Financial Sector Linkages and the Dynamics of Bank and Sovereign Credit Spreads

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Abstract

We show that financial linkages across borders are priced in the CDS markets. We construct a measure of the foreign exposure risk of a country's banking system using detailed information on the actual composition of its foreign exposures. Our measure helps explain CDS premia of banks. Implicit and explicit guarantees extended to a country's banking system in turn affect the CDS premia of the sovereign. As a consequence, foreign exposures of banks impact the dynamics of sovereign CDS spreads. Another measure including both foreign and domestic assets of the banks is highly significant in explaining bank CDS spreads even before the onset of the crisis.

Credit risk, banks, sovereign risk; **JEL:** G01; G15; G21

1. Introduction

The European debt crisis has focused the attention on bank holdings of both domestic and sovereign debt as an important source of contagion risk. We focus in this paper on an additional source of risk on the banks' asset side, namely the claims on banks and the non-bank private sector in other countries. We show that these exposures in addition to foreign sovereign exposures are important determinants of bank CDS premia. Furthermore, sovereign risk is affected by the risk of the domestic banking system through explicit and implicit bank guarantees and this leads to our second finding that sovereign CDS spreads are influenced by the foreign exposures of domestic banking systems. Hence interlinkages between countries through their banking systems are an important source of co-movement of sovereign CDS spreads.

In order to show that foreign exposures in themselves are important for understanding bank and sovereign risk, we first construct an exposure-weighted risk measure for all banking systems in our sample. From consolidated banking statistics from BIS, we learn the size of aggregate exposures of banks in one country to non-nationals, i.e. the public sector, bank and non-banks in other countries. These cross-country exposures are combined with CDS data to obtain a risk-weighted exposure measure. Our construction captures that large exposures to one country are primarily important when the credit risk of that country is high, and we obtain time-series variation in our meaasure both through shifts in the exposure patterns and through the changes in riskiness of these exposures. We show that our measure is an important determinant of bank CDS spreads after controlling for both global and local factors.

To quantify the effect of the contingent liabilities of sovereigns arising from implicit or explicit guarantees of the banking system, we combine information on the size of the banking system relative to GDP with the riskiness measured both through CDS premia and bank EDFs. As one would expect, these guarantees greatly influence sovereign CDS premia, even after controlling for traditional local fiscal measures and global factors. The natural final step is then to check whether sovereign risk is affected by the foreign exposures of domestic banks through bank guarantees and our final results show that that is indeed the case.

We also propose and extension of our risk measure for foreign exposures which takes into account the full exposure of banking systems. The extended measure combines the first risk measure with information on the relative size and riskiness of exposures to domestic government bonds and other domestic residents.

Both measures are shown to be significant in explaining changes in bank CDS spreads throughout the sample period. If we spilt our sample into a period ending in Q4:2007 close to the Bear Sterns collapse and a sample ranging from Q1:2008 to Q4:2010 and we control for global and local factors, the effect of the measure based on foreign exposures alone is not significant in the first half the sample, but it is strongly significant after the onset of the crisis. Our second measure is significant both in the full sample and in the two subsamples.

The literature on banking crises and on the role of bank risk in explaining sovereign debt crises is extensive. Reinhart and Rogoff (2009) provide an extensive account on these issues in their comprehensive treatment of financial crises through eight centuries. Reinhart and Rogoff (2011) document the link between the banking crisis and sovereign default, in different countries and in a historical perspective. Gennaioli, Martin, and Rossi (2012) provide theoretical underpinnings and evidence for the transmission of a sovereign debt crisis to the banking system and the real economy, through the banks' holdings of sovereign debt. Caceres, Guzzo, and Segoviano (2010) and Borri and Verdelhan (2012) study the impact of risk aversion on sovereign bond yields in the euro area, and the emerging markets, respectively. We focus on quantifying cross-country interlinkages that can be identified by looking at the asset side of the banks' balance sheets and we show that the measures we propose have explanatory power in addition to both global common factors and local measures of default risk of large classes of domestic borrowers. There are several theoretical reasons why we would expect such linkages to matter. For example, Kaminsky, Reinhart, and Vegh (2003) argue that a crisis of one country may spill into other countries in the presence of a "large common creditor" who in the face of losses in one country has to delever positions in other countries. This common creditor might be collections of other banks, financial institutions, or hedge finds. The same type of mechanism is explained in more detail in Tressel (2010) who specifically models the deleveraging of banks in countries whose banks have been exposed to losses in one country. In his calibration, Tressel (2010) also uses the consolidated banking statistics from BIS for his model calibration but he does not focus on the detailed time series of these statistics.

Whether network effects survive as explanatory variables once global common factors have been accounted for is not widely agreed upon. For example, Eichengreen, Mody, Nedeljkovic, and Sarno (2009) use dynamic principal component analysis to identify common latent factors underlying the dynamics of CDS premia for 45 banks in the US and 8 European countries. In their analysis of all possible combinations of pairwise influences, they find a very limited role of direct contagion. Our risk-weighted aggregate measure of exposure to all other banks does survive even after correcting for observable common factors. Rose and Spiegel (2010) find "remarkably little evidence that the intensity of the crisis across countries can be easily modeled using quantitative techniques and standard data that is either country specific or links countries to the source of the crisis." This paper shows that BIS statistics and CDS spreads do indeed contribute to our understanding of cross-border contagion. Degryse, Elahi, and Penas (2010) also use BIS consolidated banking statistics as a basis for simulating how shocks to one country's banking system may propagate through the international linkages and cause contagious defaults. Their focus is not on CDS spreads and their data end in 2006 whereas we cover the current financial crisis all through 2010.

Our paper supplements Acharya, Drechsler, and Schnabl (2011) in several aspects. They focus on the two-way feedback effect between sovereign and bank credit risk (see also Bolton and Jeanne (2011)) which we strongly confirm but with several important differences in the empirical analysis. While we also consider sovereign risk factors in our explanation of bank CDS spreads, we also include private exposures - both foreign and domestic - in our bank fundamentals. This is important since the bulk of banks' foreign exposures are to the private sector and not sovereigns. The decomposition of bank exposures to which we have access to gives a clear picture of the role of financial linkages in the determination of bank credit risk and our EDF measures also add information on the risk of bank assets. In this sense our explanatory variables are closer to true bank fundamentals than bank equity returns used in Acharya, Drechsler, and Schnabl (2011). Furthermore, for the purpose of analyzing the role of banking risk for sovereign credit risk, we extend the modeling of government guarantees. As in Acharya, Drechsler, and Schnabl (2011) we include the size of the explicit guarantees made in the wake of the Lehman default, but we use different measures to quantify the size of the guarantees. We also include a dynamic measure of the size of the contingent liability (or implicit guarantee) that the sovereign may be assumed to give for the domestic banking system.

Our paper is also related to literature on the dynamics of sovereign credit spreads, as presented for example in Longstaff, Pan, Pedersen, and Singleton (2011). The authors here show large commonality with the first principal component explaining 75% of variations in sovereign CDS spreads in the period 2007-2010. Most of the commonality in their study is driven by global factors, risk premiums and investment flows rather than local factors. We show that the risk of banks is a large component in sovereign credit spreads and that in turn, the interlinkages between banking systems across borders help explain variations in bank credit spreads.

2 The Risk-weighted Exposure Matrix

The key data describing the financial sector linkages are summarized in what we label the BIS exposure matrix. We now describe how this is used together with CDS premia to construct our risk measure for the major banks in each country. As an illustration, we use the case of Austria.

The publicly available consolidated banking statistics from BIS provide consolidated foreign claims of a national banking system in one country on all residents (i.e. public sector, banks and the non-bank private sector) of other countries. For example, the size of exposures of Austrian banks to residents of Hungary represents the aggregate claims of all Austrian-owned bank branches and subsidiaries around the world on all residents of Hungary, i.e. public sector, banks and the non-bank private sector. We do not have the precise exposures of the Austrian banking system to each of these three categories of residents, but we do know from other BIS statistics that the total claims held in Q4:2010 by BIS reporting banks outside of Hungary on banks, the public sector and the non-bank private sector in Hungary were 10%, 30% and 60%, respectively. This indicates a very significant portion of non-bank private debt, and this pattern is confirmed by the figures for BIS reporting banks' foreign claims on all the countries in the world. These were split between approximately 23% on banks, 19% on public sector and 58% on the non-bank private sector in Q4:2010.

To construct our measure of riskiness of foreign exposures, we will need a combination of BIS consolidated banking statistics measuring the size of the exposures and CDS premia either on large banks or sovereigns measuring the risk of the exposures. We include the foreign exposures of 17 countries: Austria (AT), Australia (AU), Belgium (BE), Switzerland (CH), Germany (DE), Denmark (DK), Spain (ES), France (FR), United Kingdom (GB), Greece (GR), Ireland (IE), Italy (IT), Japan (JP), Netherlands (NE), Portugal (PT), Sweden (SE), and United States (US).[1] The period covered is as with all our data Q1:2004 - Q4:2010.[2] Exposures of each of the 17 countries may well be to countries outside this set of 17 countries, and this is no problem as long as we have CDS data available for the banks or sovereigns for those other countries. For example, Korea and Iceland are not in our sample of 17 countries, since their banks do not report to BIS, but we are able to measure the riskiness of exposures *to* those two countries since there are CDS data available for their largest banks.

We do not include all foreign exposures of a country's banks, since for some countries a time series of CDS premia is not available for the sovereign or the banks. For that reason we choose to limit the counting of exposures until we have reached 85% of the total foreign exposure. More precisely, consider country A. Now list the countries to which the banks in country A are exposed and order the countries by the size of the average exposure over the sample period. Then select enough countries so that the exposure in Q4:2010 is at least 85% of total exposure. This creates a list of countries to which the banks in country A have the most significant exposures. We measure the riskiness of the foreign exposures by weighing each exposure with an appropriate CDS spread. If available, we use average bank CDS spreads for the two largest banks in the country of the exposure. The idea is that the

[1] We exclude Canada because we have no CDS data on Canadian sovereign debt, and we exclude BIS bank statistics reporting emerging markets because we have no CDS data for their banks.

[2] We use BIS consolidated statistics with residency of the ultimate obligor when available There are some holes in the data most notable prior to 2005 which are filled with foreign exposures on an immediate risk basis. The ultimate obligor refers to the counterparty who is ultimately responsible for servicing any outstanding obligations in the event of a default by the immediate borrower. Suppose that an Austrian bank extends a loan to a company based in Hungary and the loan is guaranteed by a US bank. On an immediate borrower basis, the loan would be considered a claim of an Austrian bank on Hungary, as the immediate borrower resides in Hungary. On an ultimate risk basis, however, the loan would be regarded as a claim of an Austrian bank on the United States since that is where the ultimate risk reside.We do not include foreign exposures via derivatives markets, guarantees extended and credit commitments as the data are not available for individual countries before December 2010. It is only for US banks that these other potential exposures account for a very large part of total foreign exposures. Our econometrics results are robust to making pro-rate adjustments for these other potential exposures in foreign claims.

riskiness of the private sector exposures in a given country are reflected in the CDS spreads of the largest banks in that country. When bank CDS spreads are not available for the risk weighting of exposures, as is typically the case for emerging markets, we use the sovereign CDS spreads instead. In emerging markets, a large part of the riskiness of an exposure is related to political risk and currency risk and these risks are also reflected in the sovereign CDS spreads. Empirical results in Dittmar and Yuan (2008) confirm the strong correlation between corporate credit spreads and sovereign credit spreads in emerging markets.

To illustrate the construction of our risk measure using BIS data, we return to the case of Austria. Table 1 shows the exposures to the countries towards which the Austrian banking system has its 19 largest exposures until 85% of the exposures are accounted for. The remaining exposures are collected under 'others'.

