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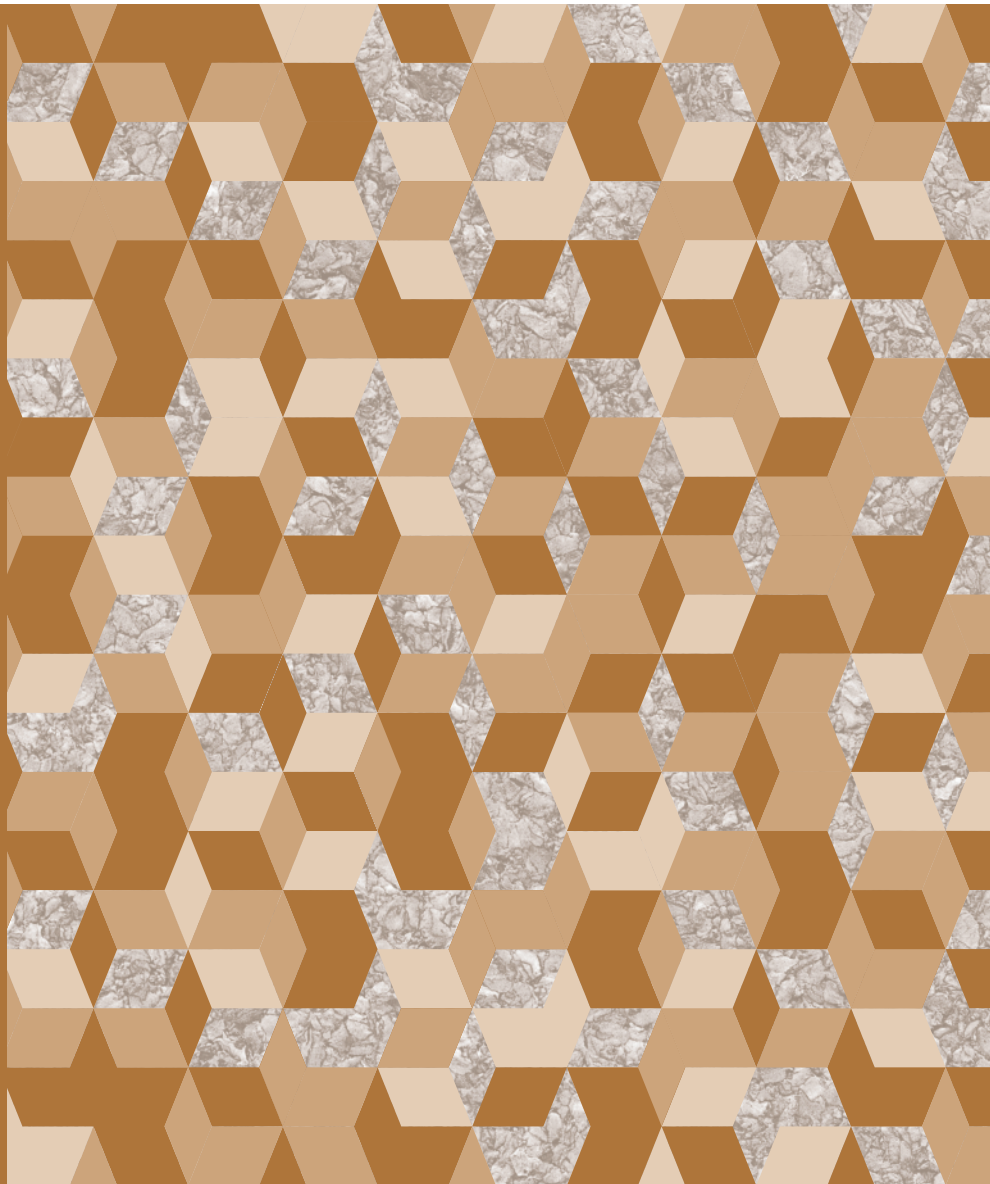

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Lending relationships and the real economy: evidence in the context of the euro area sovereign debt crisis

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Abstract
The recent euro area sovereign debt crisis put the financial sector under pressure and imposed several challenges, mainly in the countries most affected by the crisis. The sovereign-bank linkage can negatively affect the economic activity, especially by bank-dependent firms. This study explores the heterogeneity across banks in their funding structure, sovereign exposures, solvency, and availability of collateral, with the aim of investigating the effect of the crisis on firms' investment and employment decisions. Exploring a detailed database that covers virtually all bank loans granted to Portuguese firms, for the period 2007-2012, the results suggest an impact on investment and employment paths for firms whose lenders depend more heavily on interbank and market funding. Moreover, the results also stress the importance of assets eligible as collateral in monetary operations conducted by Central Bank. The findings suggest how a deterioration in sovereign creditworthiness can affect the real economy via the banking sector.

JEL: G21, G31, E22, E24, E44, E51

Keywords: Sovereign debt crisis, heterogeneity firm's lenders, firm's investment and employment.

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The analysis, opinions and findings of this paper represent the author' views, which are not necessarily those of the Banco de Portugal or the Eurosystem. All errors are author's responsibility.

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1. Introduction

Financial intermediation ensures the flow of capital from savers to firms (or other agents), which is crucial for economic activity and growth. The recent financial and sovereign debt crises implied severe dysfunction in the international financial markets, with repercussions on financial institutions. These events raise the discussion of how the crisis affects financial intermediaries' ability to grant credit, and emphasize the importance of understanding how shocks to credit suppliers affect the real economy.

The financial crisis in 2008 imposed huge losses for financial institutions worldwide, and led to a dry-up in the interbank markets. Later, the Greek bailout in mid-2010 marked the onset of the sovereign debt crisis in the euro area. The unprecedented and unexpected nature of this event changed the assessment and perception of sovereign credit risk by market participants. The sovereign bond yields of other euro area countries increased considerably, especially for Ireland, Portugal, and to a lesser extent, Spain and Italy, while other financial markets were also affected (*e.g.* Benzoni *et al.* (2015)).

The sovereign debt crisis and the tensions in financial markets in general were transmitted to credit institutions through several channels. A direct link was the negative impact on the net worth of sovereign debt securities held by institutions. These losses weakened the balance sheets position, which made those institutions appear to be riskier. Sovereign debt market developments also fueled the perception that Governments would have lower financial ability to support the national banking systems if needed. This too had severe implications for financial institutions. Indeed, the sovereign-bank linkage implied a marked increase in the funding cost for the institutions hosted or exposed to the stressed countries. Some institutions even lost access to the international financial markets in this period. This environment imposed several challenges to financial institutions and their activity.

This study investigates the effects of the sovereign debt crisis and financial market disruptions on corporate decisions in Portugal, namely firms' investment and employment, exploring the heterogeneity of firms' lenders. In particular, we compare investment and employment outcomes of firms that borrow from financial institutions with heterogeneous exposures to the sovereign and financial market developments.

Portugal figures as an interesting case study for several reasons. First, Portugal was at the core of the sovereign debt crisis in the euro area (Figure A.1, in the Appendix Section of this Chapter), which led to its rescue via International Financial Assistance in April 2011. Second, there were severe negative consequences on the Portuguese banking system, driven by the sovereign-bank linkage. Due to the increasing tensions and risk aversion in financial markets, Portuguese banks have faced daunting liquidity challenges since 2010 (Figure A.2, in the Appendix Section).

