies is higher than the size of a BBB-rated company), we conducted unreported robustness checks for size (measured by total assets). We can conclude from a sample spilt analysis (with median as cutoff) that the results for the impact of sovereign risk on corporate risk are robust for corporations of different sizes (0.102*** for small companies versus 0.0964** for large companies). We also tried including size in the baseline regressions but without any impact on the observed levels of significance. We therefore consider our results to be robust against size effects in the underlying sample. Given that our empirical analysis focuses on the most liquid CDS spreads written on the biggest European counterparties (eg, our sample is based on the iTraxx constituents), the dispersion with regard to size is biased in our data sample toward big corporations.

As a second robustness test, we performed the above baseline regression again on a sample excluding banks. The economic reasoning for this is based on a potential endogeneity issue, which might stem from a reverse causality caused by banks: if part of the sample consists of systemically important banks (especially in stressed countries), the health of the banking sector might impact sovereign risk. We can confirm that our results in the baseline regressions are robust against reverse causality (the coefficient for the impact of sovereign risk becomes 0.0901*** compared with 0.104*** in column 1 of Table 3 on the next page), and the results are also robust for the sample split with regard to years (0.0561* for the nonbank sample versus 0.0519* for the total sample for January 2009 to April 2010, and 0.104*** for the nonbank sample versus 0.128*** for the total sample for May 2010 to December 2011). For the distressed countries, however, we cannot confirm the impact of sovereign risk on corporate risk after we excluded banks from the sample; here, the effect seems to be

TABLE 3 Impact of sovereign risk on corporate CDS spreads. [Table continues on next page.]

Dependent variable sample	rCDS_Spread Jan 2009–Dec 2011	rCDS_Spread Jan 2009–Dec 2011	rCDS_Spread Jan 2009–Apr 2010	rCDS_Spread May 2010–Dec 2011	rCDS_Spread Nondistressed	rCDS_Spread Distressed
rCDS_Country	0.104***	0.0519*	0.128***	0.0933***	0.276***	
	[0.0206]	[0.0307]	[0.0290]	[0.0213]	[0.0797]	
rCDS_Liq	−0.0290**	−0.0293**	−0.0717***	−0.0146**	−0.0303**	−0.0466***
	[0.0112]	[0.0114]	[0.0247]	[0.00712]	[0.0127]	[0.0136]
rEQFirm	−0.339***	−0.333***	−0.306***	−0.455***	−0.314***	−0.406***
	[0.0454]	[0.0463]	[0.0684]	[0.0574]	[0.0480]	[0.0838]
rEQIndex	−0.292**	−0.348***	−0.340**	−0.178	0.0220	−0.913*
	[0.120]	[0.122]	[0.162]	[0.171]	[0.123]	[0.459]
rEQFirm_Vola	0.209***	0.200***	0.199**	0.181***	0.177***	0.252**
	[0.0415]	[0.0415]	[0.0852]	[0.0454]	[0.0437]	[0.0871]
rLeverage	−0.0539	−0.0468	−0.188*	−0.0436	−0.0207	−0.555*
	[0.0565]	[0.0575]	[0.110]	[0.0638]	[0.0563]	[0.273]

TABLE 3 Continued.

Dependent variable sample	rCDS_Spread Jan 2009–Dec 2011	rCDS_Spread Jan 2009–Dec 2011	rCDS_Spread Jan 2009–Apr 2010	rCDS_Spread May 2010–Dec 2011	rCDS_Spread nondistressed	rCDS_Spread distressed
rGovt_2Y	0.0442***	0.0523***	0.0179	0.0554***	0.00559	−0.0425
	[0.0140]	[0.0144]	[0.0286]	[0.0175]	[0.0159]	[0.0671]
rSlope	−0.0102***	−0.0104***	0.0685	−0.0110***	0.00695	−0.0109
	[0.00351]	[0.00350]	[0.0722]	[0.00343]	[0.0310]	[0.00630]
Constant	−0.161***	−0.0111	0.00252	−0.0468***	−0.190***	0.129*
	[0.0143]	[0.00895]	[0.0179]	[0.0128]	[0.0163]	[0.0605]
Time-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Entity-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3745	3745	1605	2140	3290	455
R^2	0.580	0.575	0.497	0.625	0.577	0.789
Number of CDS_ID	107	107	107	107	94	13