The table lists each aggregate foreign exposure as it was reported in Q4:2010. For example, the exposure to Germany was USD 42.9 bn on average throughout the entire period and it was USD 48.2 bn in Q4:2010. The list is ordered according to the largest average exposure. At the end of Q4 2010 the total foreign exposure of the Austrian banking system was USD 468.7 bn and as we see the exposure to Germany accounted for roughly 10% of this. At the end of Q4 the average CDS premium for the two largest banks was 126 bps. The risk-weighted sum of CDS spreads (in which the weights only sum to 0.86) is 163 basis points. Hence the weighted average CDS spread of the exposures that enter the sample is 1/0.86 * 163 bps = 190 bps. Note that this measure is a risk-weighted average of Austrian banks' exposure to other countries in Q4:2010. The measure changes through time as the weights of the exposures shift between countries and as the CDS spreads for the countries change. The risk-weighted foreign exposure is only expected to matter if the size of the exposure is large enough relative to other exposures. As shown in Table 2 the total exposure of the Austrian banking system is USD 1010 bn, i.e. the foreign exposures account for almost half of the total exposure.

Table 4 shows summary statistics on foreign exposures for each of the 17 countries. The table shows the relative size and the (foreign) country of the largest exposure. It also shows the standard deviation of the time-series variation in the relative size of the largest exposure. This standard deviation ranges from 0.02 to 0.1. While this does show some time-series variation in exposures, a much larger source of variation in our exposures measures

Table 1: **The foreign exposure matrix: Austria**

Rank	Country	Average (USD bn)	Q4 2010 (USD bn)	Share	Acc	Spread	Type	Share*CDS
1	DE	42.9	48.2	0.10	0.10	126	Bank	13
2	CZ	34.8	59.6	0.13	0.23	91	Sov	12
3	HU	23.2	35.0	0.07	0.34	378	Sov	28
4	RO	23.1	39.5	0.08	0.42	297	Sov	25
6	GB	21.6	15.8	0.03	0.26	169	Bank	6
5	HR	19.5	31.3	0.07	0.49	256	Sov	17
7	SK	18.8	27.9	0.06	0.55	82	Sov	5
9	US	17.4	16.3	0.03	0.58	132	Bank	5
8	IT	17.1	22.2	0.05	0.63	176	Bank	8
10	RU	11.0	15.2	0.03	0.66	147	Sov	5
11	NE	10.8	15.7	0.03	0.70	113	Bank	4
12	PL	9.6	14.3	0.03	0.73	144	Sov	4
13	SI	8.4	15.4	0.03	0.80	77	Sov	3
14	FR	8.3	9.3	0.02	0.75	142	Bank	3
15	RS	7.7	7.0	0.01	0.76	256	Sov	4
16	CH	7.7	11.2	0.02	0.82	100	Bank	2
17	UA	6.1	8.8	0.02	0.84	510	Sov	10
18	IE	6.0	2.9	0.01	0.83	1052	Bank	6
19	ES	5.5	6.7	0.01	0.86	259	Bank	4
-	Others	-	66.3	0.14	1.00	-	-	-
-	Total	-	468.7	1.00	1.00	-	-	163

The table shows the exposures to the countries towards which the Austrian banking system has its 19 largest exposures until 85% of the exposures are accounted for. There is not liquid historical CDS spread on Serbia (RS) and we thus use the one on Croatia (HR).

We compute the BIS exposure measure for the Austrian banking system by taking the weighted sum of CDS spreads for the 19 countries representing the largest exposures of the Austrian banking system. We use the share of total exposure as weight.

comes from the huge fluctuations in CDS premia. In addition, there is huge geographical variation in the countries to which different banks are exposed.

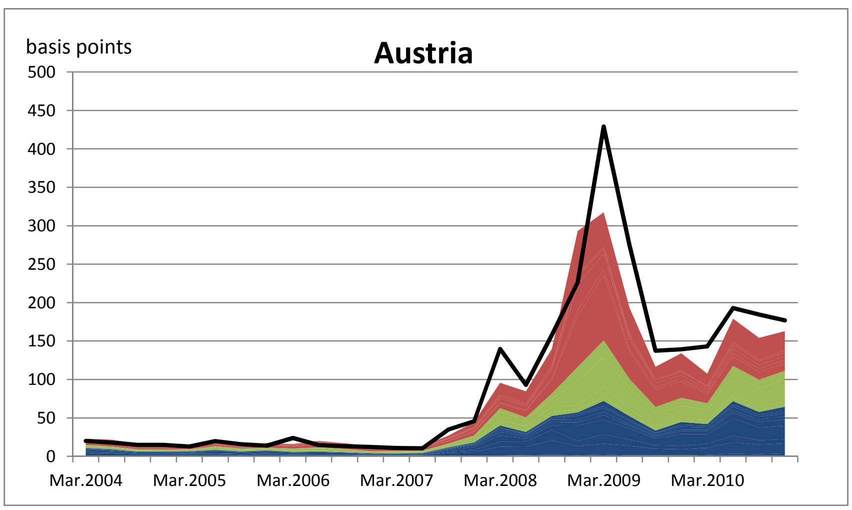
The average 5-yr CDS spread for the two largest Austrian banks depicted in Figure 1 shows a clear covariation with the exposure measure. Our hypothesis is that this covariation is not a coincidence or something caused by common variation in all CDS spreads. CDS markets in other words keep track of these expousres. To argue that this is the case, we will need to control for a number of factors, and we therefore first turn to a description of the data we will be using.

Table 2: **The total exposure: Austria**

Claims on	USD bn	% GDP	Share
Non-nationals	468.7	124	0.46
Domestic sovereign	77.7	20	0.08
Other domestic residents	464.0	122	0.46
Total	1010.4	266	1.00

The table shows the composition of assets for Austrian banks. The claims on the domestic sovereign include the domestic general government and the central bank. Assets are reported both in nominal value and as percent of GDP.

Figure 1: Austria dynamic exposure



The graph shows the exposure measure decomposed into major geographical regions. Red: Eastern Europe non-neighboring countries. Green: Eastern Europe neighboring countries (Czech Republic, Hungary, Slovakia and Slovenia). Blue: Other countries. The black curve shows the average CDS spread of the two largest Austrian banks.

3 The Data

The fundamental measure of bank and sovereign risk that we are trying to explain is CDS premia. In this section we detail the nature of the CDS data and the local and global variables that we use in our regressions. Table 5 and Table 6 contain an overview of the definition and data source behind all variables used in our regressions.

3.1 CDS Data

We use a core sample of 5-yr CDS spreads on 17 sovereigns where the contracts are denominated in US dollar or Euro. Table 7 shows summary statistics on sovereign CDS spreads. Note that every country for which we have data for the full sample period at some point had single digit spreads in basis points on their CDS contracts. The largest observed end-of-quarter premium is 1010 bps for Greece. The two countries with the lowest maximum observed premia are Germany (59 bps) and the US (67 bps).

Bank CDS data are denominated in the local currency. They are 5-yr contracts and have senior unsecured debt as reference obligation. Table 8 shows summary statistics on bank CDS spreads. The largest maximum spreads are for Greece and Ireland, and the lowest are for Japanese banks. Table 9 shows summary statistics on the risk-weighted CDS spreads. The lowest maximum is for the US whereas the highest maximum is for Greece and Austria. Note the considerable time-series variability of our measure for each country.

We obtain the CDS data from CMA which sources their information on executable and indicative prices directly from the largest and most active credit investors in the OTC market. Data from CMA are available daily since 2004 but we use end-of-quarter observations. There are some holes in the data most notably in the early period which are filled using the Fitch CDS pricing source. The included bank and sovereign CDS data often appear among the top references entities in the world with respect to net notional outstanding as reported by the Depository Trust & Clearing Corporation (DTCC).

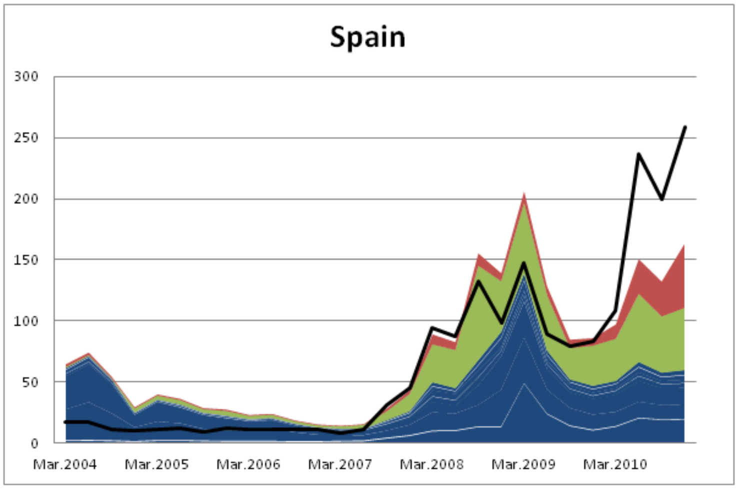
3.2 Local Bank Variables

To proxy for domestic default risk, we use an extensive data set of EDFs (Expected Default Frequencies) obtained from Moody's Analytics (Moody's KMV). EDFs provide an estimate of the default probability of a borrower. The estimate is obtained by using a structural model to back out firm asset value and asset volatility from observed equity prices and accounting information on leverage. From the estimated asset value and asset volatility, 'distance-to-default' (DD) is computed, and finally a non-parametric regression on historical data is used to find the empirical connection between DD and EDF, as explained in Crosbie and Bohn (2003).

Motivating our use of EDF data, it is useful to consider the case of Spain. Spain's BIS matrix exposure does not seem to explain the movement of Spain's average bank CDS spread throughout the entire period. As seen in Figure 2, there is an increase in CDS premia for the largest Spanish banks that is not explained entirely by the risk of their foreign exposures. To better understand the domestic drivers of default risk, we will also rely on Expected Default Frequency (EDF) measures as proxies for the bank's risk on domestic loans. Figure 3 shows the dynamics of median firm EDFs in three sectors: banking, non-financial corporates and for the real estate sector. While EDFs for both the corporate sector and the real estate sectors increase for Austria, they are at a higher level over the last two years of the sample in Spain, who sees a very large spike in the real estate EDFs and a also a higher level of corporate EDFs than Austria. The spike in bank EDFs in Spain is very large and in combination, Figures 1, 2 and 3 suggest that the crisis in Spain was much more driven by domestic factors and Austria's much more driven by foreign exposures. Table 3 lists the largest banks used to find the bank CDS spreads. In Austria, there is a high co-movement between the CDS spread for banks and the Austrian banks' foreign exposure-weighted CDS spreads. It indicates that Austrian banks were hit by a shock originating abroad, especially Eastern Europe. On the contrary, in Spain we see a low co-movement, indicating that the the credit risk primarily originated in the domestic economy.

Our extensive data set of EDF covers all countries used in our exposure matrix calculations and the data allow us to compute aggregate measures of default risk for a number of different sectors in the economy. We have sorted the EDFs into the following categories: banks, other financials, real estate, and corporate, according to their SIC codes. The EDFs in the real estate category are the ones with SIC codes for real estate firms, real estate investment firms and construction firms. In a robustness check, we have kept the EDFs in the real estate category using only those with SIC codes representing real estate firms and real estate investment firms, and included the construction firms in the corporate EDF category. For each country, we consider the median of the EDFs for each category as the relevant risk measure. We have tried using other quantiles of the EDF distribution as

Figure 2: Spain's dynamic exposure



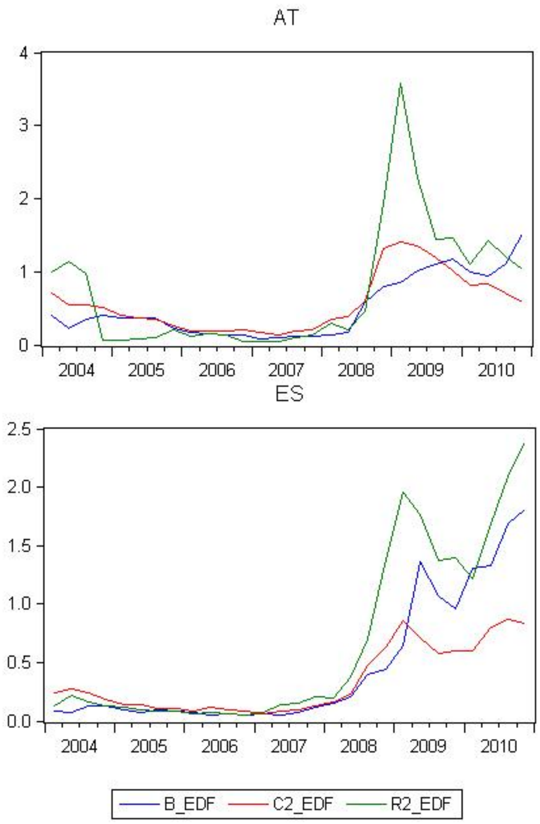
The graph shows the exposure measure for Spain decomposed into each of the two largest exposures and the remaining exposures. Red: GB; Green: Portugal; Blue: Other countries. The black curve shows the average CDS spread of the two largest Spanish banks.

well, but this did not change our results. While EDFs in general have strong predictive power, the level for banks has been suspected to be too low. Since we are focusing mainly on changes in EDFs this is a lesser concern in our paper, see Moody's (2010). Summary statistics on corporate EDFs are shown in Table 10, and Table 11 shows the corresponding statistics for the broad real estate category i.e. the one including construction firms.