This fact is especially relevant as the banking system plays a critical role as a funding source to the Portuguese economy, notably to the corporate sector.[1] Portuguese firms, comprising mainly small and medium sized-firms (SMEs), present high leverage ratios, making them more vulnerable to changes in credit institutions' financial positions. Moreover, SMEs have less access to alternative financial instruments. Finally, it is worth mentioning that the initial shock was exogenous to the Portuguese banking system, and not driven by developments in the corporate sector.[2] Indeed, the increases in the Portuguese sovereign bond yields, in opposition to other countries, such as Ireland and Spain, were not driven by the Government support to the banking system or a price bubble in the real estate market. In fact, it was related essentially to the higher concerns, following the Greek bailout, related to the Portuguese macroeconomic imbalances, namely the weakness of Portuguese public finance (excessive debt levels and high deficits). These factors are important in the analysis, as banks did not anticipate the developments recorded from mid-2010 on, and the resulting loss of access to the international wholesale debt markets.

This study contributes to the literature that analyzes the impact of bank-sovereign linkage on a firm's decisions. To perform the analysis, we use detailed micro databases for Portuguese firms and financial institutions, which allows us to match firm-bank, to explore the intensity of these relationships, and to cover different segments of the corporate sector. We investigate if there are differences in firms' investment and employment decisions based on firm-lenders relationships and the characteristics of respective lenders. Namely, we characterize firms' lenders, based on several key indicators, and identify those relationships that could be more vulnerable to the negative shock recorded in international financial markets in 2010. To the best of our knowledge, the paper most similar to ours is the recent work of Bottero *et al.* (2015). However, in this study we explore alternative channels of transmission from banks to firms that may be helpful in identifying banks more vulnerable to adverse financial developments.

According to the results obtained, the key lenders' characteristics that affect firms' decisions are related to banks' market funding positions, with a negative effect on both investment and employment. As the dependence of banks on these funding sources increases, their borrowers tend to present lower investment and employment paths. In turn, assets eligible as collateral in monetary operations seem to have a favorable impact on both firms' decisions.

1. In Portugal, and broadly in Europe, banks play an important role in financial intermediation, in contrast with other economies, such as that of the USA, where wholesale markets are also important, as discussed in Langfield and Pagano (2015).

2. As mentioned in Banco de Portugal (2011b), "*Portuguese banks' liquidity difficulties resulted, to a large extent, from a contagion effect deriving from disturbances in sovereign debt markets and not directly from intrinsic problems of solvency or profitability*".

Looking at banks' sovereign debt exposures and regulatory capital ratios, the results are mixed.

This Chapter is structured as follows: Section 2 presents a brief review of related literature. Section 3 presents the main facts regarding the Portuguese banking system under the International Financial Assistance Programme to Portugal. Section 4 describes the data sources, and the data set used in the analysis. Section 5 shows the empirical strategy adopted and presents some summary statistics for the variables under analysis. Section 6 presents the empirical specification and the econometric results. Section 7 explores an alternative empirical approach. Section 8 shows some robustness tests. Finally, Section 9 presents the main conclusions.

2. Related Literature

The value of the banking system and its impact on the real economy is not a new topic in economic and financial literature. For instance, Bernanke (1983) discussed the relevance of banks' balance sheet channel. He showed that shocks to banks' financial positions affect lending and consequently borrowers' decisions and real activity. Holmstrom and Tirole (1997) presented a model of financial intermediation in which firms and intermediaries could be capital constrained. They emphasized the role of the financial intermediaries, in addition to the wholesale market, showing that some firms have access only to external funds through those institutions or given their monitoring function. Moreover, the authors show how changes in banks' capital positions affect their credit supply, which is particularly important to less capitalized firms.

The link between the real economy and the financial sector was also emphasized in papers related to the so-called "*financial accelerator*". This literature argues that due to the existence of imperfections in the credit markets the general financial conditions account for the intensity and persistence of the economic business cycles (*e.g.* Bernanke and Gertler (1989) and Bernanke *et al.* (1999)). The asymmetric information on credit markets is especially important to smaller, younger, or less transparent borrowers, contributing to a greater sensitivity of this segment of firms to changes in the credit supply (*e.g.* Mark Gertler (1994)). King and Levine (1993), for instance, found evidence that the financial system can promote economic growth. Namely, financial developments are related to GDP growth, physical capital accumulation, and efficiency, as well as to the future evolution of these variables. The credit market imperfections and the impact of financial frictions/conditions on firms' decisions have also been a central topic in corporate finance research, both in theoretical and empirical perspectives (*e.g.* the seminal paper Fazzari *et al.* (1987), or Love (2003)).

Given its place in the financial system, bank credit has attracted intense interest in the financial literature, notably the firm-bank relationships.

According to this literature, in the borrowers' perspective, there is evidence that the number of lending relationships and the length of these relationships may affect the availability of credit and contracts conditions, *e.g.* Petersen and Rajan (1994), Ongena and Smith (1998), Boot (2000), and Berger and Udell (2006). An important point in this literature is the acquisition of soft information through repeated interactions between borrowers and lenders (*e.g.* Diamond (1984)), which helps to minimize asymmetric information issues. Nevertheless, this information acquisition, and the reliance on only a few lenders, may also contribute to hold-up problems for firms (for instance, information rents, as explored by Rajan (1992)), or switching costs (as discussed in Kim *et al.* (2003), and recently in Chodorow-Reich (2014)). Under financial distress episodes, Hoshi *et al.* (1990) showed that Japanese firms with a main bank-lending relationship have been found to obtain lower costs of overcoming those events. Bae *et al.* (2002) explored adverse events that affected the Korean banking system during the Asian crisis in the late 1990s, and showed that adverse shocks to a firm's main lender have a negative knock-on effect not only on the value of the bank but also on the value of the firm itself.

More recently, the literature on financial-real economy linkage recorded a new wave, exploring the impact of the financial and the euro area sovereign debt crises on credit institutions and firms' decisions. While the financial crisis directly affected banks' financial health and the functioning of the interbank markets, the sovereign debt crisis may have affected financial markets and the financial institutions through several channels. Sovereign debt tensions had a direct negative impact on the market value of sovereign debt securities. Moreover, financial systems were also perceived as more vulnerable as the sovereign capacity to provide financial assistance decreased. In this context, banks' funding costs also increased. In a second round, the increases in sovereign yields may have induced changes in banks' decisions, contributing to portfolio adjustments, such as an increase in sovereign holdings for less risk averse institutions. These securities presented higher returns (which improve profitability), while they did not imply additional capital needs (zero risk weights in terms of capital requirements). This strategy may reinforce the bank-sovereign linkage. It may also imply a decrease in credit supply to other economic segments (*i.e.* a crowding out effect).

