Real Effects of Financial Distress: The Role of Heterogeneity*

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Abstract

How severe are the real consequences of financial distress caused by sovereign debt crisis? What are the channels through which sovereign debt crisis affect banks and firms, and vice versa? Does firm heterogeneity matter? If yes, what are the important dimensions of heterogeneity? Using micro data from Portugal during the sovereign crisis starting in 2010, we address these questions. We make use of the Bank of Portugal's detailed credit registry database together with bank and firm balance sheets and income statements to conduct this analysis.

We first study the direct effect of the sovereign crisis on bank balance sheets by analyzing the differential impact on firms that had relations with banks who were more exposed to the sovereign (pre-crisis). We find that more fragile firms that had relations with more exposed banks contracted more than their counterparts. Specifically we find leverage and maturity structure of debt to be important dimensions of heterogeneity determining a firm's fragility. Highly leveraged firms and those that had a larger share of short term debt contracted more during the sovereign debt crisis. We analyze firm performance on the basis of growth rate of employment, assets, liabilities and usage of intermediate commodities. We show that our findings are consistent with a simple model of leverage and maturity choice.

We then document the spillover effects across firms that are mediated through the banking sector. To do this, we focus on the set of firms that were current on all their loans through the crisis, i.e., the set of performing firms. We find that performing firms that had relations with banks whose corporate loan balance sheet deteriorate by more were more affected by the sovereign crisis. Again, highly leveraged firms and those that had a larger share of short term debt contracted more during the sovereign debt crisis.

JEL Codes:
Key words: Sovereign debt, Leverage, Maturity structure, Spillovers.

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1 Introduction

Does financial distress lead to real consequences? Can the financial distress be caused by shocks to the real sector? In other words, is there a connection between health of banks on Wall Street and health of firms on Main Street, and vice versa? If yes, how strong are these two-way feedbacks? Are there potentially interesting dimensions of heterogeneity in the data that one may want to study? Such questions have come to the center of the policy debate in the aftermath of the financial crisis. In this paper, we study the real effects of financial distress experienced by banks in Portugal in the spring of 2010. We address two main questions: (i) What are the channels of transmission of shocks from the financial to the real sector? (ii) Were some firms affected more than others i.e. what does the data tell us about the heterogeneous impact of the shock on the non-financial firms. Regarding the first question, we document two channels of transmission of shocks, namely, the sovereign channel and the spillover channel.Regarding the second question, we find that exante highly leveraged firms and firms who had a substantial amount of short-term debt on their balance sheets contracted significantly more that their counterparts. The main reasons for choosing Portugal as a laboratory for this analysis are twofold: (i) Portugal is a country that has exceptional micro data which enables us to link the universe of banks to the universe of firms i.e. one can clearly observe the financial-real sector linkages and (ii) Portugal is a country that has arguably suffered large financial shocks as the sovereign debt crisis was unfolding in Europe.

The natural experiment literature on the real effects of bank balance sheet shocks at the firm level is an emerging strand and this is indeed a challenging task as it requires data on firm-bank relationships as well as information on firms and banks. For this analysis, we use data on the universe of firms and banks in Portugal, including all the firm-bank credit relationships. Our main contributions to the literature are the following. First, we highlight two channels of transmission of financial shocks to the real economy: (i) the sovereign channel and (ii) the spillover channel. The sovereign channel operates through banks' holdings of risky sovereign debt. The exposure to distressed government bonds inhibits the ability of banks to raise funds in capital markets markets, leading to a transmission of this increased borrowing costs to the interest rates paid by non-financial corporations (Committee on the Global Financial System, 2011). The spillover channel investigates whether performing firms were adversely affected owing to the accumulation of non-performing loans on the balance sheets of their lenders.[1] Next, we identify potentially important dimensions of heterogeneity among firms. We find that exante highly leveraged firms and firms with

[1]Performing firms are defined as those who did not have any loans overdue for 90 days or more during 2009 and 2010.

a more shorter maturity structure of debt contracted more in the aftermath of the shock. Finally, we look at multiple dimensions of firms outcome variables to perform holistic analysis of the real effects. We consider growth rates of firm employment, fixed assets, firm liabilities and the usage of intermediate commodities.

The literature on the causes/effects of the financial crisis is vast. There has been extensive theoretical work done on the household as well the firm side. On the household side, Mian and Sufi (2010) show that pre crisis household leverage was a powerful statistical predictor of the severity of the 2007-09 recession across U.S. counties. High household leveraged counties from 2002 to 2006 showed a sharp relative decline in durable consumption. These empirical findings are captured by means of a dynamic macro model developed in Justiniano et al. (2016). Guerrieri and Lorenzoni (2009) show that when some agents are liquidity constrained then the aggregate impact of shocks is greatly amplified. Eggertson and Krugman (2012) present a new Keynesian model where debt overhang on some agents, who are forced into rapid deleveraging, depresses aggregate demand. On the firm side, one could think about shocks propagating by means of the financial accelerator mechanism (Bernanke et al. (1999), Gertler and Kiyotaki (2009)), worse reallocation effects (Buera and Moll (2015), Gilchrist et al. (2013)) or through non-financial linkages across various sectors of the economy (Shourideh and Zeltin-Jones (2016)).

The research on the empirical side is relatively scarce as it requires detailed data on firm bank relationships as well as information on firms and banks. Regarding the recent 2008-09 financial crisis in the US, Chodorow-Reich (2014) uses the DealScan database and employment data from the U.S. Bureau of Labor Statistics Longitudinal Database to show that firms that had pre-crisis relationships with banks that struggled during the crisis reduced employment more than firms that had relationships with healthier lenders. This paper uses the collapse of Lehman Brothers in the fall of 2008 as the event around which the analysis is constructed. Similarly, Bentolila et al. (2013) matches employment data from the Iberian Balance Sheet Analysis System and loan information obtained from the Bank of Spain's Central Credit Register to document that during the recent financial crisis, Spanish firms that had relationships with banks that obtained government assistance recorded a higher job elimination than firms with relationships with healthy banks. Bofondi et al. (2013) looks at the aggregate credit supply effects of the sovereign debt crisis using data from the Italian credit register. Cingano et al. (2013) also uses the Bank of Italy's credit register to provide evidence that firms which borrowed from banks with a higher exposure to the interbank market experienced a larger drop in investment and employment levels in the aftermath of the recent financial crisis. Bottero et al. (2015) also uses data from the Italian Credit Register to show that the exogenous shock to sovereign securities held by financial intermediaries, which was triggered by the Greek bailout (2010), was passed on to firms

through a contraction of credit supply. Finally, Acharya et al. (2015) explores the impact of the European sovereign debt crisis and the resulting credit crunch on the corporate policies of firms, using data from Amadeus, SNL, Bankscope and other sources, however they only look at the syndicated loan market.