3.3 Local Government Variables

For use in our regressions for sovereign CDS spreads, we have collected quarterly balance sheet data for the individual countries from IMF International Financial Statistics (IFS), OECD and Eurostat. We define sovereign debt using nominal values of debt from the "general government sector" which comprises the subsectors of central government, state government, local government and social security funds. We include net interest payments relative to revenue and changes in the estimated budget deficit. The latter variable requires further explanation: The quarterly lending revision is calculated as the sum of the most recent year-end and year-ahead budget projection by the OECD or the IMF minus the second most recent forecast for the same period

Figure 3: Bank, corporate and real estate EDFs for Austria and Spain



Austrian banks exposed to some increase in real estate and corporate risk, but the order of magnitude is far from that of Spain. Green: Real estate 5-yr EDFs; Blueish: Bank 5-yr EDFs; Red: Non-bank corporate 5-yr EDFs.

provided by the same organization. In quarters where they do not update a new budget projection we interpolate a forecast. Other macro variables related to sovereign risk that we use in our regressions are general government gross debt, long term external debt and the current account. Table 5 contains information on the sources of the data.

3.4 Global Variables

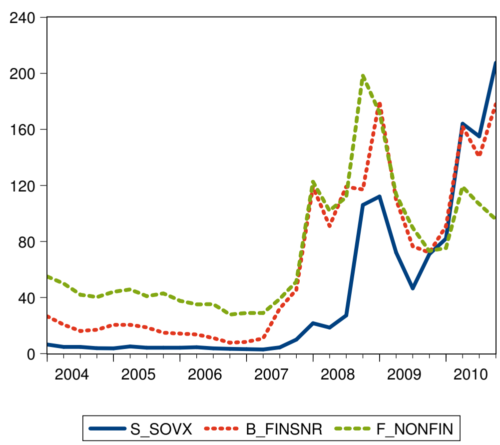
We include a number of global variables that have been used in other works to explain movements in sovereign credit spreads, see for example Longstaff, Pan, Pedersen, and Singleton (2011). These are particularly relevant to control for in our sovereign risk regressions as we wish to demonstrate the impact of banking guarantees and foreign exposures on the evolutions of sovereign CDS premia even after controlling for these factors. The variables we use are:

- Excess return for the U.S. stock market - computed as the difference between the value-weighted return on all NYSE, AMEX, and NASDAQ stocks (from CRSP) - and the three-month Treasury bill.
- Percentage changes in the 5 year constant maturity treasury yields.
- Percentage changes in the corporate yield spreads. The investment-grade yield spreads are computed on the basis-point yield spread between BBB and AAA industrial bond indices. The percentage changes in high-yield spreads are computed for the basis-point yield spread between BB and BBB industrial bond indexes. The used indices represent average yields of a broad cross-section of noncallable AAA-, BBB-, and BB-rated bonds with maturities approximately equal to five years. The source for the yield data is Bloomberg.
- The volatility risk premium. This is computed as the difference between the VIX index and the realized volatility for the S&P 500 index over the preceding three months. Source: Bloomberg.
- Percentage changes in the Libor-OIS spread which measures the difference between swap rates linked to collateralized and uncollateralized lending. Source: Bloomberg.
- Itraxx SovX Western Europe comprising 15 names from the Eurozone region plus Denmark, Norway, Sweden and United Kingdom that trade on Western European documentation. All constituents are equally weighted and we use a computed theoretical price based on individual CDS premia before the start of trading on 28 September 2009.
- The Markit iTraxx Non-Financials index comprising 100 equally-weighted European entities and the Markit iTraxx Non-Financials index which

comprises 25 equally-weighted European entities. For both the underlying reference obligations are senior unsecured debt.

Figure 4 shows the time-series behavior of the iTraxx indices. The figure clearly illustrates how the crisis which started in the banking sector and the corporate sector over time develops into a sovereign debt crisis.

Figure 4: iTraxx Financial, Non-Financial and SovX



The evolution in three major iTraxx CDS indices used for controlling for general levels of credit risk.

4 Bank Foreign Exposures and Bank CDS Dynamics

Our first task is to investigate whether movement in our risk-weighted exposure measure is capable of explaining movements in bank CDS spreads. Specifically, we analyze whether changes in the average of the CDS spreads of the two largest banks in a country can in part be explained by a change in the relative size and the riskiness of foreign exposures. We start by running the following crude panel regression:

$$
\begin{aligned}
\Delta(\text{B\_CDS})_{k,t} &= \alpha_{k,0} + \alpha_1 \times \Delta(\text{B\_BIS\_CDS})_{k,t} \\
&+ \alpha_2' \times \Delta(\text{Local Bank Variables})_{k,t} \\
&+ \alpha_3' \times \Delta(\text{Global Variables})_t + \epsilon_{k,t}
\end{aligned}
$$

Here, $\Delta(B\_CDS)_{k,t}$ denotes the change from quarter $t-1$ to t in average bank CDS spreads for country k. We follow this notation throughout, so that $\Delta(B\_BIS\_CDS)_{k,t}$ denotes the change in the exposure weighted credit spread for country k from quarter $t-1$ to t. This measure is constructed for each country in the sample and for each quarter exactly as explained for the case of Austria. Local Bank Variables are EDF measures for different sectors which control for the risk of domestic borrowers. Finally, the Global Variables is a vector of variables listed in section 3.4. The result is reported in Table 15. We perform the regression both for the full sample and for two subperiods. The first subperiod is from Q1:2004 until Q4:2007 and the second subperiod starts from Q1:2008 - the quarter in which Bear Stearns was rescued - and runs until the end of 2010. The regression uses Ordinary Least Squares (OLS) with robust standard errors and fixed effects.

The exposure-weighted credit spread is highly significant in the full sample and in both subsamples. Using the full sample results, a 100 basis point increase in the exposure-weighted credit spread corresponds to a 100 basis point increase in the average bank CDS spreads. Note that this is a panel regression result - i.e. we are estimating the same coefficient for all 17 countries.

The real estate EDF measure, R2_EDF, which measures median default probabilities in the real estate sector (broadly defined), is also highly significant in the full sample and in the second subsample consistent with the important role played by real estate in bank losses during the financial crisis. In contrast, none of the other local or global variables are significant even at the 5% level in the full sample. Surprisingly, the more general corporate EDF measure for the entire corporate sector, C2_EDF is not significant. This could be due to a multi-collinearity effect. When we regress Bank CDS premia on the EDF measure for the entire corporate sector, it is highly significant.

At this point, we have two immediate concerns: First, bank risk may be affected by the risk of the domestic sovereign through holdings of domestic sovereign debt. Second, it is conceivable that the significance of the exposure-weighted credit spread does not reflect financial linkages but that it rather captures general movements in CDS premia which also affect Bank CDS premia.

To measure the risk of domestic government debt, the CDS premium on the sovereign would seem a natural choice. However, as we show below, sovereign CDS spreads and bank CDS spreads are simultaneously determined, and we therefore follow Kallestrup (2011) and use the following measure: We regress sovereign CDS premia on a number of explanatory variables of sovereign credit risk. In our regression, three variables are significant and these are domestic and foreign currency government debt, long-term external debt, and the current account balance. S_RISK is then the fitted value of the CDS spread from this regression and it is used to measure that part of sovereign which is not related to the banking sector. Note that S_RISK is significant in the regression performed in Table 16.

To control for general movements in CDS spreads, we include three general European CDS indices: The iTraxx Sovereign Western Europe, iTraxx Senior Financials and iTraxx Non-Financials. In summary, we run new regressions in which we control for sovereign risk and for general movements of CDS premia:

$$\begin{aligned}
\Delta(\text{B_CDS})_{k,t} &= \alpha_{k,0} + \alpha_1 \times \Delta(\text{B_BIS_CDS})_{k,t} \\
&+ \alpha_2' \times \Delta(\text{Local Bank Variables})_{k,t} \\
&+ \alpha_3' \times \Delta(\text{Global Variables})_t \\
&+ \alpha_4' \times \Delta(\text{CDS Indices})_t + \epsilon_{k,t}
\end{aligned}$$

The results are reported in Table 16 and include several ways of controlling. The exposure-weighted credit spread remains highly significant. Second, we regress changes in the exposure-weighted credit spread on changes in these indices and use the residual of this regression as explanatory variable in a new regression. This residual clearly carries information on the risk of exposures that are due to linkages but not to general movements in the CDS market and even this residual explains changes in CDS spreads. In results not reported here, we have shown this to apply also in our second subsample, whereas in the first subsample the coefficient is positive but insignificant. Both when including indices and when using residuals, we find that the real estate EDF measure remains highly significant. Among the iTraxx indices, only the index for senior financials is significant in the full sample. Due to the quarterly sampling, it is difficult to show a role of government guarantees in lowering bank credit spreads over the full time series. We will return to the role of government guarantees in connection with sovereign spreads below.

4.1 Robustness checks

We perform several robustness checks to firmly establish that the cross-border exposures of banks are significant in explaining the dynamics of bank CDS spreads. First, even if we control for a number of global variables that capture common factors in CDS spreads - including CDS indices - it is still possible that we may have left out an important factor which jointly determines the level of CDS spreads across banks. We therefore replace all global factors by a time fixed effect which supplements the local explanatory variables that include EDF measures and measures of domestic sovereign risk. The results are reported in Table 17. Our measure of financial exposures is still significant over the full sample and in the subsample that begins with the onset of the financial crisis. There is even weak significance in the first subperiod as well. Note that the time fixed effect replaces all factors that are common to all countries, but we retain the country-specific EDFs ro represent country-specific credit risk, and we retain the non-bank related part of sovereign risk, as explained above. Both are significant throughout the sample as well as in subperiods, although the real estate EDF is only weakly significant in the period before the crisis.

Second, it is possible that the results are driven by a few countries in our panel who have a large fraction of their assets in foreign exposures. We divide the sample into two parts according to the average size of foreign exposures (relative to total assets) over the sample period. In the sample of countries whose banks have high foreign exposures compared to assets, the lowest average exposure is that of Great Britain with 42% and the highest is that of Belgium with 68%. In the sample with low foreign exposures compared to assets the highest is that of Spain with an average of 28% and the lowest is that of the US with 11%. As seen in Table 18 we find in both subsamples that our dynamic exposure measure is significant in explaining the dynamics of bank CDS spreads. We also leave out the US from the sample in order to exclude the possibility that the importance of the US financial system on all countries is not captured through our global factors. Excluding the US does not change our results, as seen in the last column of Table 18.

Third, we run a regression in which we use sovereign CDS premia to measure the riskiness of exposures in *all* countries - and not just those for which we have limited or no information on bank CDS spreads. The results are reported in Table 19. Again the significance of the exposure measure is not affected.

And finally, in Table 20 we test the relevance of our weighting scheme by running a regression in which we leave out for each country's banking system the five largest foreign exposures from the exposure matrix. Note that the five countries excluded vary greatly across banking systems. With this exclusion the explanatory power of our measure breaks down once we control with the CDS indices. This jointly illustrates the importance of controlling for general movements in CDS markets and the significance of our exposure measure. When we remove the five biggest exposures, the exposure measure is significant before controlling for the CDS indices, but it loses significance after controlling for the indices. This is in contrast with our exposure measure which remains significant even after including the indices. Thus, our exposure measure contains information that is reflected in CDS premia and which is not due to movements in indices or other global variables. Whether the level of detail used in the calculation is necessary would require further investigation, but it is less ad hoc than settling on a fixed number of countries or using equal weights irrespective of exposure size.