Standard errors in brackets. ***, ** and * denote $p < 0.01$, $p < 0.05$ and $p < 0.1$, respectively. This table shows the results of a regressional analysis with the monthly changes in the corporate CDSs premium as the dependent variable. The regression analysis covers the time period January 2009–December 2011 and includes monthly observations for a total of 107 major European companies. The independent variables include rCDS_Country (monthly change (%) in corresponding sovereign CDS spread), rCDS_Liq (monthly change (%) in the liquidity of the corporate CDS spread), rEQFirm (monthly change (%) in the underlying corporate stock price), rEQIndex (monthly change (%) in the corresponding national equity index), rEQFirm_Vola (monthly change (%) in the underlying equity volatility), rLeverage (monthly change (%) in the underlying leverage of the corporation), rGov_2y (monthly change (%) in the corresponding national two-year government interest rate) and rSlope (monthly change (%) of the interest rate curve).

TABLE 4 Ratings.

	Sample split for rating categories			
Dependent variable sample	**rCDS_Spread Aaa–Aa3**	**rCDS_Spread A1–A3**	**rCDS_Spread Baa1–Ba1**	**rCDS_Spread total sample**
rCDS_Country	0.0774	0.119***	0.0999***	0.104***
	[0.0510]	[0.0386]	[0.0247]	[0.0206]
rCDS_Liq	−0.0109	−0.0521***	−0.0428***	−0.0290**
	[0.00666]	[0.0114]	[0.00952]	[0.0112]
rEQFirm	−0.235***	−0.212*	−0.334***	−0.339***
	[0.0634]	[0.112]	[0.0530]	[0.0454]
rEQIndex	0.0295	−0.441*	−0.224	−0.292**
	[0.179]	[0.228]	[0.207]	[0.120]
rEQFirm_Vola	0.121*	0.185***	0.166***	0.209***
	[0.0665]	[0.0637]	[0.0604]	[0.0415]
rLeverage	−0.125	−0.00721	−0.0129	−0.0539
	[0.229]	[0.143]	[0.0552]	[0.0565]
rGovt_2Y	0.0694***	0.0442	0.0430**	0.0442***
	[0.0204]	[0.0317]	[0.0183]	[0.0140]
rSlope	−0.00504**	0.00489	−0.00703*	−0.0102***
	[0.00235]	[0.00330]	[0.00392]	[0.00351]
Constant	−0.239***	0.160***	−0.155***	−0.161***
	[0.0232]	[0.0363]	[0.0221]	[0.0143]
Time-fixed effects	Yes	Yes	Yes	Yes
Entity-fixed effects	Yes	Yes	Yes	Yes
Observations	910	1156	1679	3745
R^2	0.714	0.566	0.620	0.580
Number of CDS_ID	26	34	48	107

Standard errors in brackets. ***, ** and * denote $p < 0.01$, $p < 0.05$ and $p < 0.1$, respectively. This table shows the results of a regressional analysis with the monthly changes in the corporate CDSs premium as the dependent variable. The regression analysis is clustered into three rating clusters: Aaa–Aa3, A1–A3 and Baa1–Ba1.

strongly driven by the financial industry, which is strongly and significantly affected by the respective sovereign risk.

Finally, the results are robust and comparable with regard to the abovementioned rating analysis for both the total and nonbank samples.

6.3 Does a (local) home-market bias drive the results?

Does a (local) home-market bias drive the results? In a second step, we try to understand the reasoning behind the documented impact of sovereign risk on the pricing of the underlying corporate CDS spreads. For most companies, the domestic market

(where the company is headquartered) is the key market, typically with the most operational activity taking place. Thus, we argue that the negative impact of sovereign risk on the corporate credit risk level is justified. Therefore, a negative outlook for the domestic economy is ultimately linked to decreasing sales, which, in turn, will trigger a lower level of profitability and a lower creditworthiness of local corporations. Accordingly, we hypothesize that a strong home-country bias of revenues leads to a higher dependency of corporate creditworthiness on sovereign risk.