2 An overview of the macroeconomic events

Until late 2009 or early 2010 the viability of sovereign debt was not a concern for the markets. For over a decade, the yields of bonds issued by European countries had been low and stable. However, in the spring 2010 when the Greek government requested an EU/IMF bailout package to cover its financial needs for the remaining part of the year, markets started to doubt the sustainability of sovereign debt. Soon after Standard & Poors downgraded Greece's sovereign debt rating to BB+ ("junk bond") leading investors to be concerned with the solvency and liquidity of the public debt issued by other peripheral Eurozone countries like Ireland and Portugal.

In May 2010, following the Greek bailout request, the CDS spreads on Portuguese sovereign bonds increased dramatically (figure 1, top left panel) and suddenly the Portuguese banks lost access to international debt markets (figure 1, bottom panel). They could not obtain funding in medium and long term wholesale debt markets and this had been an important source of their funding until then. This sudden stop scenario could be attributed mainly to investors concerns on contagion from the sovereign crisis in Greece. The sudden rise in Portuguese CDS spreads meant that the banks who were more exposed to the public sector saw the risk in their balance sheets going up.[2]

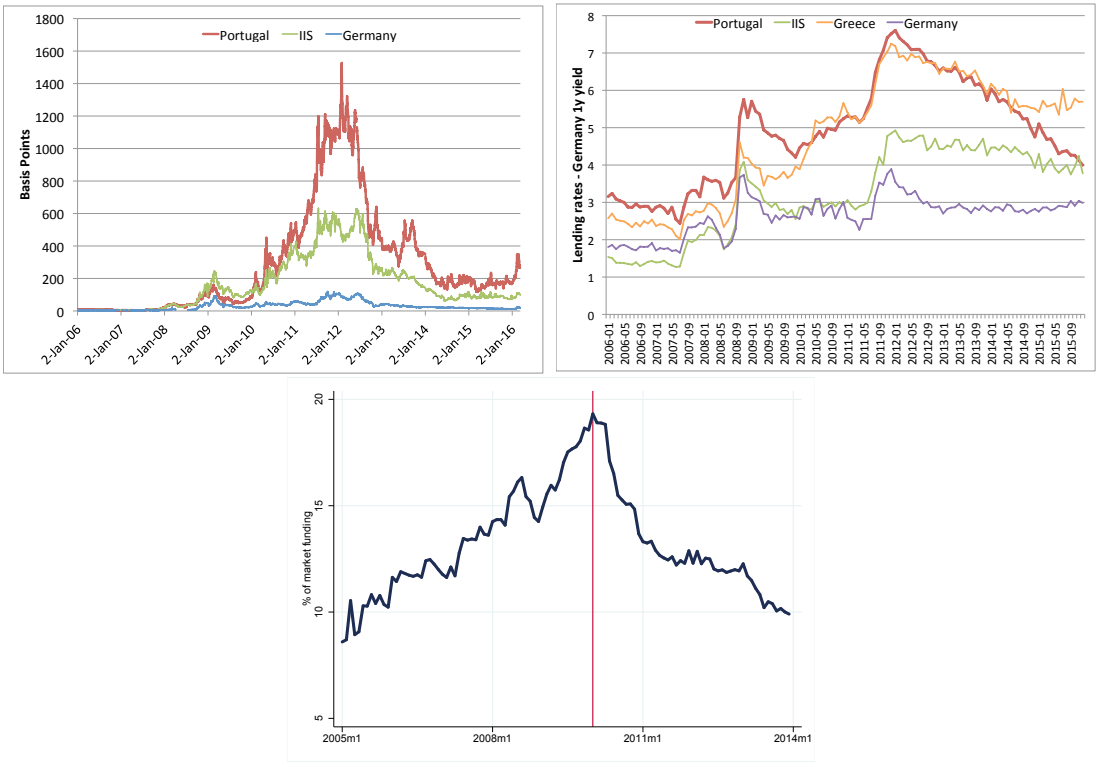
The top-left panel of figure 1 plots the sovereign credit default swap spreads. We also plot Germany as a benchmark. In the lower panel of figure 1, we plot the funding obtained through securities (market funding) as a fraction of total bank assets and the vertical line depicts May 2010.[3] The two events combined i.e. the sudden decline in the value of assets and the increase in funding costs led to a pass-through into the lending rates paid by firms. Specifically we observed a rise in the short term interest rates. The top-right panel of figure 1 shows the evolution of the spread between the average lending rates by banks at one year maturity relative to the return of a 1-year German sovereign bond. The two panels on top lend credence to the fact that the sovereign and lending rates are extremely closely related.

[2]Brunnermeier et al. (2011) argues that the sudden panics and the spike in sovereign bond yields in Portugal and elsewhere were the consequence of the close inter-linkages between banks and sovereigns. Fears about the solvency of the sovereign can put the solvency of banks in a particular country at risk, since banks typically hold a substantial fraction of their assets in the form of sovereign debt of the respective country. The situation was no different in Portugal.

[3]Source: Alves et al. (2016).

We call this channel of transmission of shock as the *sovereign channel*.

Figure 1: Sovereign CDS spreads, market funding, and bank lending spreads to NFCs



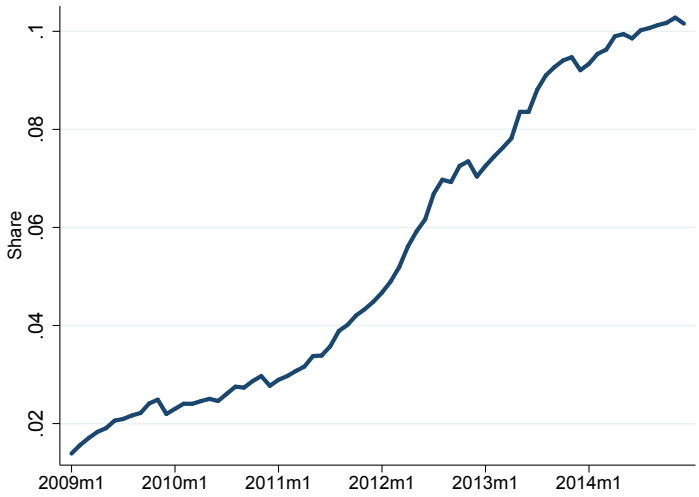
Another stylized fact that we observe in the data is the rapid accumulation of non-performing loans on the banks' balance sheets. In figure 2, we present the non-performing loans as a fraction of total loans of banks in Portugal.[4] This motivates us to think of other potential channels of transmission of financial distress onto the real sector. To elaborate further, we are interested in studying if a firm, conditional on not having any loans in default (overdue>90 days) in 2009 or 2010, was affected adversely because its lenders were accumulating defaulting assets on their balance sheet. This is what we call the *spillover channel*.