5 Extending our Risk Measure

While foreign exposures clearly are important contributors to bank risk, it is still unlikely to capture the full picture. Banks have large domestic corporate exposures and they often have exposures to their own government and central bank as well. For example, as shown in Table 2, at the end of Q4:2010 Austrian banks had total exposures of USD 1010bn corresponding to 266% of Austrian GDP. Of these exposures, 46% are foreign exposures reported to BIS, 8% are exposures to own government and central bank and the remaining 46% are other domestic exposures.

As an alternative to controlling for the domestic exposures in our regressions, we now propose a way to include the size and risk of the exposures directly into a single measure that covers all assets instead of focusing only on foreign assets. There is no CDS measure which captures the risk of domestic exposures. Instead, we use the median EDF for all sectors as the risk measure. While an EDF is not equal to a CDS spread, it is likely to be of the same order of magnitude. In a risk neutral world, the EDF measured in basis points would be larger than the CDS spread which would be roughly equal to the EDF multiplied by the loss rate in default. But risk premia are likely to make CDS spreads larger than this risk neutral level by some factor. Since, in addition, we are looking at changes in these variables, it is reasonable to assume that EDF levels and CDS premia are at the same scale. The extended bank exposure risk measure we propose to measure is then the following:

$$
\begin{aligned}
\Delta(\text{Bank Credit Risk})_{k,t} &= \left(\frac{\text{Foreign claims}}{\text{Bank assets}}\right)_{k,t} \times \Delta(\text{B\_BIS\_CDS})_{k,t} \\
&+ \left(\frac{\text{Domestic credit}}{\text{Bank assets}}\right)_{k,t} \times \Delta(\text{EDF\_ALL})_{k,t} \\
&+ \left(\frac{\text{Claims on sovereign}}{\text{Bank assets}}\right)_{k,t} \times \Delta(\text{S\_RISK})_{k,t}
\end{aligned}
$$

The BIS exposure-weighted credit spread is now weighted by the fraction of foreign exposures to total bank assets. In addition, the fitted value of the domestic sovereign CDS premium is weighted by the relative size of this exposure and the median corporate EDF is weighted by the fraction of domestic exposures to total exposure. One might alternatively use exposures relative to book value of equity but this does not change our conclusions. Summary statistics for all three risk weights are shown in Table 12, Table 13 and Table 14. As seen in Table 21 this new measure is also highly significant. Changes in the iTraxx Senior Financials remain significant. Note that our extended measure is significant even after splitting into the two subsamples with the rescue of Bear Sterns marking the beginning of the second subsample.

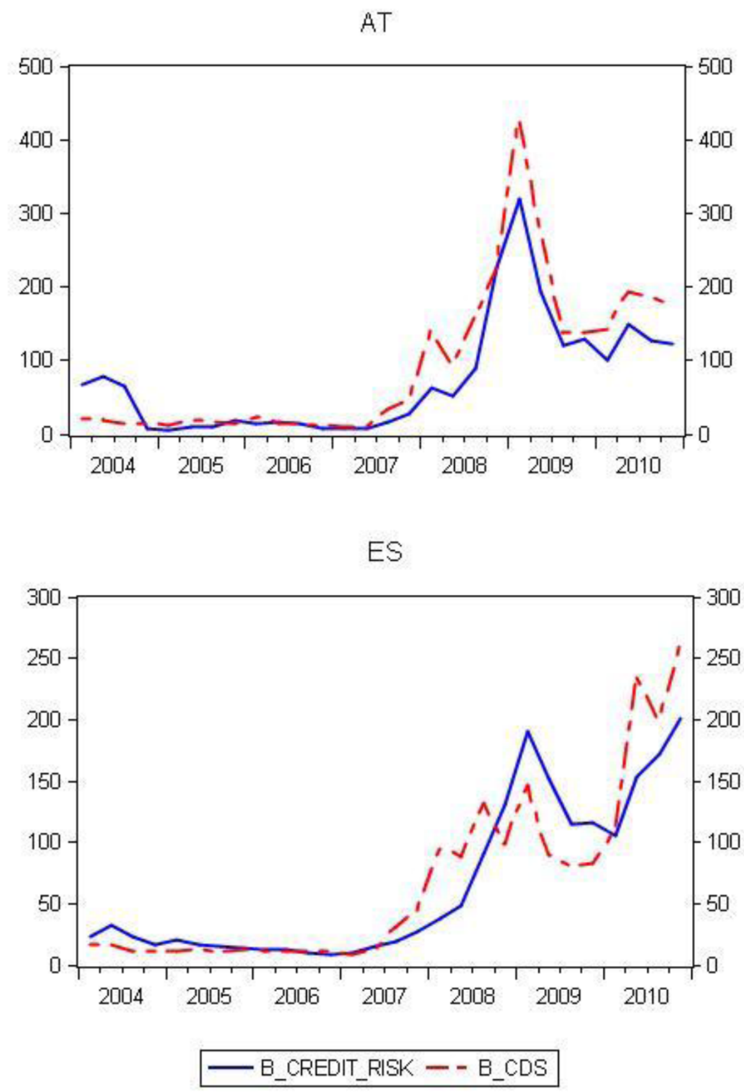
In figure 5 we show that the extended measure tracks CDS spreads for both Spain and Austria.

6 Sovereign CDS Spreads and Contingent Liabilities

So far we have focused on the asset side of banks' balance sheets focusing on measures of asset quality that include financial linkages and shown that they can help explaining bank risk as measured by CDS premia. Implicit and explicit government guarantees imply that bank risk plays a huge role on the liability side of sovereign's balance sheet. In this section we show that bank risk has become a dominating factor in the determination of sovereign credit spreads. The regression now has the following form:

$$
\begin{aligned}
\Delta(\text{S\_CDS})_{k,t} &= \alpha_{k,0} + \alpha_1' \times \Delta(\text{Domestic Government Variables})_{k,t} \\
&+ \alpha_2' \times (\text{Guarantees})_{k,t} \\
&+ \alpha_3' \times \Delta(\text{Global Variables})_t + \epsilon_{k,t}
\end{aligned}
$$

Figure 5: Our extended measure and CDS spreads for Austria and Spain



The graph compares the average CDS spreads for the two major Austria and Spain with the time series of our extended measure. This measure captures foreign as well as domestic exposures of the Austrian and Spanish banking systems.

where Global Variables and Domestic Government Variables are defined above. The fiscal variables are traditionally viewed as determinants of sovereign default risk. The term Guarantees refers to variables seeking to measure the size and riskiness of implicit and explicit guarantees made to the domestic banking system. The explicit guarantee (labeled Guarantee in Table 22) is a variable which is only active (i.e. non-zero) in quarters where a country has issued an explicit guarantee on parts of banks' liabilities.[3] When this is the case, the variable takes on a value equal to the size of the guarantee relative to GDP, as reported by IMF (2009). For all countries, this guarantee is made in Q4:2008.[4]

We have two additional variables seeking to measure the size of the sovereign's 'contingent liability' on the banking sector. The first variable is the size of the domestic banking system (measured as claims on domestic entities and non-nationals) relative to GDP multiplied by the average CDS premium of the two largest banks. This measure seeks to combine the size of the potential liability and its riskiness into one measure. The second variable uses median bank EDF instead of bank CDS to measure riskiness.

Columns I and II of Table 22 report the result of the regression when we use the CDS-based measure for the size of the implicit guarantee. Column I does not include the Q4:2008 explicit guarantees, column II does. Both implicit and explicit guarantees are highly significant. In columns III and IV the riskiness of implicit guarantees are measured using EDFs. Again, both implicit and explicit guarantees are highly significant. In all four regressions, the excess return on the US equity market, and changes in yield spreads on investment grade and high yield bonds are highly significant - consistent with the findings in Longstaff, Pan, Pedersen, and Singleton (2011).

Interestingly, changes in the domestic government variables are not seen to have a significant impact on the CDS premia. The negative sign on the LIBOR-OIS spread in somewhat puzzling. An increase in this variable should indicate an increase in general bank credit risk and we would therefore expect a positive sign of the regression coefficient.

Column V addresses the possibility of endogeneity of bank CDS premia, i.e. that sovereign and bank CDS are determined jointly. To demonstrate that Bank CDS premia do indeed influence sovereign CDS premia, we choose as instrument for bank credit risk the amount of short-term central bank

[3]There have been many types of financial support schemes, such as capital injections, purchases of assets, central bank support and liquidity provisions. These are not included here.

[4]The guarantee on the Irish banking system was given September 29 and in force September 30. The price impact seems to mostly take place in Q4, and therefore we have used this as the relevant quarter for Ireland also.

funding of banks - typically done through collateralized lending. The idea is that increases in central bank funding is a sign of increased bank credit risk. See Kallestrup (2011) for more on this.

Table 23 includes iTraxx indices as explanatory variables, but apart from this we proceed exactly as in Table 22. Implicit guarantees are still significant, and the explicit guarantees are also significant, albeit on one of the regressions only at the 10% level. Unsurprisingly, the general level of sovereign credit risk as measured by iTraxx Sovereign is significant. The presence of this variable removes the significance of the excess return on the US stock market, but not of the yield spreads on high yield bonds.

Was the importance of implicit guarantees already priced in the Sovereign CDS market before the crisis? To investigate this question, we have split our sample into two sub-periods and find the results reported in Table 24. Note that when we control for general movements in the sovereign CDS index, which are highly significant, there is no significant effect before the crisis of implicit guarantees as measured through the size and riskiness of the domestic banking system. However, after the onset there is a significant effect. This result is confirmed in Table 25 where we used a general time-fixed effect instead of the CDS indices to control for common, global factors in CDS spreads.

At this point, we have strong evidence that bank CDS spreads are affected by foreign exposures of banks and that the risk of banks in turn spills over to sovereign CDS spreads. This provides a strong case for arguing, that the evolution of sovereign CDS spreads is affected by the foreign exposures of domestic banking systems, thus establishing a concrete and measurable source of covariation between sovereign spreads. Our final goal is to examine whether this effect materializes itself in a direct regression of sovereign CDS spreads on our BIS exposure measure. In Table 26 this is shown to be the case. We include our exposure measure B_BIS_CDS in the regressions. It is shown to be significant in explaining changes on sovereign CDS spreads, even after controlling for a host of predictors. We also try to take into account how large the foreign exposures are compared to GDP by multiplying our exposure measure with the fraction of bank foreign assets to domestic GDP and this also comes out as significant. If we replace CDS spreads as our measure of riskiness and use EDFs for real estate instead, this does not come out as significant.

7 Conclusion

We show that financial linkages across borders are priced in the CDS markets beyond what can be explained by exposure to both global and country-specific factors. Financial linkages are measured using BIS consolidated banking statistics and these statistics are combined with CDS spreads to construct a risk-weighted foreign exposure measure for banking systems in 17 countries.

We also confirm that implicit and explicit guarantees extended to a country's banking system in turn affect the CDS premia of the sovereign. As a consequence, foreign exposures of banks impact the dynamics of sovereign CDS spreads. In other words, we identify foreign bank exposures as a source of co-movement in sovereign CDS spreads.

We also construct a measure which takes into account the entire asset side of banking systems by combining the information on foreign exposures with information on the relative size and riskiness of exposures to domestic government bonds and to other domestic residents. This measure also helps explaining bank CDS premia.

While the first measure is relevant for proving that banks' foreign financial exposures are reflected in CDS spreads, the second measure is a better candidate for detecting riskiness of a banking system when the risk arises both from exposure to foreign and to domestic factors. The De Larosière Report (2009) (p.63) advocates the establishment of a common data base containing relevant information on risk exposures of financial institutions and markets, both at the national and international level. The analysis here shows that markets seem to have taken such exposures into account in the pricing of CDS contracts and to the extent that CDS premia do reflect default risk, this is evidence in support of the idea, that such information could help building early warning systems.

Having established that the bank asset side provides evidence on the contagion effects of banking systems, we turn to sovereign risk and consider the effect of the contingent liabilities of sovereigns arising from implicit or explicit guarantees of the banking system. We use a dynamic measure for the implicit guarantees and a measure of the explicit guarantee after the Lehman bankruptcy and show that they help quantify how the banking system contributes to sovereign credit risk. Since banks' foreign linkages are a big factor in explaining bank risk, and bank risk clearly help explain sovereign risk, our analysis also shows that the interlinkages in the banking system contribute to systemic sovereign risk.