As can be seen in Table 5 on the next page, we addressed this issue by analyzing two different groups of subsamples. In column 1, we analyzed a subsample of companies where less than 29% of the annual revenue, which corresponds to about the median of the total sample, stems from the home country of the company (defined by the location of its headquarters). Column 2, on the other hand, shows the companies that earn more than 29% of their revenue in their home country. We find that the coefficient for sovereign risk increases to 0.139*** for companies with a strong home-country bias in revenues, as opposed to a coefficient of 0.068*** for the other sample. We conjecture from these results that the strong reliance of revenue on the home country increases the impact of sovereign risk on corporate risk. The result itself is not surprising; however, the sheer size of the effect, almost double the effect for companies with a stronger national exposure in terms of revenue, is quite remarkable.

We also control for the refinancing activities of companies, which may be affected by the conditions of the corresponding sovereign risk. During the European sovereign debt crisis, banks in distressed countries experienced difficulties refinancing themselves. This shortage of capital supply drove up banks' refinancing costs. Under the assumption that borrowing from banks is predominantly a domestic business, we could argue that a greater dependency on (local) bank debt should also lead to the sovereign counterparty risk having a greater affect on corporate CDS spreads.

Accordingly, we analyzed the refinancing side of the companies and the ratio of bank debt over total debt to get an approximation of the dependence on the local/national lending market with regard to corporate refinancing. As can be seen in Table 5 on the next page, we again split the sample into companies with less than or equal to 8.57% bank debt over total debt, with the cutoff being the median of the overall sample (column 3). It is worth noting that the median is rather low for a sample of European firms; we would have expected them to have a stronger reliance on banking relationships. However, access to international capital markets seems to be given and comparable to companies from other jurisdictions (eg, the United States).

Column 4 displays the companies with higher bank-debt-to-total-debt ratios, ie, ratios that are higher than the median. As can be seen from the analysis, the coefficients

TABLE 5 Subsample analysis for RHC and BD.

	Sample split for RHC		Sample split for BD	
Dependent variable sample	**rCDS_Spread RHC < Median (29%)**	**rCDS_Spread RHC > Median (29%)**	**rCDS_Spread BD ⩽ Median (8.57%)**	**rCDS_Spread BD > Median (8.57%)**
rCDS_Country	0.0676***	0.139***	0.0967***	0.121***
	[0.0241]	[0.0362]	[0.0298]	[0.0250]
rCDS_Liq	−0.0516***	−0.0190*	−0.0482***	−0.0204**
	[0.0142]	[0.0106]	[0.0130]	[0.00980]
rEQFirm	−0.277***	−0.386***	−0.347***	−0.327***
	[0.0773]	[0.0536]	[0.0598]	[0.0621]
rEQIndex	−0.128	−0.401***	−0.386***	−0.173
	[0.180]	[0.146]	[0.143]	[0.184]
rEQFirm_Vola	0.171***	0.236***	0.187***	0.255***
	[0.0622]	[0.0527]	[0.0544]	[0.0619]
rLeverage	0.0487	−0.205**	−0.134*	0.00272
	[0.0596]	[0.0822]	[0.0790]	[0.0616]
rGovt_2Y	0.0240	0.0568***	0.00559	0.0717***
	[0.0209]	[0.0191]	[0.0212]	[0.0171]
rSlope	−0.0178***	−0.00833*	−0.0184***	−0.00907**
	[0.00424]	[0.00433]	[0.00424]	[0.00419]
Constant	−0.201***	−0.0951***	−0.0935***	−0.0469
	[0.0229]	[0.0192]	[0.0171]	[0.0405]
Time-fixed effects	Yes	Yes	Yes	Yes
Entity-fixed effects	Yes	Yes	Yes	Yes
Observations	1880	1865	1852	1893
R^2	0.590	0.601	0.585	0.587
Number of CDS_ID	57	58	88	85