Some of the most recent research has assessed the impact of the crisis on banks' credit supply. Empirical evidence suggests a decrease in credit to firms, due to negative shocks in financial markets. Iyer *et al.* (2014) analyzed the impact of the financial crisis in 2008 on the credit supply in Portugal, exploring data from the Central Credit Register. They found that banks more dependent on the interbank market restricted credit to firms to a greater extent than did banks less exposed to that market. Bofondi *et al.* (2013) investigated a similar research question for Italy during the sovereign debt crisis. Based on the distinction between foreign and domestic banks, as the latter were affected by Italian sovereign yield increases, they found that domestic banks decreased

credit supply more than did the foreign ones. In turn, Popov and Horen (2015), and Adelino and Ferreira (2016) centered their analyses on the impact of the sovereign debt crisis on credit, evaluated through syndicated loans. Popov and Horen (2015) showed that banks with greater exposures to stressed countries recorded greater credit cuts. Exploring banks' rating downgrades as a consequence of respective sovereign ratings revisions, Adelino and Ferreira (2016) found that those banks revealed a greater impact on credit supply than did institutions that were not subject to this effect.

Another strand of the recent literature explores the potential impact of recent crises on firms' decisions, given the impact on the financial system and the relevance of bank credit as an external funding source to the corporate sector, in particular in Europe. The variables of interest are related to real decisions, such as employment and investment, as well as financial indicators, as leverage and sales growth. In general, the results suggest that there are differences in the path of firms' outcomes between firms less and more exposed to the financial and sovereign debt crises through their lenders. Based on syndicated loans, Chodorow-Reich (2014) first found that less healthy banks (exploring several metrics) reduced more credit than other banks during the financial crisis in the US.[3] He also found that firms that had pre-crisis relationships with weaker banks reduced more employment than did firms whose lenders were healthier. Similarly, Bentolila *et al.* (2015) found an impact on Spanish firms' employment policies. Firms that relied on weaker banks (in this setup, bailout banks) showed greater employment drops than firms with relationships with healthier banks. Also in the context of the financial crisis, Cingano *et al.* (2013) found that Italian firms whose lenders were more dependent on interbank funding reduced their investment more than firms less dependent on such banks. In the context of the European sovereign debt crisis, Bottero *et al.* (2015), also based on Italian data, found that banks with higher exposures to Italian sovereign debt tightened more credit supply to firms. Moreover, they found that smaller and riskier firms were not able to overcome this fact, recording a reduction in investment and employment. De Marco (2016) and Acharya *et al.* (2016) analyzed the impact of sovereign debt crisis on firms' decisions, exploring syndicated loans data. On average, firms whose lenders were more exposed to sovereign debt of stressed countries (in De Marco (2016)) or firms whose lead lender was from those countries (in Acharya *et al.* (2016)) presented a more adverse path for some firms' outputs than firms with other lending relationships.

The impact of bank credit on firms' decisions may also depend on firms' ability to substitute bank relationships or/and bank credit with other funding sources. Adjustments in firms' debt components may minimize the effects of

3. Banks' position were assessed by alternative measures related to exposures to Lehman Brothers, exposures to toxic mortgage back securities, and some balance sheet indicators.

bank credit shocks. Some papers have explored this dynamic, but the empirical results are mixed. Becker and Ivashina (2014) and Adrian *et al.* (2012), exploring debt market as alternative funding sources, argued that there were no real effects that could be related to banks' lending paths. In turn, Carvalho *et al.* (2015) found that the access to public debt markets did not offset the impact of bank distress on firms' decisions. In turn, Almeida *et al.* (2017) explored the direct negative spillovers of sovereign rating downgrades on firms' ratings, which has a negative effect on firms' funding costs. Their results suggest that firms that recorded a rating downgrade due to the sovereign ceiling policy, *i.e.* firms should not present higher ratings than the respective sovereign (firms' downgrade were not directly related to firms' fundamentals), showed greater impact on their decisions than did the other firms.[4] However, as mentioned, public debt markets are not available for all firms. Even firms that try to adjust funding within the banking system may face some important constraints. For instance, Ivashina and Scharfstein (2010) found evidence that borrowers of weaker banks could not switch to healthier banks during the financial crisis.

The present study contributes to the empirical literature that explores how the sovereign debt crisis affected financial intermediaries and corporate decisions. Looking at empirical literature, there are some papers with similarities to this analysis. Some of them analyze a similar time window, namely the euro area sovereign debt crisis, while others explore analogous databases, with special emphasis on the Central Credit Register. This database avoids the bias to larger firms that characterize some studies, such as those based on syndicated loans. Indeed, small and medium firms (SMEs) are a significant fraction of the corporate sector, and account for much of the economic activity and employment in several countries, such as Portugal. SMEs usually do not have access to the syndicated loan markets. They are typically more dependent on bank credit, and consequently more vulnerable to changes in bank credit supply. This study is also in line with papers that explore corporate decisions.

Combining all these features, to the best of our knowledge, the paper most similar to this one is the recent work of Bottero *et al.* (2015). The two papers investigate the impact of the sovereign debt crisis, exploring the Central Credit Register. This database allows a direct firm-lender match, and simultaneously an exploration of corporate heterogeneity. However, in this paper we directly explore several dimensions of a firm's lenders that may be relevant in the environment under analysis. Accordingly, in this study possible channels other than the direct exposure to sovereign debt securities are explored in more detail. For instance, we examine the structure of banks' liabilities, and especially the availability of collateral to gain access to the monetary operations conducted

4. In the Portuguese case there are few firms with rating notes and access to the wholesale funding. As a result, this direct impact is not sizeable.

by the ECB, which has not deserved much attention in the literature in this context.

3. The Portuguese International Economic and Financial Assistance Programme: Main facts on the banking system

The international financial crisis following the US sub-prime mortgage crisis and the collapse of Lehman Brothers had little direct impact on the Portuguese banking system as a whole. In general, banks were not exposed to the sub-prime market and their exposures to *"toxic assets"* were contained. Moreover, unlike other economies, Portugal did not record a bubble in the real estate market. Nevertheless, Portuguese institutions were affected by changes in financial market conditions, in particular by the dry-up in the interbank market during this period. Those constraints were minimized by monetary operations conducted by Central Banks and by issuing bonds with government guarantees (Figure A.3, in the Appendix Section). As a result, lending to non-financial corporations continued to grow at high rates in Portugal during this period (Figure A.4, in the Appendix Section).

However, the sovereign debt crisis marked the onset of a new period that saw several deleterious effects on the Portuguese economy and the banking system. With the Greek bailout and the increasing tension in sovereign debt markets in the euro area, there was a reassessment of sovereign credit risk by market participants. The yields of Portuguese government bonds rose dramatically. The sovereign-banking system link and the risk aversion in financial markets posed several challenges to Portuguese financial institutions. Given the increased weight of the international financial markets in the funding structure of Portuguese banks since the early 2000s (as a consequence of the financial integration in the context of the monetary union), and the exposure of Portuguese banks to sovereign debt securities, these developments required sizable adjustments in banks' funding and business strategies.

Due to the renewal of tensions in the European sovereign debt markets, which led to an escalation of the Portuguese bond yields, since end-2010, the Portuguese Government requested international assistance in April 2011. This led to the International Economic and Financial Assistance Programme (hereinafter Programme), defined for a horizon period of three years, and provided by the International Monetary Fund, the European Union, and the European Central Bank. The Programme focused on three main pillars: structural reforms and competitiveness of the Portuguese economy; fiscal consolidation; and deleverage of the financial and private sectors.