The fact that interlinkages are priced in CDS markets throughout the entire sample may have several explanations. This is a topic of future research, but we end with a few thoughts on the mechanism here. A common practice among hedge funds and risk managers is to hedge exposures through 'proxy hedging' - i.e. hedging through correlated but 'cheaper' hedging vehicles (see e.g. IMF (2010) and Association for Financial Markets in Europe (2011)). For example, a bank may wish to hedge emerging market credit risk in Eastern Europe, either because it has exposure to sovereigns itself (as a direct exposure or as counterparty risk in large derivatives contracts) or because it wishes to hedge a large loan exposure in such countries using a 'macro' hedge. A cheaper solution may be to buy protection on Austrian banks which are known to have large exposures in these countries. Another 'proxy hedge' is to hedge exposure to a major bank using a CDS on the sovereign whose risk reflects the explicit and implicit guarantees for the banking system.

Furthermore, the new Basel III rules encourage banks to use sovereign CDS to hedge Credit Value Adjustments (CVA). Banks are required to hold capital against potential mark-to-market losses (i.e. CVA risk) associated with deterioration in the credit worthiness of a counterparty. One way to manage this risk is to buy a CDS referencing the country of the counterparty. The Basel rules encourage an appropriate proxy spread when a CDS spread is not available or illiquid. Hence, a bank that grants credit to corporations and banks located in a particular country may use the sovereign CDS to hedge the associated credit or counterparty exposures.

Interestingly, the pricing effects that we find are stronger in the second half of our sample - a period where the hedging demand due to counterparty credit risk has increased, both because the risk itself has increased and because of regulatory requirements in Basel III. This would explain why market participants seem to follow these interlinkages carefully.

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A Summary Statistics and Variable description

Table 3: **Banking groups as percentage of GDP, 2009**

Country	Bank Name	Size of bank USD bn	GDP USD bn	%GDP
AT	Erste Group Bank AG	291	382	76
AT	Raiffeisen Zentralbank Oesterreich AG	213	382	56
AU	National Australian Bank	576	994	58
AU	Westpac	519	994	52
BE	Dexia Group NV	832	472	176
BE	KBC Group NV	467	472	99
CH	UBS AG	1301	492	264
CH	Credit Suisse Group AG	1001	492	203
DE	Deutsche Bank AG	2162	3339	65
DE	Commerzbank AG	1216	3339	36
DK	Danske Bank AS	597	310	193
ES	Banco Santander SA	1600	1468	109
ES	Banco Bilbao Vizcaya Argentaria SA	771	1468	53
FR	BNP Paribas	2964	2656	112
FR	Crédit Agricole-Crédit Agricole Group	2440	2656	92
GB	Royal Bank of Scotland Plc	2749	2179	126
GB	Barclays Bank Plc	2234	2179	103
GR	National Bank of Greece SA	163	331	49
GR	EFG Eurobank Ergasias SA	121	331	37
IE	Bank of Ireland Plc	261	222	117
IE	Allied Irish Banks Plc	251	222	113
IT	Unicredit SpA	1338	2118	63
IT	Intesa Sanpaolo SpA	900	2118	42
JP	Mitsubishi UFJ Financial Group	1930	5069	38
JP	Sumitomo Mitsui Financial Group	1144	5069	23
NE	ING Group NV	1676	797	210
NE	Rabobank	875	797	110
PT	Banco Comercial Portugues SA	138	233	59
PT	Banco Espirito Santo SA	119	233	51
SE	Nordea Bank AB	731	406	180
SE	Skandinaviska Enskilda Banken AB	324	406	80
US	Bank of America Corporation	2223	14119	16
US	JP Morgan Chase Co.	2032	14119	14

The table lists the largest banks in each country used to find the average bank CDS spread.

Table 4: Summary Statistics: Foreign exposures

Country	Share of Exposure Explained in Q4 2010	Countries Included	Maximum Exposure	Country with Maximum Exposure	Standard Deviation of Maximum Exposure
AT	0.86	19	0.16	DE	0.02
AU	0.87	9	0.49	NZ	0.02
BE	0.87	13	0.63	NE	0.02
CH	0.85	17	0.51	US	0.04
DE	0.85	32	0.24	GB	0.03
DK	0.86	7	0.29	GB	0.02
ES	0.86	9	0.36	GB	0.04
FR	0.86	25	0.27	US	0.03
GB	0.86	20	0.36	US	0.03
GR	0.85	13	0.31	TR	0.05
IE	0.85	9	0.39	GB	0.03
IT	0.85	19	0.35	DE	0.10
JP	0.86	16	0.47	US	0.02
NE	0.88	13	0.28	US	0.04
PT	0.86	16	0.21	ES	0.02
SE	0.85	9	0.28	DK	0.04
US	0.85	19	0.23	GB	0.03

The table shows the relative size and the country of the largest exposure. It also display the time-series variation in the relative size of the largest exposure. Source: Bank for International Settlements and own calculations. Exposure data for Ireland exists from 2006 to 2010.

Table 5: Country Specific Variables

Variable [5]	Description	Source
B_GDP	Aggregates data regarding: • banks' claims on domestic central bank (percent of GDP); • banks' claims on domestic general government (percent of GDP); • banks' claims on other sectors in the country (percent of GDP); • banks' claims on non-nationals (percent of GDP).	IFS & BIS
B_CREDIT	Banks' claims on other sectors in the country. Percent of GDP	IFS
B_EDF	Median of the 5-year EDFs' for the banking sector	Moody's KMV
B_FExp	Banks' claims on non-nationals. Percent of GDP	BIS
B_CB_L	Banks' liabilities to the domestic central bank. Percent of GDP	IFS and the Bank of England
B_CDS	Average of 5-year CDS on domestic banks	CMA and Fitch CDS Pricing
B_BIS_CDS	Exposure-weighted credit spread computed using both sovereign and bank CDS data. See the main text	BIS
B_BIS_RES	A fitted value from a regression of B_BIS_CDS on the CDS indeces B_FINSNR, F_NONFIN, S_SOVX	own calculations

[5] All data are quarterly.* denotes quarterly or interpolated from yearly data. IFS: IMF International Financial Statistics.

Table 5: (continued)

Variable	Description	Source
B_BIS_NOT5	Exposure-weighted credit spread computed using both sovereign and bank CDS data, but *leaving out the largest 5 exposures*. See the main text	BIS
BIS_NOT5_RES	A fitted value from a regression of B_BIS_NOT5 on the CDS indeces B_FINSNR, F_NONFIN, S_SOVX	own calculations
B_CREDIT_RISK	uses the exposure measure obtained by combining foreign exposures (weighted by B_BIS_CDS) with domestic exposures weighted by the fitted value of the CDS spreads (for domestic government bonds) or EDFs for other exposures as explained in equation 5. See main text.	own calculations
C2_EDF	Median of the 5-year EDFs' for domestic corporate sector	Moody's KMV
R2_EDF	Median of the 5-year EDFs' for real estate firms, real estate investment firms and construction firms	Moody's KMV
GUARANTEES	Sovereign guarantees to the banking sector	See IMF (2009)
M_CA	Current account (seasonally adjusted). Percent of GDP	OECD, IFS
S_IRN_REV*	General government net interest expenditure to revenue	Fitch, Eurostat, IMF, OECD and IFS
S_RISK	A fitted value from a regression of sovereign CDS spread on general government gross debt to GDP, long-term external debt, and the current account	See Kallestrup (2011)
S_BIS_CDS	Exposure-weighted credit spread computed using sovereign CDS data. See the main text.	BIS
S_CDS	The 5-year sovereign CDS spread	CMA and Fitch CDS Pricing
S_DEBT_GDP*	General government gross debt to GDP.	Eurostat, OECD and IFS

Table 5: (continued)

Variable	Description	Source
S_FDEF_GDP	The quarterly lending revision is calculated as the sum of the most recent year-end and year-ahead budget projection by the OECD or the IMF minus the second most recent forecast for the same period provided by the same organization. In quarters where they do not update a new budget projection we interpolate a forecast	OECD EO and IMF WEO
S_GEXT_L	General government's long-term external liabilities. Percent of GDP	QEDS

Table 6: Global Variables

Variable[6]	Description	Source
B_FINSNR	The Markit iTraxx Senior Financials index comprises 25 equally-weighted European names	J.P.Morgan: DataQuery
F_NONFIN	The Markit iTraxx Non-Financials index comprises 100 equally-weighted European names	J.P.Morgan: DataQuery
S_SOVX	The 5-year Itraxx SovX Western Europe index comprises 15 sovereign names where all constituents are equally weighted (It is a theoretical price before the start of trading on 28 September 2009)	J.P.Morgan: DataQuery
VPSPX	Volatility Risk Premium. Computed as the difference between the VIX index and the realized volatility for the S&P 500 index over the preceding three months	Bloomberg
ER3M	Excess Return for the U.S. Stock Market. It is computed as the difference between the value-weighted return on all NYSE, AMEX, and NASDAQ stocks and the three-month Treasury-bill return	Bloomberg. The Center for Research in Security Prices
$\%\Delta$(OISUS)	Percentage change in the 3 month US LIBOR - OIS spread	Bloomberg
$\%\Delta$(5YCMT)	Percentage change in the 5 year constant maturity treasury yields	Federal Reserve/Bloomberg
$\%\Delta$(HY)	Percentage change in the US corporate yield spreads. The investment-grade yield spreads are computed on the basis-point yield spread between BBB and AAA industrial bond indices. The percentage changes in high-yield spreads are computed for the basis-point yield. The used indices represent average yields of a broad cross-section of non-callable AAA-, BBB-, and BB-rated bonds with maturities approximately equal to five years	Bloomberg

[6] All data are quarterly.

Table 6: (continued)

Variable	Description	Source
$\%\Delta$(IG)	Percentage change in the US corporate yield spreads. Spread between BB and BBB industrial bond indexes. See above	Bloomberg

Table 7: Sovereign CDS spreads

ISOCODE	Mean	Max	Min	Std. Dev.	Obs.
AT	35	177	2	49	28
AU	25	131	2	34	28
BE	36	222	1	54	28
CH	55	128	35	30	8
DE	15	59	1	19	28
DK	20	115	1	28	28
ES	58	350	2	89	28
FR	22	108	1	30	28
GB	42	123	2	41	19
GR	150	1010	4	275	28
IE	120	609	2	164	21
IT	57	240	4	70	28
JP	26	95	3	30	28
NE	25	91	1	28	22
PT	72	501	4	126	28
SE	22	124	2	32	28
US	16	67	0	21	28
All	46	1010	0	100	434

Summary statistics on sovereign CDS spreads. Note that every country for which we have data for the full sample period have had single digit spreads in basis points on their CDS contracts. The largest observed end-of-quarter premium is 1010 bps for Greece. The two countries with the lowest maximum observed premia are Germany (59 bps) and the US (67 bps).

Table 8: Average bank CDS spreads

ISOCODE	Mean	Max	Min	Std. Dev.	Obs.
AT	93	429	10	104	28
AU	53	160	6	51	28
BE	104	390	8	116	28
CH	65	217	8	66	28
DE	58	160	10	48	28
DK	47	199	4	52	28
ES	66	259	8	73	28
FR	49	147	6	48	28
GB	73	278	6	78	28
GR	166	989	6	289	28
IE	162	1052	7	244	28
IT	56	176	8	54	28
JP	45	120	7	36	28
NE	49	170	5	51	28
PT	115	851	10	187	28
SE	52	194	8	52	28
US	70	300	12	67	28
All	78	1052	4	123	476

The table shows summary statistics on bank CDS spreads. The largest maximum spreads are for Greece and Ireland, and the lowest are for Japanese banks.