To sum up, the entire economic environment in Portugal at this time was adverse all the agents of the economy were under stress.[5] The banks were hit particularly hard as they were the center of the capital flows and in 2010 accounted for approximately half of the net

[4]Our analysis will however be strictly cross-sectional and we do not provide explanations for the spike in NPLs over time.

[5]For a further detailed description we refer the reader to Reis (2013) who documents the events as they happened in the aftermath of the sovereign debt crisis in Greece. The yields on 10 year Portuguese bonds rose from 3.9% to 6.5% during 2010. Public spending also rose markedly, partly because of the automatic stabilizers, and partly because the government implemented a campaign promise of raising public sector wages after years of zero increases. The sudden stop in capital inflows affected, especially, the non-tradables sector and brought about a sharp decline in output, a phenomenon that has also been observed in many Latin American countries.

Figure 2: Non-performing loans as a fraction of total loans



foreign debt of Portugal. Arguably the trigger for these events was the bailout request by Greece in April 2010. This bailout request prompted a complete reassessment of the default risk of a number of countries of the European Economic and Monetary Union (especially the peripheral European countries) and can be considered as the first, unprecedented, and unanticipated episode that challenged the notion of risk-less sovereign debt in the euro area since the adoption of the Euro.

3 The empirical analysis

3.1 Our data

For this analysis we build a unique dataset for the Portuguese economy. We mainly use three separate datasets, which can be merged using the firm and bank identification codes. The datasets used were the Central Credit Register (CRC), the Central Balance Sheet Database (CBSD) and the Monetary and Financial Statistics.[6]. The CRC is managed by Bank of Portugal and contains information reported by the participants (the institutions which extend credit) concerning credit granted to individuals and non-financial corporations and the situation of all such credits extended. Any loan equal to or above 50 euros is recorded in the credit register. For this analysis, we only consider credit extended to non-financial corporations and exclude the household sector. Further, we will only consider the total

[6]Our data on firm level employment come from a separate dataset called Quadros de Pessoal (QP)

committed credit between the firm and a bank.[7] The CBSD is based on accounting data of individual firms. Since 2006, annual CBSD data has improved significantly and has been based on mandatory financial statements reported in fulfillment of firms statutory obligations under the Informação Empresarial Simplificada (Simplified Corporate Information, Portuguese acronym: IES). The MFS data provides us with information on the bank balance sheet components. Variables such as bank size, capital ratio, and liquidity ratio are obtained from this database. The CRC and the CBSD can be merged using the firm identifier and then using the bank identifier, we merge it with the MFS to get our comprehensive dataset.

In tables 1 & 2 we provide an overview of the datastet we use. Table 1 reports aggregate statistics on firms while table 2 reports bank level characteristics. The first column of table 1 represents all firms from the CBSD i.e. all firms who file taxes in Portugal, the second column includes firms who have obtained credit from a financial institution while the last column only shows firms who have multiple banking relationships. All figures reported are for 2009:Q4. Table 2 reports data from the financial institutions operating in Portugal. We group the individual banks in 33 banking groups and work at this level of consolidation.[8]

3.2 Regression specifications

For the empirical analysis, all growth rates were constructed following Fort et al., i.e.,

$$g_t^E = \frac{E_t - E_{t-1}}{X_t}$$

Here, g_t^E is the growth rate of variable 'E' at time 't'. And the variable X is defined as:

$$X_t = 0.5 * (E_t + E_{t-1})$$

This measure of net growth is bounded between +2 and -2 and symmetric around zero. Its desirable properties are discussed extensively in Davis et al. (1996). This method of computing the growth rates helps us account for both the intensive and the extensive margin.

In what follows we document the real effects of the sovereign debt crisis in Portugal. We construct a weighted sovereign exposure measure for each firm. To elaborate, we note all the bank-firm relationships in the fourth quarter of 2009 and the banks' respective sovereign holdings as a fraction of their total assets. Using the relative shares of each bank in a firms loan portfolio, we can construct our sovereign exposure measure for each firm. For the rest of the analysis, we keep the shares and therefore exposures constant. In other words, a

[7] We only consider regular and potential credit and ignore items such as written off credit that also appears in the database.

[8] For confidentiality reasons we are not able to provide further information on the identity of firms or banks used in this analysis.

firms exposure to the sovereign through its lenders are predetermined in our model. The implicit assumption is that the banks transmit shocks to the real sector, proportional to their pre-crisis exposures. Figure 2 presents the distribution of the weighted sovereign exposures of the firms in September 2009.

To be more precise, our firm level sovereign exposure measure is generated as:

$$sov_{j,Q4:2009} = \sum_{b \epsilon B_j} s_{j,b} * sovshare_b, \tag{1}$$

where $s_{j,b}$ is the share of bank 'b' in the total borrowing of firm 'j' and $sovshare_b$ is the total Portuguese sovereign bond holdings of bank 'b' normalized by total assets. A similar exposure measure has been used in Bottero et al. (2015) which looks at the real effects of the sovereign debt crisis in Italy. Next we construct the growth rates of our real variables namely employment, fixed assets, firm liabilities and usage of intermediate commodities using the methodology described earlier. We use stocks in the fourth quarter of 2009 and 2010 to construct our growth rates. Other robustness measures like taking 2 year averages on either side of the sovereign shock were also conducted and the results were consistent with the ones reported here. We prefer this specification as the sovereign holdings in 2009 exhibit more heterogeneity than 2008 and given that 2009 was still a tranquil period in Portugal, econometrically, we think there results are much more robust.

Before analyzing the real effects, we document the effects on lending on the intensive margin using the methodology developed in Khwaja & Mian (2008). In Portugal, on average, around half of the firms have multiple banking relationships and we exploit this fact to identify if there were any adverse effects on lending, on the intensive margin. The baseline regression model we estimate is the following:

$$\%\Delta L_{i,j,Q4:10-Q4:09} = \alpha_0 + \alpha_1 sov_{j,Q4:09} + B_{j,Q4:09} + \alpha_i + \epsilon_j, \tag{2}$$

$\%\Delta L_{i,j,Q4:10-Q4:09}$ is the growth rate of total committed credit between a firm-bank pair between Q4:09 and Q4:10. $sov_{j,Q4:09}$ is the sovereign share of the bank in Q4:09 and α_i are firm fixed effects. We later augment the above equation to include interaction terms with high leverage and high short-term debt dummies to identify such heterogeneities in the data.

The results are presented in Table 3. Column (1) reports a bank level regression of loan growth on sovereign exposures. Columns (2) - (6) represent regression results for firms having multiple banking relationships exante while columns (7) & (8) include firms having single relationships as well, for sake of completeness. Column (2) presents the baseline case without interactions and we observe no significant average effect of bank sovereign

exposures on lending. However, when we include interaction terms with a high leverage dummy and a dummy that captures high short-term debt, we observe quite different results. We find that there was an overall reduction of lending to firms who were highly leveraged and those that had a significant share of short-term debt on their balance sheets.