Looking at the banking system, the Programme sought to ensure an orderly and gradual deleveraging process and the reinforcement of regulatory capital positions. Simultaneously, a close assessment of the financial conditions in the economy was to be conducted, in order to ensure an equilibrium

between the necessary deleveraging adjustment and the financial support to the economic activity. Three fundamental dimensions should be highlighted: *i)* the implementation of measures to ensure sufficient liquidity in the banking system; *ii)* the design of funding and capital plans for short and medium terms, to monitor the gradual deleveraging, the reduction of funding from the Eurosystem, and the path of capital needs; *iii)* the reinforcement of capital positions.

In order to achieve a stable funding structure, the Programme set specific targets for some key indicators. For instance, the Programme established a gradual convergence to 120 per cent of the loan-to-deposit ratio.[5] As far as regulatory capital was concerned, the Programme imposed higher minimum levels to the Core Tier 1 ratio, namely 9 per cent by the end 2011 and 10 per cent by the end of 2012.

The Programme included a backstop facility of 12 billion euros to the financial system (out of the 78 billion euros included in the Programme), in order to face potential capital needs, due to the new capital requirements and the adverse economic and financial environment that was foreseen during the horizon period of the Programme. Note that low capital ratios, *i.e.* close to the minimum regulatory threshold, may have a direct impact on a bank's activity.

In parallel, due to the general tensions in the sovereign debt markets in the euro area and the exposure of the European banks to sovereign assets, in 2011 the European Banking Authority (EBA) imposed the so-called "*sovereign capital buffer*" on the major banks in the European Union.[6] The "*sovereign capital buffer*" was computed taking into account banks' sovereign debt portfolios and the respective market value assessed in September 2011. This buffer was to be in place by the end of June 2012. These new rules imposed additional capital needs on some Portuguese banks.[7]

Therefore, banks had to manage their capital positions in order to meet all the new capital requirements. Against this background some banks realized significant capital increases over these years. Some of them applied to the financial system facility included in the Programme, namely BCP, Banco BPI (mostly due to the "*sovereign capital buffer*"), and Banif. CGD also increased its capital significantly, but in a different set up, given that CGD is a state-owned bank. Additionally, in this demanding environment banks were forced to adjust their activity strategies.

5. However, these targets were revised during the Programme, and they were replaced by guidelines aiming at a stable funding structure.

6. European banks included in the stress tests exercise conducted by the EBA.

7. In Portugal four banks were subjected to EBA's rules, namely CGD, Banco BPI, BCP, and ESFG.

4. Data and descriptive statistics

4.1. Data sources

The data set used in this study combines three different micro databases, available at Banco de Portugal, namely Central Credit Register (CRC), Bank Supervisory Data, and the Central Balance Sheet Database.

The CRC contains information on all credit granted by financial intermediaries operating in Portugal. CRC includes information on the outstanding amounts, as well as information regarding credit overdue events for each borrower, among other loan characteristics.[8] Institutions are required to report this information on a monthly basis to Banco de Portugal. Given the low lending threshold required for this report (50 euros), this database affords high coverage of the credit granted by the banking system to the corporate sector. It also allows identifying firm-bank lending relationships at each moment and the exposure of each institution to each firm.

The second database is the Bank Supervisory Data submitted by financial institutions to Banco de Portugal for different reference periods. This database contains financial statements for institutions operating in Portugal and prudential reports for those institutions under supervision of the Portuguese authorities. Note that some institutions, due to their typology, do not report all items.[9] This database allows us to obtain several financial and prudential indicators of institutions, which will be important to assess their vulnerability to financial market developments.[10]

For the corporate sector, we use the Simplified Corporate Information (*Informação Empresarial Simplificada* - IES), which was introduced in 2006. IES contains detailed financial data based on accounting reports, as well as other firm characteristics, such as the industry sector, age, and the average number of employees. This information allows us to characterize firms over time. It is noteworthy that IES covers virtually the entire Portuguese corporate sector. This avoids the potential sample bias that voluntary survey may introduce (the approach in place before 2006), and allows us to explore different firm segments.[11]

8. For further details on the CRC, see Booklet Nr.5 of Banco de Portugal (Banco de Portugal (2011a)).

9. For instance, subsidiaries of European Union institutions are not required to provide information on capital adequacy ratios to the Portuguese Bank Supervision Authority.

10. In this analysis we use data at consolidated level, taking into account that some bank decisions may be defined at the group level (such as specific portfolios).

11. Before 2006 the Central Balance Sheet Database followed a survey approach, based on economic activity criteria. After 2005, with IES, it covers virtually the entire corporate sector. For further details on the IES databases, see Supplement of Statistical Bulletin (Banco de Portugal (2008)).

4.2. Data set

For credit institutions we restrict the database to those classified as "Monetary Financial Institutions". Then, we collected balance sheet and profit and loss account data, allowing us to analyze the structure of assets and liabilities of institutions and their respective performance. The detailed data also allow us to determine the weight of sovereign debt securities portfolios. Based on prudential reports, we obtain the capital adequacy ratios.

In CRC, we match borrowers and all respective lenders. We define lending relationships at the banking group level, *i.e.* if a firm borrows from two institutions that belong to the same group, we define it as a single lending relationship. Then, we compute the relevance of each group to each firm, taking into account the share of credit provided by each banking group in the firm's total bank debt.

As far as IES data are concerned, we impose some criteria. First, the financial and public administration sectors were excluded. We also excluded observations with missing data for total assets, business volume, number of employees, and age. Furthermore, firms with fewer than five employees were dropped. Moreover, in order to remove outliers, we winsorize the top and bottom two per cent of the distributions of the variables under analysis. Additionally, given the purpose of this study, we collapse the corporate sample to firms that have records on the CRC.[12]

After the merger of the three databases and the application of the criteria, we shrunk the data set to a balanced panel data. We adopted this condition in order to analyze firms that performed their activity over the crisis period. We obtain a data set with around 219,000 firm-year observation for the period 2007-2012.

The balanced panel data implies that all firms grow more mature over the horizon period, which may have some impact on firms' outcomes. For instance, it is not expected that firms continue to present high levels of investment or employment growth over the life cycle. Other assumptions in the definition of the data set could be adopted, leading to an unbalanced panel data. However, that procedure may include other effects and events related to the financial and sovereign debt crises, for instance, the possible relationship between the financial and sovereign debt crises and firms' survival or bankruptcy episodes.

12. At this stage this criterion imposed a reduction of around 85,000 observations in the IES data set.

5. Empirical strategy

The empirical strategy adopted in this study proceeds as follows: we characterize credit institutions based on their financial and prudential reports. Then, we match firm-banks and compute a weighted indicator for each firm, based on the financial and prudential position of all firm's lenders. The weights applied correspond to the share of the credit granted by each lender in the firm's total bank debt. In other words, for each firm-year observation we obtain a weighted indicator based on the firm's lending relationships. The weighted scheme intends to control for the dependence of firms on each lender, *i.e.* control for the intensity of each lending relationship. Hereinafter, the weighted indicator is termed *Lenders' Indicator*. Finally, we analyze if there are significant differences in firms' outcomes, exploring firms' lenders' characteristics and the respective heterogeneity, controlling for other firms' characteristics (that may affect the outcomes).