Table 9: Risk-weighted sum of CDS spreads

ISOCODE	Mean	Max	Min.	Std. Dev.	Obs.
AT	81	318	10	87	28
AU	47	164	5	46	24
BE	60	195	7	62	28
CH	59	217	10	55	28
DE	65	210	9	63	28
DK	51	175	7	52	28
ES	74	206	10	55	28
FR	63	204	9	60	28
GB	57	215	10	53	28
GR	107	344	20	94	28
IE	69	161	7	53	20
IT	64	210	9	62	28
JP	57	210	9	54	28
NE	58	180	10	52	28
PT	72	234	10	72	28
SE	48	190	6	51	28
US	57	160	10	45	28
All	64	344	5	62	464

The table shows summary statistics on the risk-weighted CDS spreads. The lowest maximum is for the US whereas the highest maximum is for Greece and Austria.

Table 10: Corporate EDFs

ISOCODE	Mean (%)	Max (%)	Min (%)	Std. Dev.	Obs.
AT	0.6	1.4	0.1	0.4	28
AU	1.0	2.8	0.4	0.7	28
BE	0.4	0.9	0.2	0.2	28
CH	0.3	0.6	0.1	0.1	28
DE	0.9	1.8	0.4	0.5	28
DK	0.6	2.2	0.1	0.6	28
ES	0.3	0.9	0.1	0.3	28
FR	0.9	2.1	0.3	0.5	28
GB	1.0	2.9	0.4	0.7	28
GR	2.7	7.0	0.5	1.8	28
IE	0.8	2.6	0.2	0.7	28
IT	0.7	1.9	0.2	0.6	28
JP	0.9	2.4	0.3	0.6	28
NE	0.5	1.3	0.1	0.3	28
PT	0.9	2.0	0.2	0.6	28
SE	1.0	2.6	0.3	0.6	28
US	1.3	4.2	0.4	0.9	28
All	0.9	7.0	0.1	0.9	476

The table shows summary statistics on the median corporate expected default frequency in each country. The maximum is for Greece.

Table 11: Real estate EDFs

ISOCODE	Mean (%)	Max (%)	Min (%)	Std. Dev.	Obs.
AT	0.7	3.6	0.0	0.9	28
AU	1.4	7.2	0.2	1.9	28
BE	0.2	0.5	0.1	0.2	28
CH	0.2	0.4	0.1	0.1	28
DE	0.9	2.2	0.2	0.7	28
DK	1.2	3.9	0.2	1.1	28
ES	0.7	2.4	0.1	0.8	28
FR	0.5	1.5	0.1	0.4	28
GB	0.9	3.3	0.1	0.9	28
GR	2.9	6.0	0.8	1.5	28
IE	3.0	19	0.1	4.8	28
IT	0.7	2.1	0.1	0.7	28
JP	2.3	6.2	0.6	1.5	28
NE	0.6	3.0	0.1	0.7	28
PT	1.8	7.8	0.0	2.3	28
SE	0.7	2.6	0.1	0.7	28
US	1.4	6.8	0.3	1.7	28
All	1.2	19	0.0	1.8	476

The table shows summary statistics on the median for the broad real estate category (i.e. the one including construction firms) in each country. The maximum is for Ireland.

Table 12: The share of banks' claims on foreigners

ISOCODE	Mean (%)	Max (%)	Min (%)	Std. Dev.	Obs.
AT	0.44	0.52	0.23	0.10	28
AU	0.26	0.27	0.23	0.01	28
BE	0.63	0.72	0.40	0.11	28
CH	0.71	0.78	0.60	0.06	28
DE	0.44	0.48	0.39	0.02	28
DK	0.25	0.32	0.10	0.06	28
ES	0.28	0.33	0.23	0.02	28
FR	0.47	0.52	0.40	0.04	28
GB	0.42	0.45	0.37	0.02	28
GR	0.19	0.28	0.11	0.04	28
IE	0.56	0.64	0.44	0.04	28
IT	0.22	0.31	0.14	0.06	28
JP	0.15	0.19	0.10	0.02	28
NE	0.55	0.63	0.42	0.07	28
PT	0.25	0.27	0.20	0.02	28
SE	0.51	0.56	0.40	0.04	28
US	0.11	0.18	0.08	0.03	28
All	0.38	0.78	0.08	0.18	476

The table shows summary statistics on the share of banks' claims on foreigners in each country. The Swiss banking system has the largest exposure abroad.

Table 13: The share of banks' claims on the domestic sovereign

ISOCODE	Mean (%)	Max (%)	Min (%)	Std. Dev.	Obs.
AT	0.08	0.12	0.05	0.02	28
AU	0.01	0.02	0.00	0.01	28
BE	0.09	0.13	0.06	0.02	28
CH	0.03	0.06	0.02	0.01	28
DE	0.11	0.13	0.09	0.01	28
DK	0.04	0.10	0.01	0.03	28
ES	0.07	0.11	0.05	0.02	28
FR	0.09	0.11	0.07	0.01	28
GB	0.02	0.04	0.00	0.01	28
GR	0.15	0.20	0.10	0.03	28
IE	0.03	0.08	0.02	0.01	28
IT	0.14	0.17	0.09	0.02	28
JP	0.26	0.31	0.23	0.03	28
NE	0.04	0.07	0.02	0.01	28
PT	0.03	0.07	0.02	0.01	28
SE	0.03	0.06	0.01	0.01	28
US	0.08	0.13	0.05	0.03	28
All	0.08	0.31	0.00	0.06	476

The table shows summary statistics on the share of banks' claims on the domestic sovereign in each country. The Japanese banking system has the largest exposure towards its own government.

Table 14: The share of banks' claims on domestic residents

ISOCODE	Mean (%)	Max (%)	Min (%)	Std. Dev.	Obs.
AT	0.49	0.65	0.43	0.08	28
AU	0.73	0.75	0.71	0.01	28
BE	0.28	0.47	0.21	0.09	28
CH	0.26	0.35	0.21	0.05	28
DE	0.45	0.49	0.42	0.02	28
DK	0.71	0.81	0.67	0.04	28
ES	0.65	0.69	0.61	0.02	28
FR	0.44	0.49	0.41	0.03	28
GB	0.56	0.63	0.52	0.03	28
GR	0.66	0.71	0.58	0.04	28
IE	0.41	0.48	0.35	0.04	28
IT	0.64	0.74	0.57	0.07	28
JP	0.59	0.65	0.53	0.04	28
NE	0.41	0.52	0.34	0.06	28
PT	0.72	0.76	0.70	0.02	28
SE	0.46	0.58	0.42	0.04	28
US	0.81	0.86	0.70	0.06	28
All	0.55	0.86	0.21	0.16	476

The table shows summary statistics on the share of banks' claims on domestic residents in each country. The U.S. banking system has the largest exposure towards its own residents.

B Regression Results

Table 15: **Regressing bank CDS spreads on exposure-weighted spreads in different periods.** This table reports the coefficients and t-statistics for the panel regression:

$$\begin{aligned}\Delta(\text{B\_CDS})_{k,t} &= \alpha_{k,0} + \alpha_1 \times \Delta(\text{B\_BIS\_CDS})_{k,t} + \alpha_2' \times \Delta(\text{Local Bank Variables})_{k,t} \\ &\quad + \alpha_3' \times \Delta(\text{Global Variables})_t + \epsilon_{k,t}\end{aligned}$$

$\Delta(\bullet)$ and $\%\Delta(\bullet)$ stand for first difference and percentage change of the variable over the quarter, respectively. k is the index for countries and t is the index for time. We perform the analysis first for the whole sample from the first quarter of 2004 to the last quarter of 2010. Afterwards we perform the same analysis on sub-periods. All equations are estimated by OLS with robust standard errors and country fixed effects.

VARIABLES	FULL SAMPLE	Q1 2004 - Q4 2007	Q1 2008 - Q4 2010
INTERCEPT	1.110	-0.431	9.078**
	(0.414)	(-1.069)	(2.274)
Δ(B_BIS_CDS)	1.004***	0.460**	0.981***
	(5.533)	(2.442)	(4.777)
Δ(R2_EDF)	10.18***	1.187	11.46***
	(6.055)	(1.151)	(9.190)
Δ(C2_EDF)	11.23	-1.486	1.376
	(0.374)	(-0.491)	(0.037)
ER3M	-65.03	-4.164	-17.37
	(-0.994)	(-0.307)	(-0.161)
VPSPX	1.558	0.408***	1.102
	(1.575)	(3.114)	(0.953)
%Δ5YCMT	7.061	-8.697***	25.76
	(0.731)	(-4.251)	(0.737)
%ΔHY	-16.24	7.074***	7.774
	(-1.031)	(3.374)	(0.158)
%ΔIG	-11.11	5.403***	-33.05
	(-0.885)	(3.824)	(-1.232)
%Δ(OISUS)	4.295*	0.124	12.13**
	(1.667)	(0.408)	(2.056)
Adjusted R-squared	0.3818	0.5266	0.3806

Table 16: **Controlling for the comovement of the CDS market - Introducing the CDS index.** This table reports the coefficients and t-statistics for the panel regression:

$$\begin{aligned}\Delta(\text{B\_CDS})_{k,t} &= \alpha_{k,0} + \alpha_1 \times \Delta(\text{B\_BIS\_CDS})_{k,t} + \alpha_2' \times \Delta(\text{Local Bank Variables})_{k,t} \\ &\quad + \alpha_3' \times \Delta(\text{Global Variables})_t + \alpha_4' \times \Delta(\text{CDS Indices})_t + \epsilon_{k,t}\end{aligned}$$

$\Delta(\bullet)$ and $\%\Delta(\bullet)$ stand for first difference and percentage change of the variable over the quarter, respectively. k is the index for countries and t is the index for time. In Column II, we simply introduce the indexes along the BIS matrix. In column III, we have regressed the BIS matrix on the CDS indexes and used the residuals from this regression as a variable to explain the CDS spreads. All equations are estimated by OLS with robust standard errors and country fixed effects.

Variable	I	II	III
INTERCEPT	2.03	−1.673	−0.745
	(1.014)	(-0.534)	(-0.251)
Δ(B_BIS_CDS)	0.781***	0.481***	
	(4.65)	(3.494)	
Δ(B_BIS_RES)			0.212**
			(2.4)
Δ(R2_EDF)	10.8***	9.386***	9.158***
	(6.077)	(6.099)	(6.09)
Δ(C2_EDF)	−10.76	6.311	12.61
	(-0.431)	(0.225)	(0.364)
ER3M	−37.4	27.89	10.89
	(-0.686)	(0.403)	(0.154)
VPSPX	0.279	0.743	0.427
	(0.484)	(0.922)	(0.448)
%Δ5YCMT	14.06	2.319	8.191
	(1.333)	(0.263)	(0.696)
%ΔHY	−31.07*	−7.91	−10.45
	(-1.786)	(-0.766)	(-0.927)
%ΔIG	−22.38	5.869	10.06
	(-1.615)	(0.474)	(0.796)
%Δ(OISUS)	6.407**	1.966	2.427
	(2.135)	(0.858)	(0.978)
Δ(S_RISK)	0.267**	0.260464*	0.283*
	(2.473)	(1.926316)	(1.729)
Δ(S_SOVX)		0.328	0.316
		(1.066)	(1.028)
Δ(F_NONFIN)		0.749	1.154*
		(-1.476)	(-1.734)
Δ(B_FINSNR)		0.749***	1.154***
		(3.221)	(5.413)
Adjusted R-squared	0.388	0.426	0.424

Table 17: **Time effects.** This table reports the coefficients and t-statistics for the panel regression:

$$\Delta(\text{B\_CDS})_{k,t} = \alpha_{k,0} + \alpha_{0,t} + \alpha_1 \times \Delta(\text{B\_BIS\_CDS})_{k,t} + \alpha_2' \times \Delta(\text{Local Bank Variables})_{k,t} + \epsilon_{k,t}$$

$\Delta(\bullet)$ and $\%\Delta(\bullet)$ stand for first difference and percentage change of the variable over the quarter, respectively. k is the index for countries and t is the index for time. We perform the analysis first for the whole sample from the first quarter of 2004 to the last quarter of 2010. Afterwards we perform the same analysis on sub-periods. All equations are estimated by OLS with robust standard errors, and country and time fixed effects.