The baseline regression, to analyze real-effects, is the following:

$$\%\Delta V_{j,Q4:10-Q4:09} = \alpha_0 + \alpha_1 sov_{j,Q4:09} + \Gamma_j^1 F_j + \Gamma_j^2 B_j + \beta_1^{ind} + \beta_2^{sizeage} + \epsilon_j, \tag{3}$$

where the variable 'V' represents employment, fixed assets, firm liabilities and intermediate commodities, F_j is a set of firm specific controls and in this vector we use measures of profitability, leverage and maturity structure of debt. B_j is a vector of weighted bank controls and the variables we use here are the bank size, average interest rate on loans, capital ratio and the liquidity ratio. We also have controls for the profitability, age, size, and the industry to which the firm belongs.

The results are presented in Table 4. On average we do not find significant effects of the shock after controlling for bank and firm specific characteristics. However, we are interested in exploring potentially interesting dimensions of heterogeneity and we learn from the corporate finance literature that firm leverage and maturity structure of debt are two of the most important financial variables. Having this overall broad idea in mind, we proceed to estimate regressions that address more specific questions. The first question we ask is, are the firms that are highly leveraged more adversely affected than their lower leveraged counterparts? To answer this question, we modify equation (2) as follows:

$$\begin{aligned}\%\Delta V_{j,Q4:10-Q4:09} = \alpha_0 + \alpha_1 sov_{j,Q4:09} + \alpha_2 sov_{j,Q4:09} * hlev + \alpha_4 hlev \\ + \Gamma_j^1 F_j + \Gamma_j^2 B_j + \beta_1^{ind} + \epsilon_j,\end{aligned} \tag{4}$$

Here we include a dummy for firms having pre-crisis leverage of higher than 47% and also the interaction of the dummy with the sovereign exposure measure. The results are reported in table 5. Here the coefficient on the sovereign share variable captures the impact for the low leveraged firms where we do not find a significant effect. The total real effect of the crisis on the highly levered firms can be obtained by taking the sum of the coefficients on the sovereign exposure term and the interaction term. Here we do find significant negative effects of the crisis. The employment, capital, firm liabilities and intermediate commodities, all, show a relative decline. In other words, firms that were highly leveraged prior to the onset of the sovereign debt crisis, appear to contract more than the ones who were less leveraged (better capitalized).

We also estimate a regression to answer the question if firms that have significant share

of short term debts on their balance sheet were more adversely affected by the sovereign debt crisis. The intuition is that the firms that have a longer maturity structure will not need to refinance in the height of the crisis and therefore would be relatively hedged. We conduct this analysis by using a dummy that is set equal to 1 for firms having a pre-crisis share of short term debt greater than 86%.

$$\%\Delta V_{j,Q4:10-Q4:09} = \alpha_0 + \alpha_1 sov_{j,Q4:09} + \alpha_2 sov_{j,Q4:09} * hstdebt + \alpha_4 hstdebt$$
$$+\Gamma_j^1 F_j + \Gamma_j^2 B_j + \beta_1^{ind} + \epsilon_j, \quad (5)$$

The results are presented in table 6. Just as in the previous case, we do find significant negative effects of the sovereign crisis on the firms who have a larger share of short term debt on their balance sheets. These results are robust across all our independent variables. We also report p values from the one sided t-test for the sum of the two coefficients of interest to be less than zero and we fail to reject the null hypotheses in all the cases considered.

We have thus far documented that the overall level of debt and the maturity structure of debt were individually detrimental for real activity in the aftermath of the sovereign debt crisis. However, one may wish to see if either of the two variables dominate or are they both equally important? To answer this question, we include both the interaction terms in our baseline regression and the results are presented in table 7. We find persistently significant negative effects on the firms who were highly leveraged and those who had a significant share of short term debt. This makes us infer that both variables are equally important while analyzing the real effects of the crisis in Portugal.

3.3 Exposure to sovereign debt of GIIPS countries

Thus far we have only considered the exposure of the banks to the Portuguese sovereign and arguably this was the most important source of risk for the Portuguese banks. However, one can argue that a broader measure of exante vulnerability could be constructed by allowing for the exposure to the sovereign debt of the GIIPS countries.[9] To this effect, we now construct a firm level sovereign exposure variable, as before, allowing for the sovereign debt holdings for the GIIPS countries. Tables 8 and 9 highlight the fact that our previous results are robust. This is intuitive in the sense that now our risk exposure measure includes even more risk. So after the advent of the shock, highly leveraged firms and firms that had a significant amount of short term debt on their balance sheets, contracted more.

[9]Greece, Ireland, Italy, Portugal and Spain.

3.4 Discussion

A number of robustness checks were conducted to ensure the validity of our results. The first robustness check was with respect to the holding of other sovereign bonds. The main results are with respect to the Portuguese sovereign bond holdings of the banks. We also report the results allowing for the holdings of Italian, Irish, Spanish, and Greek debt. Similar checks were done with the banks' holding of Portuguese and Greek debt and Portuguese and Spanish debt. In all these cases, our results and conclusions remain unaltered.

The next robustness check was done with respect to the selection of the time window. We compute growth rates between Q4:09 and Q4:10 and this is our main window of analysis. However, we also conducted our analysis for Q4:08 and Q4:11 and also by taking growth rates of the average values of Q4:08 and Q4:09 and Q4:10 and Q4:11. Once again our results remain qualitatively unaltered. One of the principle reasons, for not including 2011 in the baseline analysis, is that 2011 was a very eventful year in terms of many events occurring simultaneously e.g. Portugal requested the eurosystem bailout, the EBA conducted the stress tests and the capital exercise etc.

More analysis was done to make sure that our results are not driven by some particular way in which banks might be operating. For example, could it be that banks who were, exante, lending more to the weaker firms, also had higher sovereign exposures? This could be justified as a case of diversification. Sovereign debt was considered safe and so could it be that banks were diversifying the risk? To verify that this was not the case, we constructed bank level risk measures (share of non performing loans in total loans), from the credit registry, and computed the correlations with sovereign holdings, exante. The correlation turned out to be insignificant. Despite this, we augmented our regressions with sector and location specific fixed effects as such (possible) matching might take place because of the presence of the firm and the bank in a particular sector or location. This is particularly importa

We also verify that our results are not driven by one particular sector. When one thinks about which sectors could be particularly adversely affected by the sovereign debt crisis, construction is the first that comes to mind. Although we have sector fixed effects in all our regressions, we reran our regressions without the construction sector and our results hold even in that sub-sample.