Standard errors in brackets. ***, ** and * denote $p < 0.01$, $p < 0.05$ and $p < 0.1$, respectively. This table shows the results of a regressional analysis with the monthly changes in the corporate CDSs premium as the dependent variable. The regression analysis covers the time period January 2009–December 2011 and includes monthly observations for a total of 107 major European companies. The independent variables include rCDS_Country (monthly change (%) in corresponding sovereign CDS spread), rCDS_Liq (monthly change (%) in the liquidity of the corporate CDS spread), rEQFirm (monthly change (%) in the underlying corporate stock price), rEQIndex (monthly change (%) in the corresponding national equity index), rEQFirm_Vola (monthly change (%) in the underlying equity volatility), rLeverage (monthly change (%) in the underlying leverage of the corporation), rGov_2y (monthly change (%) in the corresponding national two-year government interest rate) and rSlope (monthly change (%) of the interest rate curve).

of the two samples for the impact of sovereign risk are slightly different (0.121*** versus 0.097***), but, due to large standard errors, the resulting difference is not significant. Therefore, we interpret our results as follows: the dependence of corporate activity on national markets has a strong influence on the exposure of the corporation

toward sovereign risk. This effect is, however, not confirmed for the refinancing side of the company's balance sheet.[2]

Our interpretation is further confirmed by unreported regression analyses that we performed in order to better understand the impact of RHC and BD. Therefore, we included the interaction terms RHC*rCDS_Country and BD*rCDS_Country in the analysis and introduced BD and RHC as additional explanatory variables. Through these tests, our preliminary results from the sample splits can be confirmed: the relationship between BD and the impact of sovereign risk is not given, ie, the interaction term is neither statistically significant nor economically relevant. The analysis for the home-country bias, however, shows a positive and significant value for the interaction term (0.093*), which supports our result that the exposure toward sovereign risk is more severe and heavily influenced by the percentage of operational activity of the company in its home country.

In an unreported subsample analysis, we again controlled for the impact of the banking sector. The results that rely on a subsample excluding banks are fairly robust for the subsample without banks; the effect of revenue in the home country is a little less pronounced but still solid and significant for the nonbanking sample (0.0660** versus 0.0999*** compared with 0.0676*** versus 0.139*** in the total sample). The same holds for the impact of bank debt, with comparable results between the overall and nonbank samples.

7 CONCLUSION

Against the background of the recent sovereign debt crisis in Europe, we showed that, for CDS markets, sovereign risk overleaps to the pricing of corporate debt instruments. We extended the existing literature and found that this effect is present not only for banks but also for corporates from other industries. We documented that the impact of sovereign CDS is highest in the case of the so-called peripheral eurozone countries. It also increased for the whole data sample with an intensifying sovereign debt crisis in 2010–11. We are the first to explain this effect by a strong dependence to the local market of a country in which a corporation is headquartered: the impact of sovereign risk increases with a home bias to the local market (eg, a high domestic sales ratio). However, we do not find significant empirical proof that the link between sovereign risk and corporate credit risk is driven by access to local bank financing.

[2] This interpretation, however, needs to be handled with care, as per definition the sample suffers from a sample bias toward large corporations. The observed link between sovereign risk and corporate credit risk with regard to bank debt may be even stronger for small-to-medium enterprises (SMEs) that rely more heavily on bank financing, as other authors have confirmed (Bedendo and Colla 2013).

APPENDIX A

TABLE A.1 Reference entities.