Variables	Full sample	2004 q1 - 2008 q2	2008 q3- 2010 q4
INTERCEPT	-0.947	1.015	-1.701
	(-0.128)	(0.23)	(-0.422)
Δ(B_BIS_CDS)	0.939**	0.677***	0.85***
	(2.584)	(2.875)	(2.721)
Δ(R2_EDF)	11.43**	10.41**	11.84***
	(2.238)	(2.076)	(6.559)
Δ(C2_EDF)	-19.77	-14.6	-9.836
	(-1.032)	(-0.738)	(-0.319)
Δ(S_RISK)	1.255***	1.166***	1.2***
	(3.211)	(2.855)	(3.261)
Adjusted R-squared	0.410	0.462	0.48

Table 18: **Countries with strong and weak connections.** This table reports the coefficients and t-statistics for the panel regression:

$$\begin{aligned}\Delta(\text{B\_CDS})_{k,t} &= \alpha_{k,0} + \alpha_1 \times \Delta(\text{B\_BIS\_CDS})_{k,t} + \alpha_2' \times \Delta(\text{Local Bank Variables})_{k,t} \\ &\quad + \alpha_3' \times \Delta(\text{Global Variables})_t + \alpha_4' \times \Delta(\text{CDS Financials Index})_t + \epsilon_{k,t}\end{aligned}$$

$\Delta(\bullet)$ and $\%\Delta(\bullet)$ stand for first difference and percentage change of the variable over the quarter, respectively. k is the index for countries and t is the index for time. We perform the analysis on three sub-groups: countries whose foreign exposure weights more than 40% of their portfolio, whose foreign exposure (FExp) weights less than 40% of their portfolio and all the countries except the US. In the first group, we have Austria, Belgium, Switzerland, Germany, France, Great Britain, Ireland, Netherlands, Sweden. In the second group, we have Australia, Denmark, Spain, Greece, Italy, Japan, Portugal, United States. All equations are estimated by OLS with robust standard errors, and country fixed effects.

Variable	FExp$\geq$ 40%	FExp$\leq$ 40%	No US
INTERCEPT	1.259	-11.69^{***}	-6.856^{*}
	(0.445)	(-2.784)	(-1.649)
Δ(B_BIS_CDS)	0.496^{**}	0.5^{**}	0.564^{***}
	(2.38)	(2.01)	(4.428)
Δ(R2_EDF)	13.36^{***}	2.908	11.38^{***}
	(10.16)	(0.543)	(7.413)
Δ(C2_EDF)	-75.85^{***}	10.98	-13.04
	(-4.403)	(0.584)	(-0.522)
ER3M	2.727	45.12	23.76
	(0.05)	(0.302)	(0.388)
VPSPX	-1.125^{**}	2.096^{*}	1.205
	(-2.109)	(1.882)	(1.466)
%Δ5YCMT	4.274	7.364	1.173
	(0.273)	(0.386)	(0.088)
%ΔHY	-19.3	13.27	-4.506
	(-1.645)	(0.717)	(-0.394)
%ΔIG	21.61	-8.789	12.27
	(1.593)	(-0.39)	(1.002)
%Δ(OISUS)	2.811	1.604	2.028
	(1.161)	(0.394)	(0.871)
%Δ(S_RISK)	0.167	1.229^{***}	0.838^{***}
	(1.277)	(4.477)	(2.945)
Δ(B_FINSNR)	0.815^{*}	0.491^{*}	0.622^{**}
	(1.796)	(1.780)	(2.470)
Adjusted R-squared	0.469	0.525	0.455

Table 19: **Using sovereign CDS premia to measure exposure risk.** This table reports results obtained by performing robustness checks on the BIS matrix described in section 2. Column I reports results from the panel regression:

$$\begin{aligned}\Delta(\text{B\_CDS})_{k,t} &= \alpha_{k,0} + \alpha_1 \times \Delta(\text{S\_BIS\_CDS})_{k,t} + \alpha_2' \times \Delta(\text{Local Variables})_{k,t} \\ &\quad + \alpha_3' \times \Delta(\text{Global Variables})_t + \epsilon_{k,t}.\end{aligned}$$

Column II reports results obtained by adding the CDS indexes to the above. Last column reports results obtained by running the panel regression as in Table 17. $\Delta(\bullet)$ and $\%\Delta(\bullet)$ stand for first difference and percentage change of the variable over the quarter, respectively. k is the index for countries and t is the index for time. Our sample runs from the first quarter of 2006 to the last quarter of 2010. All equations are estimated by OLS with robust standard errors, and country fixed effects. Last column is estimated using also time effects.

Variable	I	II	III
INTERCEPT	8.952	-2.455	8.519***
	(1.34)	(-0.566)	(4.076)
Δ(S_BIS_CDS)	1.073**	0.798***	0.978***
	(2.474)	(2.982)	(3.059)
Δ(R2_EDF)	9.928**	9.159*	10.64***
	(1.987)	(1.875)	(6.652)
Δ(C2_EDF)	-0.266	4.072	8.996
	(-0.009)	(0.136)	(0.23)
ER3M	-331.5***	2.897	
	(-3.147)	(0.068)	
VPSPX	1.208	1.057	
	(0.757)	(1.279)	
%Δ5YCMT	0.142	10.9	
	(0.004)	(0.611)	
%ΔHY	-84.71**	-18.48	
	(-2.19)	(-0.831)	
%ΔIG	-50.45**	11.63	
	(-2.508)	(0.555)	
%Δ(OISUS)	16.35**	4.394	
	(2.485)	(1.122)	
Δ(S_RISK)	0.378***	0.348**	0.372*
	(3.202)	(2.408)	(1.816)
Δ(S_SOVX)		-0.035	
		(-0.362)	
Δ(F_NONFIN)		1.123	
		(-1.507)	
Δ(B_FINSNR)		1.123***	
		(6.429)	
Adjusted R-squared	0.355	0.430	0.428

Table 20: **Excluding the biggest 5 exposures.** In this table, we repeat the equations estimated in table 16 but we are using a BIS exposure matrix from which we have excluded the biggest 5 exposures.

Variable	I	II	III
INTERCEPT	-4.793	-7.972^{*}	-7.817^{*}
	(-1.347)	(-1.917)	(-1.807)
Δ(B_BIS_NOT5)	1.432^{***}	0.589	
	(6.23)	(1.287)	
Δ(BIS_NOT5_RES)			0.068
			(0.33)
Δ(R2_EDF)	12.24^{***}	10.72^{***}	10.35^{***}
	(4.743)	(6.89)	(8.721)
Δ(C2_EDF)	-1.893	-6.697	-3.948
	(-0.157)	(-0.312)	(-0.155)
ER3M	-237.4^{***}	-28.74	-37.41
	(-4.367)	(-0.467)	(-0.587)
VPSPX	1.998^{***}	1.234	1.181
	(2.65)	(1.627)	(1.308)
%Δ5YCMT	-14.15	-5.525	-4.116
	(-1.01)	(-0.623)	(-0.358)
%ΔHY	-43.72	-5.225	-3.982
	(-3.294)	(-0.721)	(-0.573)
%ΔIG	-15.37	16.55	19.06^{*}
	(-1.359)	(1.409)	(1.789)
%Δ(OISUS)	9.958^{***}	2.059	1.83
	(4.267)	(0.994)	(0.883)
%Δ(S_RISK)	0.905^{***}	0.787^{***}	0.781^{***}
	(6.722)	(2.702)	(2.743)
Δ(S_SOVX)		0.974^{***}	1.099^{***}
		(3.527)	(4.697)
Δ(F_NONFIN)		-0.349	-0.373
		(0.381)	(0.652)
Δ(B_FINSNR)		-0.349	-0.373^{***}
		(-1.396)	(-1.469)
Adjusted R-squared	0.368	0.465	0.447

Table 21: **Total bank credit risk.** This table reports the coefficients and t-statistics for the panel regression:

$$\begin{aligned}\Delta(\text{B\_CDS})_{k,t} &= \alpha_{k,0} + \alpha_1 \times \Delta(\text{Bank Credit Risk})_{k,t} \\ &+\alpha_2' \times \Delta(\text{Global Variables})_t + \alpha_3' \times \Delta(\text{CDS Indices})_t + \epsilon_{k,t}\end{aligned}$$

$\Delta(\bullet)$ and $\%\Delta(\bullet)$ stand for first difference and percentage change of the variable over the quarter, respectively. k is the index for countries and t is the index for time. The equation is estimated by OLS with robust standard errors and country fixed effects.

VARIABLES	FULL SAMPLE	Q1 2004 - Q4 2007	Q1 2008 - Q4 2010
IINTERCEPT	-2.528	-0.659	-2.153
	(-0.787)	(-1.434)	(-0.451)
Δ(B_CREDIT_RISK)	0.184***	0.016***	0.191**
	(3.1)	(3.608)	(2.496)
ER3M	-13.32	29.67**	40.69
	(-0.184)	(2.502)	(0.381)
VPSPX	0.819	0.189	0.683
	(1.161)	(1.369)	(0.397)
$\%\Delta$5YCMT	4.016	6.399***	6.656
	(0.43)	(3.401)	(0.292)
$\%\Delta$HY	-5.049	3.488**	-15.15
	(-0.877)	(2.179)	(-0.216)
$\%\Delta$IG	13.86	1.531	22.77
	(1.435)	(1.297)	(0.921)
$\%\Delta$(OISUS)	1.67	0.952***	9.738*
	(1.087)	(3.046)	(1.897)
Δ(S_SOVX)	0.384	2.311***	0.267
	(1.148)	(4.152)	(0.701)
Δ(F_NONFIN)	-0.445**	0.216**	-0.309
	(-2.251)	(1.99)	(-1)
Δ(B_FINSNR)	1.097***	0.065	1.107***
	(4.523)	(0.586)	(4.281)
Adjusted R-squared	0.406	0.616	0.391

Table 22: **The Sovereign CDS equation.** This table reports the coefficients and t-statistics for the panel regression:

$$\Delta(\text{S\_CDS})_{k,t} = \alpha_{k,0} + \alpha_1' \times \Delta(\text{Domestic Government Variables})_{k,t} + \alpha_2' \times (\text{Guarantees})_{k,t} + \alpha_3' \times \Delta(\text{Global Variables})_t + \epsilon_{k,t}$$

$\Delta(\bullet)$ and $\%\Delta(\bullet)$ stand for first difference and percentage change of the variable over the quarter, respectively. k is the index for countries and t is the index for time. In column III and IV we use the EDFs as a measure of risk for the banking systems instead of the CDS's. Equations reported in Column I to IV are estimated by OLS. Column V is estimated with 2SLS where the change in central bank collateralized loans is an instrument for Δ(B_CDS). Country fixed effects and robust standard errors are used for all the estimations.