More analysis was done to make sure that our results are not driven by some particular way in which banks might be operating. For example, could it be that banks who were, exante, lending more to the weaker firms, also had higher sovereign exposures? This could be justified as a case of diversification. Sovereign debt was considered safe and so could it be that banks were diversifying the risk? To verify that this was not the case, we

constructed bank level risk measures (share of non performing loans in total loans), from the credit registry, and computed the correlations with sovereign holdings, exante. The correlation turned out to be insignificant. Figure 6 in the appendix lends credence to this statement. We report scatter plots and correlation coefficients in the four quarters prior to the sovereign shock. Despite this analysis, we augmented all our regressions with sector and location specific fixed effects as such (hypothetical) matching might take place because of the presence of the firm and the bank in a particular sector or location. This verification is particularly important in context of the spillover analysis that we conduct in the following section.

4 The spillover channel

In the last section, we have documented the real effects of financial distress originating from the banks' holding of (ex ante risk-free) sovereign assets. In this section, we explore another novel channel of transmission of shocks from the financial to the real sector. The only difference is that in this section we look at the real effects on firms who did not have any non-performing loan in our sample period. The question we ask is were the firms, all of whose loans were in good standing, affected in any way by the aggregate shock to the economy. We perform the analysis in 3 steps.

1. We start by analyzing the non-performing loans (NPL) of the firms, in 2009:Q4 and 2010:Q4, as a fraction of total outstanding loans. We construct a dummy which takes a value of 1 if the firm has an NPL share bigger than 0. We then regress the NPL dummy in 2010 on the NPL dummy in 2009 and firm level controls in 2009. The predicted value from this regression is the probability that a particular firm will have some NPLs in 2010 conditional on it having a positive NPL share in 2009. This is therefore a firm level variable. In particular, we run the following regression and obtain the predicted values:

$$NPL_{j,Q4:2010} = NPL_{j,Q4:2009} + X_{j,Q4:2009} + \nu_j \tag{6}$$

2. The next step was to convert this firm level variable into a bank level variable and this is our proxy for risk on the banks' balance sheet. Our measure of exante bank risk is computed as follows:

$$Risk_{b,Q4:2009} = \sum_{j \epsilon F_j} s_{j,b} * \widehat{NPL}_{j,Q4:2010},$$

where, $s_{j,b}$ is the share of bank b's loans going to firm 'j' in Q4:2009. In this way we are able to generate a bank specific risk measure. To analyze spillover effects, we however need to look at firms who had all their loans in good standing in both the time periods under analysis. We do this in step 3.

3. We take recourse to the central credit registry database once again. We drop all the firms who had any loans overdue for 90 days or more. For these firms, we can now construct a weighted risk measure using the lending shares in Q4:2009 and the bank level risk measures from step 2 above. We can then use this as our main explanatory variable to see if these 'good' firms experienced some real distress owing to the weakening of bank balance sheets.

The results are presented in tables 10 and 11. The broad message emanating from these tables is once again that heterogeneity matters and particularly leverage and the maturity structure of debt. Our results from the sovereign channel are once again replicated in the spillover channel analysis. The conclusion that arises is that irrespective of the firm being in good standing or not, leverage and debt maturity structure are important determinants of a firms' access to credit and performance when the overall macroeconomic scenario is adverse.

5 Conclusion

Using a novel loan level dataset from Portugal, we study two channels (sovereign and spillover) through which financial shocks may be transmitted to the real sector. The sovereign channel operates through the banks' holdings of risky public debt while the spillover channel operates through the accumulation of non-performing loans on the bank's balance sheets. We first analyze firms' access to credit and then proceed onto studying firm performance in terms of employment, assets, liabilities and usage of intermediate commodities, in the aftermath of the financial shock. Although we do not find significant effects on average, firm heterogeneity seems to matter significantly. Specifically, we show that exante highly leveraged firms and firms that had a shorter maturity structure of debt contracted significantly more than their counterparts. The overall amount of debt and the maturity structure, both seem to be important determinants of firm performance when the overall macroeconomic scenario is adverse. We also document that similar results hold also for firms who themselves did not have any loans in default but were indirectly affected because their lenders were in distress.

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A Tables

Table 1: Descriptive Statistics (Firms)

	CBSD		CBSD & CRC		>1 Relations	
Variables	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Employment	13.66	120.345	14.81	126.864	18.89	150.535
Fixed Assets	934068.3	2.98e+07	886924.3	2.92e+07	1190380	3.52e+07
Tot. Liab	2848650	8.58e+07	2522380	8.69e+07	3404019	1.05e+08
Int. Comm. Usage	203245.3	2.05e+06	214196.5	2.15e+06	278098.5	2.58e+06
EBIT	80525.3	2684130	75880.12	2354905	103475.7	2845427
ST debt share	.7710766	.3644306	.7721372	.3627501	.7490936	.3674383
No. of firms	138211		106723		82561	

Figures are for 2009:Q4. IES is the firm balance sheet data, CRC is the central credit registry.

Table 2: Descriptive Statistics (Banks)

Variable	**Mean**	**SD**	**Min**	**Max**
Total Assets	13978.2	27837.63	106.25	106398.5
Cap. Ratio	14.85727	7.744448	0	32.8125
Avg. Int. Rate	2.664033	2.294107	.1869576	9.594814
Overdue/total loans	3.56929	5.17381	0	24.1589
Corp share	28.84509	18.73572	1.16245	70.93906
Sovereign share	5.8221	5.65742	0	18.47539
No. of Banks	33	33	33	33

Figures are for 2009:Q4. Consolidated for 33 main financial institutions.

Table 3: Lending Effects

	(1) Bank Level	(2) Baseline	(3) Leverage	(4) Leverage	(5) ST Debt	(6) ST Debt	(7) Lev (All)	(8) ST Debt (All)
Sov_exp.	-1.252***	0.094	0.135	0.353	0.206	0.442	0.280	0.391
	(0.605)	0.409	(0.409)	(0.473)	(0.393)	(0.470)	(0.393)	(0.411)
Highlev*sov_exp			-0.412***	-0.360**			-0.279**	
			(0.146)	(0.155)			(0.140)	
ST debt*sov_exp					-0.537***	-0.556***		-0.560**
					(0.163)	(0.187)		(0.223)
Cap_ratio				0.192		0.202	0.054	0.071
				(0.438)		(0.438)	(0.464)	(0.475)
Liq_ratio				1.108		1.089	0.973	0.946
				(1.124)		(1.133)	(1.116)	(1.163)
Bank_size				0.042**		0.043**	0.033**	0.035**
				(0.017)		(0.017)	(0.016)	(0.017)
Highlev							-0.025**	
							(0.010)	
ST debt								0.006
								(0.015)
Constant	0.172**						-0.423**	-0.440**
	(0.067)						(0.184)	(0.189)
Firm FE	N	Y	Y	Y	Y	Y	N	N
Observations	64	144,966	144,966	144,966	139,821	139,821	198,708	184,416