There is no single criterion by which to classify credit institutions' vulnerability to the adverse financial market developments seen during the sovereign debt crisis. Given the nature of the negative shocks, several banks' dimensions are addressed. Due to the tensions in the international financial markets and the value of these funding sources to Portuguese institutions since the establishment of the euro area, we explore variables related to banks' liabilities structure. Therefore, looking at the funding structure, the indicators are related to banks' dependence on financial markets, customers' resources, and money market (variables computed with balance sheet data). We also assess the exposure of each institution to sovereigns by the sovereign debt securities portfolios, given the concerns related to the losses that institutions may incur due to sovereign yields increases. Moreover, we also explore the solvency position, since capital ratios are critical indicators for banks, and they may effectively constrain banks' activity. It is expected that institutions with greater capital buffers should present a greater ability to absorb unanticipated negative shocks without sizeable constraints on their activity, especially lending.

5.1. Variables and summary statistics

This sub-section provides descriptive statistics of variables related to firms and credit institutions included in the analysis.[13]

13. Note that due to missing data regarding some components, the number of observations included in the econometric analysis (presented in the next sections) may be slightly different from the figures presented below. However, this fact has not sizeable impact on major descriptive statistics.

Table 1 displays the composition of firms included in the data set. A significant fraction of the sample corresponds to micro and small firms.[14,15] Firm size can be a relevant indicator in the analysis, as empirical evidence suggests there are differences in the access to external funding by firms' size, usually a proxy for asymmetric information and firms' credit quality. Namely, the empirical literature suggests that smaller firms face greater constraints in obtaining external financing, which may be related to the lack of information available to external agents (less transparent firms), lower diversified activity (so, lower ability to react to unexpected negative shocks), or even lower pledgable assets. These firms are therefore the ones that are potentially more vulnerable to changes in credit supply.

	Total	**By firm's size:** Micro	Small	Medium	Large
2007	36,457	11,829	20,276	3,684	668
2008	36,457	11,306	20,638	3,825	688
2009	36,457	11,546	20,470	3,782	659
2010	36,457	11,412	20,531	3,832	682
2011	36,457	11,938	20,057	3,772	690
2012	36,457	13,394	18,829	3,582	652
Total	218,742	71,425	120,801	22,477	4,039

TABLE 1. Sample summary statistics

As mentioned, one of the variables of interest in this study is firm's investment. For this, we focus on yearly investment flows. Investment (INVESTMENT) is defined as the flow of investment in tangible and intangible assets of firm i in year t over the total of those assets at the end of the previous year $(t-1)$.[16] The first columns of Table 2 present the path of this variable over the sample period. On average, investment presents a notable decrease in 2009, a year of economic recession in several economies, the Great Depression,

14. Firm size defined in line with the European Commission Recommendation of 6 May 2003 (2003/361/EC), Micro firms are defined as those with fewer than 10 employees and less than 2 million euro of business volume or total assets; Small firms are those with fewer than 50 employees and less than 10 million euro of business volume or total assets; Medium firms are those with fewer than 250 employees and a business volume below 50 million euros or whose total assets is lower than 43 million euros. The remaining firms are considered Large firms.

15. Recall that in the definition of the data set, we imposed some criteria. We excluded firms with fewer than five employees, which affects the micro segment.

16. The results were very similar when investment was defined based only on tangible assets.

after the collapse of Lehman Brothers at the end of 2008. From 2010 on, it continuous a downward trend.[17]

Table 2 also presents similar statistics for employment. IES database includes some firm characteristics in addition to financial statements, including the average number of employees. Based on this information we obtain the yearly employment change, which can be interpreted as a proxy for firm's employment decisions. Thus, the employment variable (EMPLOYMENT) corresponds to the change in the average number of employees of firm i in period t over the average number of employees at the end of the previous year $(t-1)$. Broadly, based on mean figures, we observe a downward trend during the period under analysis.

	INVESTMENT			**EMPLOYMENT**		
	Mean	Median	Sd	Mean	Median	Sd
2007	0.365	0.090	0.753	0.090	0.000	0.277
2008	0.314	0.103	0.812	0.060	0.000	0.207
2009	0.196	0.086	0.750	0.039	0.000	0.190
2010	0.342	0.041	0.682	0.006	0.000	0.176
2011	0.244	0.085	0.745	0.022	0.000	0.180
2012	0.174	0.044	0.629	-0.002	0.000	0.164

Note: INVESTMENT is defined as the flow of investment in tangible and intangible assets for each in a year over the total of those assets at the end of the previous year. EMPLOYMENT is defined as the change in the average number of employees of each firm in a year over the average number in the previous year. sd stands for standard deviation. The Mean and Median figures are based on the distribution of each variable. Note that there were some changes in the IES report in 2010, which may be underlying the evolution of investment rate between 2009 and 2010.

TABLE 2. Firm's decisions: investment and employment

Table 3 presents the summary statistics of firm-level variables that may affect firms' decisions. Those variables include profitability, sales growth, size, and the leverage of firms.

Profitability (PROFITABILITY) is defined as net earnings before provisions and depreciations over total assets. This variable captures the ability of each firm to generate funds internally, so it may be less dependent on external funding. Sales growth (SALES GROWTH) is the year-on-year change of real sales, and it is meant to control for the firm's growth opportunities.[18] Firm's size (SIZE) is included as the logarithm of total real assets. Size is usually related

17. From 2009 to 2010, the significant difference in the average rates should be related to a series break due to changes in IES's reports and accounting rules. Nevertheless, this was a transversal event to all firms included in the sample, so its impact should be captured by time dummies.

18. In empirical research, firm's growth opportunities are usually controlled through measures related to firm's market value. However, this approach is not possible to implement in the Portuguese case, as the share of quoted firms is very small.

to asymmetric information and credit quality. The leverage of firms is also an important dimension to control for. We therefore include the bank debt ratio (BANK DEBT), defined as bank debt over total assets.[19]

	Nr.	Mean	Sd	p10	p25	p50	p75	p90
SIZE	211,741	13.78	1.45	12.11	12.82	13.63	14.58	15.63
PROFITABILITY	211,752	0.09	0.12	-0.01	0.04	0.09	0.14	0.22
SALES GROWTH	211,747	-0.03	0.26	-0.32	-0.14	-0.02	0.09	0.24
BANK CREDIT	211,752	0.66	0.31	0.30	0.47	0.66	0.81	0.93

Note: sd stands for standard deviation, while p10, p25, p50, p75, and p90 stand for the percentiles 10, 25, 50, 75, and 90, respectively, of the distribution of each variable, for observations included in the econometric analysis.

TABLE 3. Sample summary statistics - Firm characteristics

Looking at financial institutions, Table 4 shows some descriptive statistics for different indicators that may identify institutions that are more vulnerable to the adverse financial market conditions, in the context of the sovereign debt crisis. Therefore, the figures correspond to the distribution of the *Lenders' Indicator*, *i.e.* firm's lenders' positions, weighted by the share of each lender in the firm's total bank debt, in the sample period.[20]

Concerning lenders' funding structure, the set of indicators includes the central bank funding (CENTRAL BANK), defined as central bank liabilities over total assets, interbank funding (INTERBANK), which corresponds to interbank market liabilities over total assets, and the funding in financial markets (MARKET FUNDING), defined as the wholesale debt and interbank funding over total assets. It also comprises the relevance of customers' resources, through the ratio of customers' deposits over total assets (DEPOSITS_A), and loans over customers' deposits (LOAN-TO-DEPOSIT).