VARIABLE	I	II	III	IV	V
Intercept	1.794	1.368	1.939	1.481	1.296
	(1.37)	(0.99)	(0.876)	(0.664)	(0.993)
Δ(S_IRN_REV)	-5.092	-4.828	-4.6	-4.358	-5.247^{*}
	(-1.487)	(-1.372)	(-0.971)	(-0.908)	(-1.832)
S_FDEF_GDP	1.173^{***}	1.405^{***}	0.427	0.699	1.923^{**}
	(3.128)	(4.113)	(0.416)	(0.764)	(2.364)
Δ(S_GEXT_L)	-9.02^{***}	-8.922^{***}	-10.9^{***}	-10.82^{***}	-8.136^{**}
	(-2.711)	(-2.646)	(-2.717)	(-2.663)	(-2.318)
Δ(M_CA)	6.271^{*}	5.648^{*}	7.462^{*}	6.852^{*}	5.157
	(1.787)	(1.651)	(1.89)	(1.763)	(1.464)
Δ(S_DEBT_GDP)	4.102^{***}	3.882^{***}	4.018^{***}	3.779^{***}	3.777^{***}
	(6.921)	(5.817)	(6.906)	(6.071)	(4.841)
GUARANTEES		0.302^{***}		0.311^{***}	0.312^{***}
		(4.498)		(5.116)	(4.806)
Δ(B_CDS)×B_GDP	0.085^{***}	0.086^{***}			0.115^{***}
	(4.301)	(4.368)			(8.833)
Δ(B_EDF)×B_GDP			1.861^{***}	1.965^{***}	
			(9.411)	(11.6)	
ER3M	-40.08^{**}	-43.71^{***}	-162.9^{***}	-167^{***}	1.477
	(-2.328)	(-2.744)	(-3.983)	(-4.234)	(0.038)
VPSPX	1.077^{**}	1.179^{***}	2.046^{**}	2.162^{***}	0.869
	(2.419)	(2.618)	(2.545)	(2.661)	(1.525)
%Δ5YCMT	-19.57^{***}	-18.100^{**}	-29.28^{***}	-27.736^{***}	-14.365^{**}
	(-2.667)	(-2.528)	(-2.865)	(-2.770)	(-2.221)
%ΔHY	27.258^{***}	23.080^{***}	16.186^{***}	21.228^{**}	28.197^{***}
	(3.997)	(3.298)	(3.031)	(2.223)	(4.241)
%ΔIG	24.716^{***}	-3.548^{***}	23.975^{***}	21.228^{***}	-4.685^{***}
	(4.070)	(3.674)	(3.262)	(2.984)	(3.797)
%ΔOISUS	0.000^{***}	-3.548^{***}	-1.509	-0.761	-4.685^{***}
	(-5.051)	(-4.088)	(-1.381)	(-0.718)	(-4.312)
Adjusted R-squared	0.531	0.540	0.390	0.400	0.521

Table 23: **The Sovereign CDS equation with indices.** This table reports the coefficients and t-statistics for the panel regression:

$$\Delta(\text{S\_CDS})_{k,t} = \alpha_{k,0} + \alpha_1' \times \Delta(\text{Domestic Government Variables})_{k,t} + \alpha_2' \times (\text{Guarantees})_{k,t} + \alpha_3' \times \Delta(\text{Global Variables})_t + \alpha_4' \times \Delta(\text{CDS Indices})_t + \epsilon_{k,t}$$

$\Delta(\bullet)$ and $\%\Delta(\bullet)$ stand for first difference and percentage change of the variable over the quarter, respectively. k is the index for countries and t is the index for time. In column III and IV we use the EDFs as a measure of risk for the banking systems instead of the CDS's. Equations reported in Column I to IV are estimated with OLS. Column V is estimated with 2SLS where the change in central bank collateralized loans is an instrument for Δ(B_CDS). Country fixed effects and robust standard errors are used for all the estimations.

VARIABLE	I	II	III	IV	V
Intercept	1.218	0.994	−0.686	−0.945	1.687
	(0.664)	(0.547)	(-0.248)	(-0.346)	(0.8)
Δ(S_IRN_REV)	−4.517*	−4.467	−4.539	−4.49	−4.595*
	(-1.691)	(-1.638)	(-1.378)	(-1.348)	(-1.951)
S_FDEF_GDP	0.482	0.574*	−0.642	−0.521	1.193
	(1.582)	(1.802)	(-0.908)	(-0.749)	(1.089)
Δ(S_GEXT_L)	−8.039**	−8.04**	−9.531**	−9.532**	−7.511**
	(-2.5)	(-2.48)	(-2.361)	(-2.343)	(-2.273)
Δ(M_CA)	4.528*	4.349*	5.213*	5.005*	4.111*
	(1.733)	(1.661)	(1.757)	(1.663)	(1.589)
Δ(S_DEBT_GDP)	3.006***	2.947***	2.557***	2.484***	3.038***
	(4.813)	(4.548)	(5.612)	(5.005)	(3.464)
GUARANTEES		0.109**		0.127**	0.111**
		(2.167)		(2.208)	(2.043)
Δ(B_CDS)×B_GDP	0.075***	0.075			0.101***
	(4.097)	(4.135)			(11.14)
Δ(B_EDF)×B_GDP			1.485***	1.521***	
			(7.215)	(7.458)	
ER3M	11.06	10.21	0.015	−1.132	11.89
	(0.599)	(0.554)	(0.001)	(-0.058)	(0.588)
VPSPX	0.206	0.273	0.777	0.858*	0.106
	(0.63)	(0.85)	(1.52)	(1.711)	(0.293)
%Δ5YCMT	−23.15***	−22.823***	−28.98***	−28.587***	−20.631***
	(-2.617)	(-2.593)	(-2.717)	(-2.674)	(-2.636)
%ΔHY	9.278	9.210	10.949**	10.911*	9.219
	(1.594)	(1.574)	(1.976)	(1.961)	(1.559)
%ΔIG	6.965	−2.088	14.880**	−2.112**	−2.114
	(1.529)	(1.547)	(2.555)	(2.554)	(0.834)
%ΔOISUS	0.718***	−2.088***	0.826***	−2.112***	−2.114***
	(-3.166)	(-3.044)	(-3.063)	(-2.971)	(-2.944)
Δ(S_SOVX)	0.718***	0.700***	0.826***	0.805***	0.661***
	(4.563)	(4.307)	(4.237)	(4.012)	(3.561)
Δ(F_NONFIN)	−0.030	−0.045**	−0.140	−0.157	−0.004
	(-0.296)	(-0.451)	(-1.150)	(-1.331)	(-0.034)
Δ(B_FINSNR)	−0.193***	−0.174***	0.073	0.094	−0.280**
	(-2.788)	(-2.442)	(0.997)	(1.307)	(-2.291)
Adjusted R-squared	0.615	0.615	0.527	0.528	0.603

Table 24: **Sovereign Equation on sub-periods** The first two columns report the coefficients and t-statistics for the panel regression:

$$\begin{aligned}\Delta(\text{S\_CDS})_{k,t} &= \alpha_{k,0} + \alpha_1' \times \Delta(\text{Domestic Government Variables})_{k,t} + \alpha_2' \times (\text{Guarantees})_{k,t} \\ &\quad + \alpha_3' \times \Delta(\text{Global Variables})_t + \alpha_4' \times \Delta(\text{CDS Indices})_t + \epsilon_{k,t}\end{aligned}$$

The regression is performed on two subperiods. $\Delta(\bullet)$ and $\%\Delta(\bullet)$ stand for first difference and percentage change of the variable over the quarter, respectively. k is the index for countries and t is the index for time. All equations are estimated with 2SLS where the change in central bank colleralised loans is an instrument for Δ(B_CDS).The regressions are estimated with country fixed effects and robust standard errors.

VARIABLE	Q1 2004-Q4 2007	Q1 2008-Q4 2010
Intercept	−0.136	12.86
	(-0.464)	(1.636)
Δ(S_IRN_REV)	−0.56*	−6.136
	(-1.706)	(-1.532)
S_FDEF_GDP	−0.187	2.691
	(-0.863)	(1.457)
Δ(S_GEXT_L)	0.03	−10.96**
	(0.243)	(-2.204)
Δ(M_CA)	0.151	1.87
	(0.368)	(0.744)
Δ(S_DEBT_GDP)	0.106	2.581
	(0.934)	(1.65)
GUARANTEES		0.129**
		(2.469)
Δ(B_CDS)×B_GDP	−0.027	0.104***
	(-0.537)	(6.816)
ER3M	16.68	−24.47
	(1.594)	(-0.57)
VPSPX	−0.029	−0.754
	(-0.327)	(-0.81)
%Δ5YCMT	1.067	−21.188
	(0.734)	(-1.461)
%ΔHY	−0.176	21.524
	(-0.149)	(0.410)
%ΔIG	0.965	−5.645
	(0.806)	(-1.296)
%ΔOISUS	1.805*	−5.645
	(1.877)	(-1.048)
Δ(S_SOVX)	1.805***	0.677***
	(2.864)	(4.026)
Δ(F_NONFIN)	−0.010	−0.165
	(-0.156)	(-0.405)
Δ(B_FINSNR)	−0.100	−0.363
	(-0.990)	(-1.292)
Adjusted R-squared	0.269	0.620

Table 25: **Sovereign Equation. Time effects.** The table reports the coefficients and t-statistics for the panel regression:

$$\Delta(\text{S\_CDS})_{k,t} = \alpha_{k,0} + \alpha_{0,t} + \alpha_1 \times \text{Guarantees}_{k,t} + \alpha_2' \times \Delta(\text{Local Government Variables})_{k,t} + \epsilon_{k,t}$$

We perform the analysis first for the whole sample from the first quarter of 2004 to the last quarter of 2010. Afterwards we perform the same analysis on sub-periods. $\Delta(\bullet)$ and $\%\Delta(\bullet)$ stand for first difference and percentage change of the variable over the quarter, respectively. k is the index for countries and t is the index for time. All equations are estimated with 2SLS where the change in central bank colleralised loans is an instrument for Δ(B_CDS).The regressions are estimated with both country and time fixed effects and robust standard errors.

VARIABLE	Time Effects, Q1 2004-Q4 2010	Time Effects, Q1 2004-Q4 2007	Time Effects, Q1 2008-Q4 2010
Intercept	4.294*	0.581	9.872*
	(8.56)	(1.596)	(3.545)
Δ(S_IRN_REV)	−4.444*	−0.476	−5.314
	(-1.829)	(-1.431)	(-1.523)
S_FDEF3_GDP	2.315	−0.18	2.928
	(1.496)	(-0.784)	(1.486)
Δ(S_GEXT_L)	−8.374**	0.094	−11.22**
	(-2.096)	(0.617)	(-2.209)
Δ(M_CA)	4.419	0.107	3.282
	(1.543)	(0.286)	(1.027)
Δ(S_DEBT_GDP)	4.876**	0.048	5.214*
	(2.123)	(0.489)	(1.926)
GUARANTEES	0.076		0.102
	(0.837)		(1.304)
Δ(B_CDS)×B_GDP	0.108***	−0.031	0.101***
	(10.6)	(-0.642)	(6.952)
Adjusted R-squared	0.573	0.260	0.603

Table 26: **Sovereign Equation including BIS information.** The table reports the coefficients and t-statistics for the panel regression:

$$\begin{aligned}\Delta(\text{S\_CDS})_{k,t} \quad &= \quad \alpha_{k,0} + \alpha_1' \times \times \Delta(\text{Domestic Variables})_{k,t} + \alpha_2' \times (\text{Explicit Guarantees})_{k,t} \\ &\quad + \alpha_3' \times \Delta(\text{B\_BIS\_CDS})_{k,t} + \alpha_4' \times \Delta(\text{Global Variables})_t + \alpha_5' \times \Delta(\text{CDS Indices})_t + \epsilon_{k,t}\end{aligned}$$

$\Delta(\bullet)$ and $\%\Delta(\bullet)$ stand for first difference and percentage change of the variable over the quarter, respectively. k is the index for countries and t is the index for time. In the first column, both Δ(B_BIS_CDS) and Δ(R2_EDF) are weighted by their size relative to the GDP. Both columns report equations estimated with 2SLS where the change in central bank collateralised loans is an instrument for Δ(B_CDS); country fixed effects and robust standard errors are used in both cases.

VARIABLE	I	II
Intercept	0.027	−3.544
	(0.008)	(-0.688)
Δ(S_IRN_REV)	−2.922	−5.911
	(-0.64)	(-1.052)
S_FDEF3_GDP	−1.44*	−3.966**
	(-2.586)	(-2.027)
Δ(S_GEXT_L)	−9.455**	−2.473
	(-2.151)	(-0.709)
Δ(M_CA)	5.34	2.557
	(1.291)	(0.437)
Δ(S_DEBT_GDP)	2.517***	1.593
	(3.508)	(1.024)
GUARANTEES	0.594	0.911
	(1.073)	(1.492)
Δ(B_BIS_CDS)×B_FExp	0.93**	
	(2.002)	
Δ(B_BIS_CDS)		3.84**
		(2.367)
Δ(R2_EDF)× B_CREDIT	−0.003	
	(-0.091)	
Δ(R2_EDF)		0.062
		(1.518)
ER3M	117.7	435.406***
	(2.478)	(2.598)
VPSPX	0.628	1.272
	(1.023)	(1.108)
%Δ5YCMT	−13.861	−8.968
	(-1.372)	(1.022)
%ΔHY	−6.081	−8.968
	(1.374)	(-0.730)
%ΔIG	−6.081	−55.963**
	(-0.545)	(-1.982)
%ΔOISUS	−2.038**	0.728
	(-2.317)	(0.389)
Δ(S_SOVX)	0.745***	0.531**
	(3.307)	(2.276)
Δ(F_NONFIN)	0.220	1.382*
	(0.904)	(1.787)
Δ(B_FINSNR)	−0.748	−2.957**
	(-1.631)	(-2.176)
Adjusted R-squared	0.134	-1.129