Selection of iTraxx Europe Index Series 17 companies		
Adecco	E.ON	RWE
Aegon	EADS	Rentokil Initial PLC
Ahold Koninkljike	EDF	Repsol
Akzo Nobel NV	Electrolux AB	Royal Bank of Scotland
Allianz	EnBW	SABMiller PLC
Alstom SA	Enel	STMicroelectron
Anglo American PLC	Eni	Sanofi
Assicurazioni Generali	Ericsson	Siemens AG
Aviva	Experian PLC	Société Générale
Axa	France Telecom	Solvay SA
BAE Systems PLC	GDF Suez	Suedzucker AG
BASF	Gas Natural SDG	Svenska Cellulosa AG
BMW AG	HSBC	Swiss Re
BNP Paribas	Hannover Rueck	Tate & Lyle
BT Group	Henkel AG	Telecom Italia
Banca Monte di Paschi di Sie	Holcim Ltd	Telefonica
Banco Bilbao Vizcaya Argentaria	Iberdrola	Telekom Austria
Banco Santander	Imperial Tobacco Group	TeliaSonera
Barclays	Intesa Sanpaolo	Tesco
Bayer AG	KPN Kon	Total
Bouygues SA	Kingfisher PLC	UBS
British American Tobacco PLC	LVMH	UniCredit
British Sky	Lanxess	Unilever
Carrefour SA	Linde AG	United Utilities
Casino Guichard	Lloyds Banking Group	Valeo SA
Centrica	Marks & Spencer	Veolia
Cie de St-Gobain	Metro AG	Vinci SA
Commerzbank	Michelin	Vivendi
Credit Agricole	Muenchner Rueck	Vodafone
Credit Suisse	Nestle SA	Volkswagen AG
DSM Koninklijke	Next PLC	Volvo AB
Daimler AG	PPR	WPP
Danone SA	Pearson	Wolters Kluwer
Diageo PLC	Philips Electronics Kon	Xstrata PLC
Deutsche Bank	PostNL NV	Zurich
Deutsche Telekom	Publicis Groupe	

Markit iTraxx Europe Index Series 17 final member list comprises 125 CDS contracts on senior unsecured debt with maturity five years on investment grade entities. The Markit index rolls every six months. In our analysis, we used the above 107 entities.

TABLE A.2 Diversification across industries/countries.

Industries	iTraxx	Country	iTraxx
Autos & Industrials	27	Austria	1
Consumers	24	Belgium	1
Energy	14	France	24
Financials	25	Germany	20
TMT	17	Italy	7
		Netherlands	9
		Spain	6
		Sweden	5
		Switzerland	8
		United Kingdom	26

Number of reference entities used clustered per iTraxx industry segment and country of origin.

TABLE A.3 Definition of variables.

(a) Dependent variable	
rCDS_Spread	Monthly change (%) in the corporate CDS premium
(b) Independent variables	
rCDS_Country	Monthly change (%) in corresponding sovereign CDS spread
rCDS_Liq	Monthly change (%) in the liquidity of the corporate CDS spread
rEQFirm	Monthly change (%) in the underlying stock price
rEQIndex	Monthly change (%) in the corresponding national equity index
rEQFirm_Vola	Monthly change (%) in the underlying equity volatility
rLeverage	Monthly change (%) in the underlying leverage of the corporation
rGovt_2Y	Monthly change (%) in the corresponding two-year government interest rate
rSlope	Monthly change (%) of the interest rate curve

TABLE A.4 Correlation matrix.

	rCDS	rCDS_ Country	rCDS_ Liq	rEQFirm	rEQIndex	rEQFirm_ Vola	rLeverage	rGovt_ 2Y	rSlope
rCDS	1								
rCDS_Country	0.4676	1							
rCDS_Liq	−0.1079	0.003	1						
rEQFirm	−0.4744	−0.3822	0.0155	1					
rEQIndex	−0.5891	−0.5709	0.0193	0.6252	1				
rEQFirm_Vola	−0.011	−0.0959	0.0004	0.1931	0.0643	1			
rLeverage	0.3376	0.2675	−0.003	−0.6496	−0.4604	−0.0224	1		
rGovt_2Y	−0.1482	−0.13	0.0194	0.1112	0.1526	−0.0872	−0.0954	1	
rSlope	−0.0711	−0.0151	0.0003	0.0264	0.0468	0.0134	−0.0261	−0.1495	1

DECLARATION OF INTEREST

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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