We expect to see a positive relationship between the levels of interbank and financial markets indicators and the lenders' vulnerability to market developments. Higher shares of these funding sources correspond to greater dependence on financial markets, and consequently institutions may be more exposed to the adverse developments and conditions recorded in those markets during the horizon period. For the loans-to-deposits ratio a similar rationale applies: a higher ratio means that the bank uses funding resources rather than customers' deposits (perceived as more stable funding source) to finance their

19. The definition of each variable for firms is presented in Table A.1 in the Appendix Section of this Chapter. Table A.2 presents summary statistics for some other firm characteristics included in the data set.

20. The definitions underlying each variable are presented in Table A.3 in the Appendix Section. Table A.4 presents the correlation matrix between firms' decisions and lenders' indicators.

lending activity.[21] In line with this perception, a negative relationship is also expected between deposit-to-assets and bank's vulnerability to financial market events. For the central bank indicator, during the sample period there is no clear "*a priori*" expectation. On one hand, the relationship may be positive, given that the ECB was crucial as a lender of last resort. On the other, since it may also identify banks' liquidity needs, the relationship may have the opposite sign. The central bank was an important funding source in the period, due to the constraints in access to alternative finance sources faced by institutions.

Concerning the sovereign exposures (the indicator most used in the recent empirical literature), we assess the total sovereign debt securities (SOVEREIGN), as the ratio of sovereign debt securities portfolio over total assets, and the Portuguese sovereign debt securities (PT SOVEREIGN), which corresponds to the Portuguese sovereign debt securities over total assets. Given the tensions in the euro area sovereign debt markets and the extreme increases in sovereign bond yields, institutions with greater sovereign exposures may be assessed as more vulnerable (which is in line with the EBA's decision about the "*Sovereign capital buffer*" in 2011). For these institutions, the bank-sovereign linkage is expected to be more important.

Finally, for the solvency position, the analysis takes into account the Total capital ratio (CAPITAL RATIO), *i.e.* the total regulatory capital over risk weighted assets. It also includes the Tier 1 capital ratio (TIER 1 RATIO), defined as the Tier 1 capital over risk-weighted assets, which became more relevant after the onset of the crisis. Based on capital ratios, institutions can be seen as weaker, *i.e.* more vulnerable, if they present ratios close to the legal threshold. This means that those institutions have lower capital to absorb unexpected negative shocks. Therefore, they have lower ability to react to those shocks without restrictions on their activity (and) or increases in their regulatory capital levels.

6. Empirical results

6.1. Empirical specification

The empirical strategy explores firms' decisions conditioned on their lenders' vulnerability to the adverse developments recorded in the financial markets. Therefore, in this Section, we run the following reduced-form specification:

$$y_{i,t} = c + \alpha X_{i,t-1} + \delta z_i + \varphi w_t + \beta_1 LI_{i,t-1} + \beta_2 LI_{i,t-1} \times Crisis + \mu_{i,t} \quad (1)$$

21. Indeed, in Portugal even during the crisis, customers' deposits presented a positive path, which reflected customers' confidence in the Portuguese financial system. At aggregate level customers' deposits in the Portuguese banking system increased by around 15 per cent from 2008 to 2012, mainly since 2010.

	Nr.	Mean	Sd	p10	p25	p50	p75	p90
Funding structure:								
CENTRAL BANK	211,752	0.05	0.04	0.00	0.02	0.04	0.08	0.12
INTERBANK MARKET	211,752	0.11	0.12	0.03	0.05	0.08	0.12	0.24
MARKET FUNDING	211,752	0.27	0.13	0.13	0.20	0.27	0.35	0.44
DEPOSITS_A	211,752	0.45	0.13	0.30	0.38	0.45	0.51	0.60
LOAN-TO-DEPOSIT	211,752	2.31	11.20	0.86	1.05	1.29	1.56	1.85
Debt securities portfolio:								
PT SOVEREIGN	211,752	0.03	0.03	0.00	0.01	0.03	0.05	0.06
SOVEREIGN	211,752	0.04	0.03	0.01	0.02	0.04	0.05	0.07
Solvency:								
TIER 1 CAPITAL	211,752	0.07	0.05	0.05	0.06	0.08	0.09	0.11
TOTAL CAPITAL	211,752	0.09	0.05	0.06	0.09	0.10	0.11	0.12

Note: sd stands for standard deviation, while p10, p25, p50, p75, and p90 stand for the percentiles 10, 25, 50, 75, and 90, respectively, of the distribution of each indicator. The *Lenders' Indicator* corresponds to a weighted indicator at firm level, based on share of each lender on firm's total bank debt.

TABLE 4. Descriptive statistics - Lenders' Indicators

where the left-hand-variable, $y_{i,t}$, corresponds to the decision of firm i in period t, namely investment or employment decisions. $X_{i,t-1}$ is a vector of firm-specific variables that may affect a firm's decisions, measured at $t-1$.[22] z_i corresponds to the firm's time-invariant components. The firm fixed-effects control for unobserved firm characteristics that are unchanged over time. w_t represents year dummies, which control for changes in the general macroeconomic and financial environment that affect all firms simultaneously. LI is the *Lenders' Indicator*, the variable that characterizes the position of all firms' lenders. $LI_{i,t-1}$ reflects firm i's lenders' position, based on the criterion under analysis, at $t-1$. The specification also includes an interaction term between this variable and the time dummy variable $Crisis$, that takes the value one for the period after the onset of the euro area sovereign debt crisis, *i.e.* after 2009 ($LI_{i,t-1} \times Crisis$). Finally, $\mu_{i,t}$ corresponds to the error term.

Based on equation 1, we are interested in the sign of the β_2 coefficient, as it allows us to know if the sensitivity of firms' decisions to lenders' characteristics changed after 2009, when banks suffered the negative shock related to the outbreak of the euro area sovereign debt crisis, and the spillovers to Portuguese agents and economy.

As the specification includes fixed-effects at firm level, the identification comes from the comparison within firms' changes in employment and investment, for firms that borrow from lenders with different exposures to

22. The inclusion of control variables with a lag period avoids the contemporaneous effect between firm's characteristics and its decisions.

the crisis. Moreover, due to the specificities of the data set, the econometric procedure includes robust standard errors.

6.2. Econometric results

i) Investment decisions

As mentioned, the purpose of this study is to explore if firms that have relationships with lenders more vulnerable to the adverse environment, *i.e.* subject to higher challenges during the sovereign debt crisis and the adverse financial market developments, present significant differences in their decisions. In this section, we focus on investment outcomes.

Investment is an important component for firm's prospects, and, at the aggregate level, it is closely related to economic growth. In fact, as shown in Amador and Coimbra (2007) and Almeida and Félix (2006), capital stock developments have made an important contribution to Portuguese economic growth in the past few decades. More recently, the low performance of the Portuguese economy has been linked to a strong fall in investment.[23] In general, investment is fundamental in determining the future productive capacity and economic growth in the long-run (*e.g.* King and Levine (1993)).