Note: The dependent variable is the loan growth rate at the bank-firm level. Column (1) reports a bank level regression of loan growth on sovereign exposures. Columns (2) - (6) represent regression results for firms having multiple banking relationships exante. Column (2) presents the baseline regression with no interaction terms. Columns (3) - (6) introduce interactions with the high leverage dummy and the high ST debt dummy. Columns (7) & (8) include firms having single relationships as well. Clustered standard errors (bank level) are reported in the parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 4: Average Effects

VARIABLES	(1) Gr_emp	(2) Gr_ast	(3) Gr_liab	(4) Gr_int
Wtd_sov_holding	-0.002	-0.427	-0.034	-0.048
	(0.091)	(0.268)	(0.245)	(0.093)
Constant	0.166***	-0.453***	0.108***	0.093***
	(0.019)	(0.043)	(0.027)	(0.017)
Firm Controls	Y	Y	Y	Y
Wtd. Bank Controls	Y	Y	Y	Y
Sector FE	Y	Y	Y	Y
Observations	88,204	89,410	89,466	89,823

Clustered standard errors (bank level) are reported in the parentheses
* p<0.1, ** p<0.05, *** p<0.01

Table 5: Interaction with leverage

VARIABLES	(1) Gr_emp	(2) Gr_ast	(3) Gr_liab	(4) Gr_int
Wtd_sov_holding (α_1)	0.030	-0.279	0.233	0.024
	(0.083)	(0.248)	(0.206)	(0.078)
Wtd_sov_holding*Highlev (α_2)	-0.199*	-0.834***	-1.605***	-0.450***
	(0.112)	(0.207)	(0.410)	(0.142)
Highlev	0.023***	-0.009	0.001	0.050
	(0.008)	(0.161)	(0.027)	(0.085)
Constant	0.168***	-0.422***	0.131***	0.096***
	(0.019)	(0.043)	(0.027)	(0.016)
Firm Controls	Y	Y	Y	Y
Wtd. Bank Controls	Y	Y	Y	Y
Sector FE	Y	Y	Y	Y
P($\alpha_1 + \alpha_2 < 0$)	0.96	0.99	0.99	0.99
Observations	88,204	89,410	89,466	89,823

Note: The dependent variables are the growth rates of employment, fixed assets, bank liabilities and usage of intermediate commodities, respectively. The main independent variable is the weighted Portuguese sovereign bond holdings of firms in Sept. 09. Firm level controls include age, size, value added, and sector fixed effects. Weighted bank controls include capital ratio, liquidity ratio and average interest rates charged by the respective banks. Clustered standard errors (bank level) are reported in the parentheses. We also report the p-values from a one sided t-test with H0: $\alpha_1 + \alpha_2 < 0$. *** p<0.01, ** p<0.05, * p<0.1

Table 6: Interaction with short term debt

VARIABLES	(1) Gr_emp	(2) Gr_ast	(3) Gr_liab	(4) Gr_int
Wtd_sov_holding (α_1)	0.017	-0.392	0.097	-0.019
	(0.090)	(0.256)	(0.349)	(0.092)
Wtd_sov_holding* High_stdebt (α_2)	-0.140**	-0.265**	-0.289**	-0.218***
	(0.069)	(0.110)	(0.125)	(0.046)
High_stdebt	-0.023	-0.144	0.097***	0.000
	(0.017)	(0.160)	(0.036)	(0.044)
Constant	0.165***	-0.454***	0.142***	0.093***
	(0.019)	(0.042)	(0.033)	(0.017)
Firm Controls	Y	Y	Y	Y
Wtd. Bank Controls	Y	Y	Y	Y
Sector FE	Y	Y	Y	Y
P($\alpha_1 + \alpha_2 < 0$)	0.98	0.98	0.98	0.99
Observations	88,204	89,410	89,828	89,823

Note: The dependent variables are the growth rates of employment, fixed assets, bank liabilities and usage of intermediate commodities, respectively. The main independent variable is the weighted Portuguese sovereign bond holdings of firms in Sept. 09. Firm level controls include age, size, value added, and sector fixed effects. Weighted bank controls include capital ratio, liquidity ratio and average interest rates charged by the respective banks. Clustered standard errors (bank level) are reported in the parentheses. We also report the p-values from a one sided t-test with H0: $\alpha_1 + \alpha_2 < 0$. *** p<0.01, ** p<0.05, * p<0.1

Table 7: Leverage and Short term debt

VARIABLES	(1) Gr_emp	(2) Gr_ast	(3) Gr_liab	(4) Gr_int
Wtd_sov_holding	0.047	-0.250	0.876	0.050
	(0.084)	(0.238)	(0.355)	(0.078)
Wtd_sov_holding * Highlev	-0.194*	-0.825***	-2.408***	-0.443***
	(0.111)	(0.206)	(0.519)	(0.142)
Wtd_sov_holding* High_stdebt	-0.131*	-0.229**	-0.163	-0.199***
	(0.067)	(0.107)	(0.110)	(0.045)
Highlev	0.024***	-0.008	-0.03	0.051
	(0.008)	(0.161)	(0.028)	(0.085)
High_stdebt	-0.025	-0.290	0.13	0.015
	(0.019)	(0.216)	(0.116)	(0.034)
Constant	0.168***	-0.422***	0.101**	0.096***
	(0.019)	(0.043)	(0.044)	(0.016)
Firm Controls	Y	Y	Y	Y
Wtd. Bank Controls	Y	Y	Y	Y
Sector FE	Y	Y	Y	Y
Observations	88,204	89,410	89,828	89,823

Note: The dependent variables are the growth rates of employment, fixed assets, bank liabilities and usage of intermediate commodities, respectively. The main independent variable is the weighted Portuguese sovereign bond holdings of firms in September 2009. The firm level controls used were firm age, firm size, value added, and fixed effects for the sector of operation. The weighted bank controls used were bank capital ratio, liquidity ratio and average loan interest rates charged by the respective banks. Clustered standard errors (bank level) are reported in the parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 8: Interaction with leverage (GIIPS exposure)

VARIABLES	(1) Gr_emp	(2) Gr_ast	(3) Gr_liab	(4) Gr_int
Wtd_GIIPS (α_1)	0.010	-0.159	0.292	0.031
	(0.065)	(0.214)	(0.121)	(0.060)
Wtd_GIIPS*Highlev (α_2)	-0.179*	-0.758***	-1.447***	-0.410***
	(0.105)	(0.172)	(0.338)	(0.122)
Highlev	0.023***	-0.010	0.000	0.050
	(0.008)	(0.162)	(0.027)	(0.085)
Constant	0.169***	-0.426***	0.126***	0.096***
	(0.019)	(0.043)	(0.026)	(0.016)
Firm Controls	Y	Y	Y	Y
Wtd. Bank Controls	Y	Y	Y	Y
Sector FE	Y	Y	Y	Y
P($\alpha_1 + \alpha_2 < 0$)	0.95	0.99	0.99	0.99
Observations	88,204	89,410	89,466	89,823