As mentioned above, we explore alternative indicators to characterize firm's lenders' position regarding funding structure, sovereign credit risk exposure, and solvency. We also control for the importance of each lender in the firm's total bank debt, which allows us to control for the dependence of the firm on each lender. The higher is the dependence of firms on lenders identified as potentially more vulnerable to the adverse market conditions, we expect that those firms face higher constraints, *ceteris paribus*. This is in line with hold-up issues and switching costs related to bank lending relationships, *i.e.* it may not be easy for firms to change lenders. Indeed, in the context of the financial crisis, Ivashina and Scharfstein (2010) found evidence that borrowers from weaker banks could not switch to healthier banks. It is also linked to the empirical evidence toward adjustments in credit supply during crisis periods, as shown by Chodorow-Reich (2014), Iyer *et al.* (2014), and Bofondi *et al.* (2013).

Table 5 presents the results of equation 1 for investment. Each column of the table corresponds to one of the alternative indicators that underlies the characterization of firm's lenders' vulnerability. For instance, the first five columns of the table present the results exploring the five funding structure criteria.

According to the results obtained, the coefficient of interbank funding is negative and statistically significant. The interaction term with the crisis dummy also has a negative and statistically significant coefficient. These results

23. Note that the concept of investment at aggregate level may not match with the investment measures computed at the micro level.

suggest that the firms whose lenders had a higher dependence of this funding source presented a poorer path for investment, and this effect was intensified after 2009. Looking at market funding, the interaction term also shows a statistically significant and negative coefficient. This result is in line with the constraints in the access to the wholesale debt markets that banks faced in that period, and the tensions in the interbank market. The deposits-to-asset ratio has a statistically significant coefficient for the interaction term, but with a negative sign. This result contradicts the *a priori* expectations, given that a higher ratio corresponds to lower dependence on alternative funding sources (rather than deposits) to finance lending operations. The coefficients of the other funding indicators are not statistically significant in this approach.

As far as lenders' sovereign debt securities are concerned, in columns 6 and 7, the empirical evidence does not suggest impacts on firm's investment. The coefficients of total sovereign debt securities portfolio, and the Portuguese sovereign debt securities holdings, are not statistically significant.

Columns 8 and 9 present the results based on Tier 1 and Total capital ratios, respectively. According to the estimates, there is no statistically significant impact on firm's investment influenced by lenders' capital ratios.

Summing up. The empirical evidence suggests that the main dimension that affect a firm's investment decision is related to the funding structure of their lenders. Broadly, according to the results, firms whose lenders depend more on funding obtained in the financial and interbank markets present lower investment after 2009, in comparison with the previous years. We find that, on average, a one standard-deviation increase in lenders' interbank funding leads to around 0.7 percentage points additional decline in firm's investment after the outbreak of the crisis.

The importance of lenders' funding structure is in line with Cingano *et al.* (2013), who also explored lenders' funding sources, even though during the financial crisis. However, these results are unlike those in De Marco (2016), who explored the sovereign debt crisis based on banks' exposures to sovereigns. However, the analysis was based on syndicated loans, which are usually biased to larger firms, and consequently may have influence in the analysis.

Firm control variables. Finally, all firms' control variables included in the specifications (the $X_{i,t-1}$ vector) are statistically significant and present the expected sign. This confirms that firm characteristics are also important factors underlying firms' investment. In particular, SIZE shows a negative coefficient, suggesting that larger firms tend to present lower investment, which should be in line with the firm's life cycle (*i.e.* typically investment is stronger in initial phases of firms). SALES GROWTH, a variable that seeks to capture the potential growth, shows a positive coefficient. This suggests that corporate investment is sensitive to the demand for firms' products and opportunities to expand. Additionally, firms with higher indebtedness level (BANK DEBT)

tend to present lower investment in the following year. A possible reason for this result may be the fact that firms with higher debt ratios tend to face higher financial constraints. In turn, PROFITABILITY presents a positive and statistically significant coefficient. This suggests that firms use part of internal funds for investment (which is in line with the "*pecking order theory*" of Myers (1984), arguing an optimal hierarchy for funding).

ii) Employment decisions

Funding is important for investment decisions, but also for other dimension of firms' activity. Therefore, we perform an analysis similar to that conducted above, but exploring firm's employment decisions. Indeed, employment is also an important firm decision.

Employment can be seen as a complementary input to production, due to the usual complementarity of physical capital and human resources in the production function. However, if firms face financial difficulties, they may also adjust this factor *per se* to levels more consistent with firms' current financial position. As described in the literature section, some papers reported evidence that firms adjust employment after a shock that affected their lenders negatively, for instance, the findings of Chodorow-Reich (2014) in the US, Bentolila *et al.* (2015) for Spanish firms, and Bottero *et al.* (2015) for smaller firms in Italy.

IES includes the average number of employees for each firm. Based on this information, we explore the potential impact of lenders' exposure to the crisis on firms' employment decisions. The econometric results for this analysis are presented in Table 6. The structure of this table follows the previous one, so each column corresponds to the alternative indicator used to characterize institutions potentially more vulnerable to the adverse financial market developments, during the sovereign debt crisis.

For lenders' funding structure, in general, firms whose lenders are more dependent on the financial market tend to present a higher adjustment in the number of employees. In particular, the coefficients of interbank and market funding indicators are negative and statistically significant after 2009. The analysis based on deposits-to-assets ratio presents a positive coefficient after the onset of the sovereign debt crisis. This result suggests that firms whose lenders finance their activity more intensively by customers' resources present a more favorable employment path, reinforcing the previous findings regarding market funding. The estimates for the remaining indicators related to lenders' liabilities are not statistically significant.

When we characterize institutions based on sovereign debt securities portfolios, both criteria (total sovereign and Portuguese sovereign securities) present positive coefficients in the period after the outbreak of the euro area sovereign debt crisis. If we expect that higher exposures imply higher risk for institutions, and consequently (negative) "differentiation" by investors in

financial markets, these results are somewhat puzzling. However, this may be related to the general position of these institutions. Note that before the unexpected Greek bailout, sovereign debt securities were perceived as safe assets, and in that period the returns were high.

Based on the regulatory capital position, the Tier I and Total capital ratios are not statistically significant.

In terms of magnitudes, the estimates obtained indicate that, on average, firm's employment decreases by 0.3 percentage points based on a one standard-deviation increase in lender's market funding, after the onset of the sovereign debt crisis. In turn, a one standard deviation increase in the lenders' sovereign portfolio leads to an increase by around 0.6 percentage points in firm's employment changes.

All in all, looking at firms' employment decisions, the results are broadly in line with those observed for investment as far as lenders' funding position is concerned. However, in this analysis the results suggest that some other lenders' characteristics may also play a role on firms' employment, namely the sovereign debt securities portfolios.