Note: The dependent variables are the growth rates of employment, fixed assets, bank liabilities and usage of intermediate commodities, respectively. The main independent variable is the weighted GIIPS sovereign bond holdings of firms in September 2009. The firm level controls used were firm age, firm size, value added, and fixed effects for the sector of operation. The weighted bank controls used were bank capital ratio, liquidity ratio and average loan interest rates charged by the respective banks. Clustered standard errors (bank level) are reported in the parentheses. We also report the p-values from a one sided t-test with H0: $\alpha_1 + \alpha_2 < 0$. *** p<0.01, ** p<0.05, * p<0.1

Table 9: Interaction with ST Debt (GIIPS exposure)

VARIABLES	(1) Gr_emp	(2) Gr_ast	(3) Gr_liab	(4) Gr_int
Wtd_GIIPS (α_1)	0.002	-0.244	0.155	-0.001
	(0.072)	(0.220)	(0.290)	(0.072)
Wtd_GIIPS * High_stdebt (α_2)	-0.129**	-0.242*	-0.269**	-0.204***
	(0.052)	(0.122)	(0.100)	(0.037)
High_stdebt	-0.023	-0.145	0.098***	0.000
	(0.017)	(0.160)	(0.036)	(0.044)
Constant	0.166***	-0.458***	0.139***	0.092***
	(0.019)	(0.043)	(0.032)	(0.017)
Firm Controls	Y	Y	Y	Y
Wtd. Bank Controls	Y	Y	Y	Y
Sector FE	Y	Y	Y	Y
P($\alpha_1 + \alpha_2 < 0$)	0.99	0.97	0.99	0.99
Observations	88,204	89,410	89,828	89,823

Note: The dependent variables are the growth rates of employment, fixed assets, bank liabilities and usage of intermediate commodities, respectively. The main independent variable is the weighted GIIPS sovereign bond holdings of firms in September 2009. The firm level controls used were firm age, firm size, value added, and fixed effects for the sector of operation. The weighted bank controls used were bank capital ratio, liquidity ratio and average loan interest rates charged by the respective banks. Clustered standard errors (bank level) are reported in the parentheses. We also report the p-values from a one sided t-test with H0: $\alpha_1 + \alpha_2 < 0$. *** p<0.01, ** p<0.05, * p<0.1

Table 10: Spillover effects (Interaction with leverage)

VARIABLES	(1) Gr_emp	(2) Gr_ast	(3) Gr_liab	(4) Gr_int
Wtd_$\widehat{NPL}$ (α_1)	-0.113	0.107	-1.261**	-0.133**
	(0.088)	(0.173)	(0.516)	(0.054)
Wtd_$\widehat{NPL}$ * Highlev (α_2)	-0.150***	-0.261***	-1.070***	-0.146***
	(0.030)	(0.051)	(0.111)	(0.033)
Highlev	0.002	-0.156***	0.409***	-0.058***
	(0.008)	(0.010)	(0.037)	(0.010)
Constant	0.031**	0.350***	-0.023	0.163***
	(0.015)	(0.023)	(0.096)	(0.023)
Firm Controls	Y	Y	Y	Y
Wtd. Bank Controls	Y	Y	Y	Y
Sector FE	Y	Y	Y	Y
P($\alpha_1 + \alpha_2 < 0$)	0.99	0.99	1.00	0.99
Observations	53,780	53,528	52,936	54,444

Note: The firms included in this regression are the ones who did not have any loan overdue for 90 days or more in 2009:Q4 or 2010:Q4. The dependent variables are the growth rates of employment, fixed assets, bank liabilities and usage of intermediate commodities, respectively. The main independent variable is the weighted GIIPS sovereign bond holdings of firms in September 2009. The firm level controls used were firm age, firm size, value added, and fixed effects for the sector of operation. The weighted bank controls used were bank capital ratio, liquidity ratio and average loan interest rates charged by the respective banks. Clustered standard errors (bank level) are reported in the parentheses. We also report the p-values from a one sided t-test with H0: $\alpha_1 + \alpha_2 < 0$. *** p<0.01, ** p<0.05, * p<0.1

Table 11: Spillover effects (Interaction with ST debt)

VARIABLES	(1) Gr_emp	(2) Gr_ast	(3) Gr_liab	(4) Gr_int
Wtd_$\widehat{NPL}$ (α_1)	-0.076	0.203	-0.849	-0.067
	(0.089)	(0.180)	(0.512)	(0.053)
Wtd_$\widehat{NPL}$* High_stdebt (α_2)	-0.251***	-0.582***	-2.420***	-0.358***
	(0.031)	(0.087)	(0.334)	(0.040)
High_stdebt	-0.061	1.209*	-0.890	-0.063
	(0.287)	(0.615)	(0.809)	(0.366)
Constant	0.040**	0.344***	-0.049	0.158***
	(0.016)	(0.023)	(0.096)	(0.021)
Firm Controls	Y	Y	Y	Y
Wtd. Bank Controls	Y	Y	Y	Y
Sector FE	Y	Y	Y	Y
P($\alpha_1 + \alpha_2 < 0$)	1.00	0.99	1.00	1.00
Observations	53,780	53,528	52,936	54,444

Note: The firms included in this regression are the ones who did not have any loan overdue for 90 days or more in 2009: Q4 or 2010:Q4. The dependent variables are the growth rates of employment, fixed assets, bank liabilities and usage of intermediate commodities, respectively. The main independent variable is the weighted GIIPS sovereign bond holdings of firms in September 2009. The firm level controls used were firm age, firm size, value added, and fixed effects for the sector of operation. The weighted bank controls used were bank capital ratio, liquidity ratio and average loan interest rates charged by the respective banks. Clustered standard errors (bank level) are reported in the parentheses. We also report the p-values from a one sided t-test with H0: $\alpha_1 + \alpha_2 < 0$. *** p<0.01, ** p<0.05, * p<0.1

B Figures

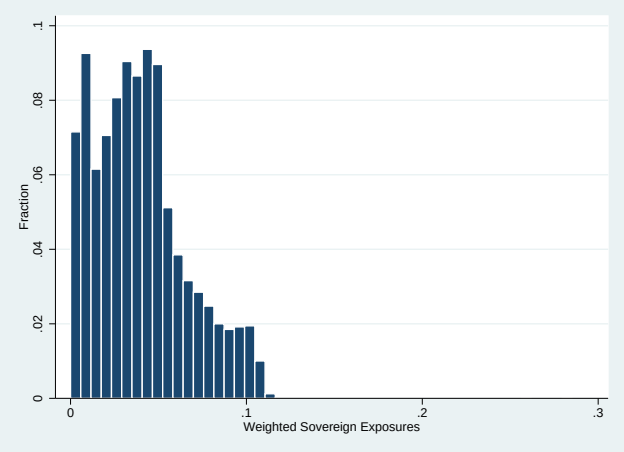


Figure 2: Firm weighted sovereign exposures

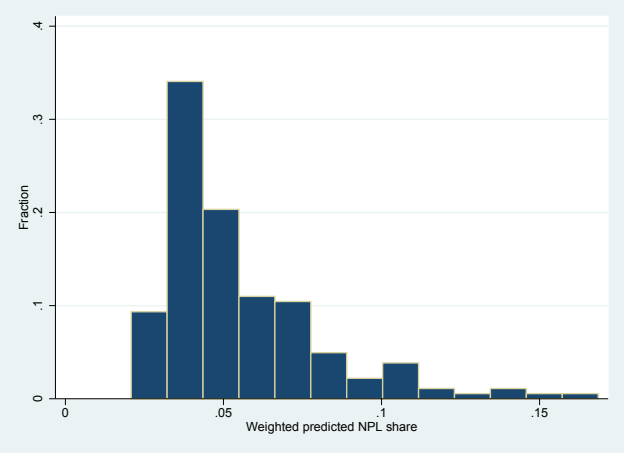


Figure 3: Firm weighted predicted NPL shares

Figure 4: Effects over time: Leverage

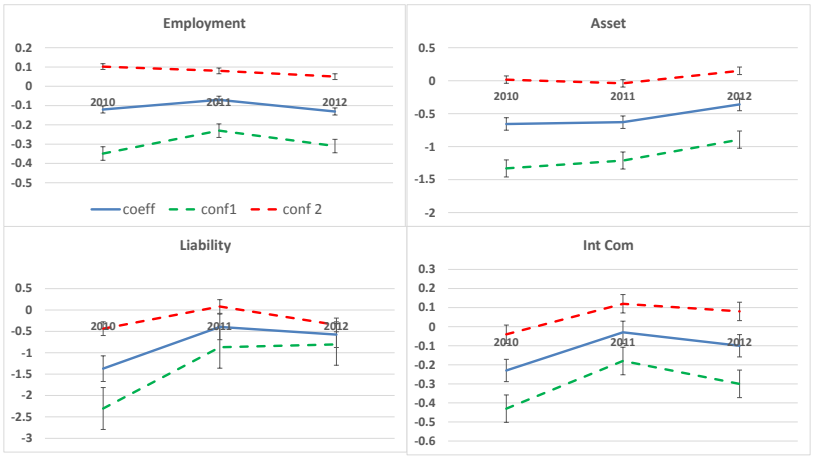
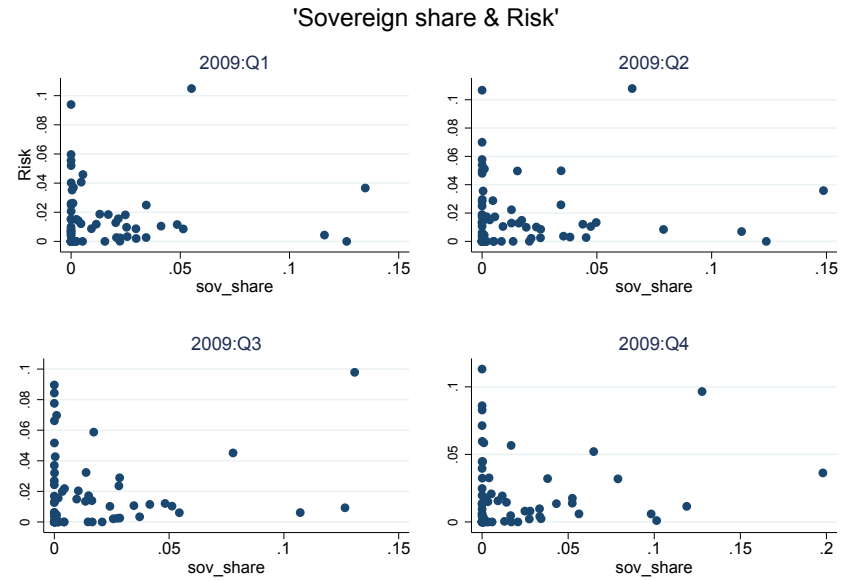


Figure 5: Effects over time: ST debt



Note: The respective correlations are -0.064, -0.067, -0.033 & -0.041 and none of them are statistically significant.

Figure 6: Bank sovereign shares vs. risk

C Additional Tables

Table 12: Relationship Regression

	$Y_t = lead_t$	$Y_t = lead_t$	$Y_t = any_t$	$Y_t = any_t$
$Y_{t-1} = lead_{t-1}$	0.802***			
	[0.000]			
$Y_{t-1} = any_{t-1}$			0.867***	
			[0.000]	
$Y_{t-1} * 2006.year$		0.827***		0.876***
		[0.000]		[0.000]
$Y_{t-1} * 2007.year$		0.810***		0.856***
		[0.000]		[0.000]
$Y_{t-1} * 2008.year$		0.818***		0.859***
		[0.000]		[0.000]
$Y_{t-1} * 2009.year$		0.760***		0.864***
		[0.000]		[0.000]
$Y_{t-1} * 2010.year$		0.795***		0.876***
		[0.000]		[0.000]
$Y_{t-1} * 2011.year$		0.792***		0.864***
		[0.000]		[0.000]
$Y_{t-1} * 2012.year$		0.810***		0.870***
		[0.000]		[0.000]
Const	-0.001***	-0.001***	-0.001***	-0.001***
	[0.000]	[0.000]	[0.000]	[0.000]
Time Effects	Y	Y	Y	Y
Number of obs.	84790059	84790059	84790059	84790059

Robust standard errors in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Table 13: NPL Predictor

VARIABLES	(1) basic
L.NPL	0.790***
	(0.002)
Tobacco	-0.027***
	(0.002)
Textiles	0.015***
	(0.004)
Leather	0.029***
	(0.003)
Printing	0.016***
	(0.004)
Metal Extraction	0.011***
	(0.003)
Transportation	0.054***
	(0.012)
Construction	0.038***
	(0.002)
Civil Engineering	0.026***
	(0.003)
Repair	0.015***
	(0.002)
Lodging and Restaurants	0.016***
	(0.003)
Editing	0.015***
	(0.006)
Telecommunications	0.034***
	(0.012)
Real Estate Activities	0.020***
	(0.003)
Management Consulting	0.012***
	(0.003)
Advertising	0.019***
	(0.004)
Rental Activities	0.019***
	(0.005)
Tourism Agencies	0.014***
	(0.005)
Constant	0.027***
	(0.002)
Observations	503,324
R-squared	0.535

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1