	Funding structure					Sovereign exposure		Solvency	
	1	2	3	4	5	6	7	8	9
LI:	Central bank	Interbank	Market	Dep_A	LTD	Sovereign	PT Sovereign	Tier 1 Capital	Total capital
LI_{t-1}	0.1845	-0.0659**	-0.0582**	0.0403	-0.0010	0.4398	-0.0297	-0.0911	-0.0840
	(1.07)	(-2.02)	(-2.01)	(1.47)	(-1.57)	(1.20)	(-0.11)	(-1.04)	(-0.97)
LI_{t-1}*CRISIS	-0.1272	-0.0627**	-0.0689**	-0.0591**	-0.0004	-0.4451	-0.0333	0.0053	-0.0235
	(-0.73)	(-1.96)	(-2.31)	(-2.15)	(-0.62)	(-1.33)	(-0.13)	(0.06)	(-0.29)
PROFITABILITYt-1	0.0793***	0.0807***	0.0802***	0.0792***	0.0802***	0.0794***	0.0791***	0.0794***	0.0795***
	(3.22)	(3.27)	(3.25)	(3.21)	(3.25)	(3.22)	(3.21)	(3.22)	(3.22)
SALES GROWTHt-1	0.1051***	0.1046***	0.1047***	0.1050***	0.1049***	0.1050***	0.1050***	0.1050***	0.1050***
	(14.54)	(14.48)	(14.50)	(14.53)	(14.52)	(14.53)	(14.54)	(14.54)	(14.54)
SIZEt-1	-0.5163***	-0.5154***	-0.5161***	-0.5165***	-0.5162***	-0.5164***	-0.5165***	-0.5165***	-0.5165***
	(-49.70)	(-49.59)	(-49.69)	(-49.64)	(-49.69)	(-49.70)	(-49.69)	(-49.72)	(-49.73)
BANK DEBTt-1	-0.3935***	-0.3930***	-0.3945***	-0.3962***	-0.3943***	-0.3947***	-0.3946***	-0.3941***	-0.3943***
	(-22.74)	(-22.72)	(-22.80)	(-22.81)	(-22.80)	(-22.74)	(-22.73)	(-22.79)	(-22.80)
Constant	yes	yes	yes	yes	yes	yes	yes	yes	yes
Year dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes
Firm-fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
Nr.	211,752	211,752	211,752	211,752	211,752	211,752	211,752	211,752	211,752
R^2	0.0520	0.0521	0.0521	0.0520	0.0522	0.0520	0.0520	0.0520	0.0520

Note: ***, **, and * denote statistical significance levels at 1, 5, and 10 per cent, respectively. The t-statistics are in parentheses. The econometric models include firm-fixed effects and robust standard errors. All regressions include a constant term. Each column corresponds to an alternative criterion to classify firms' lenders as more vulnerable to sovereign debt crisis and its consequences (*i.e.* more vulnerable institutions). The dependent variable is INVESTMENT, defined as the flow of investment in tangible and intangible assets for each firm in a year over the total of those assets at the end of the previous year. Looking at the independent variables, PROFITABILITY is defined as net earnings before provisions and depreciation over total assets; SALES GROWTH is defined as year-on-year change rate of sales; SIZE is based on the natural logarithm of real total assets; BANK DEBT defined as debt over total assets. $LI_{i,t-1}$ is the interaction term between the firm-lenders indicator under analysis in each column and the weight of each lender in firm's debt. $LI \times Crisis$ corresponds to the interaction between the previous variable and the dummy variable that identifies the period after 2010 (2010 to 2012).

TABLE 5. Firms' investment decisions

	Funding structure					Sovereign exposure		Solvency	
	1	2	3	4	5	6	7	8	9
LI:	Central bank	Interbank	Market	Dep_A	LTD	Sovereign	PT Sovereign	Tier 1 Capital	Total capital
LI_{t-1}	-0.0474	0.0059	0.0030	-0.0123*	0.0003*	-0.1408	-0.0994	0.0313	0.0345
	(-1.08)	(0.76)	(0.41)	(-1.80)	(1.85)	(-1.39)	(-1.42)	(1.39)	(1.57)
LI_{t-1}*CRISIS	0.0445	-0.0184**	-0.0252***	0.0176**	-0.0001	0.1949**	0.1435**	-0.0160	-0.0258
	(1.00)	(-2.35)	(-3.40)	(2.52)	(-0.88)	(2.10)	(2.22)	(-0.75)	(-1.25)
PROFITABILITYt-1	0.0809***	0.0811***	0.0811***	0.0810***	0.0808***	0.0810***	0.0810***	0.0809***	0.0809***
	(12.94)	(12.96)	(12.96)	(12.94)	(12.93)	(12.94)	(12.94)	(12.94)	(12.94)
SALES GROWTHt-1	0.0367***	0.0367***	0.0367***	0.0368***	0.0368***	0.0368***	0.0368***	0.0367***	0.0367***
	(17.35)	(17.34)	(17.35)	(17.37)	(17.37)	(17.36)	(17.36)	(17.36)	(17.36)
SIZEt-1	-0.0418***	-0.0417***	-0.0417***	-0.0417***	-0.0418***	-0.0417***	-0.0417***	-0.0417***	-0.0418***
	(-19.48)	(-19.43)	(-19.47)	(-19.44)	(-19.49)	(-19.45)	(-19.44)	(-19.47)	(-19.48)
BANK DEBTt-1	-0.0389***	-0.0386***	-0.0387***	-0.0382***	-0.0387***	-0.0382***	-0.0383***	-0.0388***	-0.0388***
	(-8.88)	(-8.83)	(-8.85)	(-8.70)	(-8.85)	(-8.71)	(-8.73)	(-8.87)	(-8.86)
Constant	yes	yes	yes	yes	yes	yes	yes	yes	yes
Year dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes
Firm-fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
Nr.	212,288	212,288	212,288	212,288	212,288	212,288	212,288	212,288	212,288
R^2	0.0396	0.0397	0.0397	0.0397	0.0397	0.0397	0.0397	0.0396	0.0396

Note: ***, **, and * denote statistical significance levels at 1, 5, and 10 per cent, respectively. The t-statistics are in parentheses. The econometric models include firm-fixed effects and robust standard errors. All regressions include a constant term. Each column corresponds to an alternative criterion to classify firms' lenders as more vulnerable to sovereign debt crisis and its consequences (*i.e.* more vulnerable institutions). The dependent variable is EMPLOYMENT, defined as change in the average number of employees for each firm in a year over the average number of employees at the end of the previous year. Looking at the independent variables, PROFITABILITY is defined as net earnings before provisions and depreciation over total assets; SALES GROWTH is defined as year-on-year change rate of sales; SIZE is based on the natural logarithm of real total assets; BANK DEBT defined as debt over total assets. $LI_{i,t-1}$ is the interaction term between the firm-lenders indicator under analysis in each column and the weight of each lender in firm's debt. $LI \times Crisis$ corresponds to the interaction between the previous variable and the dummy variable that identifies the period after 2010 (2010 to 2012).

TABLE 6. Firms' employment decisions

6.3. Firms' decisions sensitivity over time

In this sub-section we replace the iteration term between the *Lenders' Indicator* and the crisis dummy in equation 1, by interaction terms between $LI_{i,t-1}$ and the year dummies variables, w_t. This specification allows us to observe how the impact of lenders' characteristics changes year by year on firms' decisions. Thus, we run the following specification:

$$y_{i,t} = c + \alpha X_{i,t-1} + \delta z_i + \varphi w_t + \beta_1 LI_{i,t-1} + \beta_{2,t} LI_{i,t-1} \times w_t + \mu_{i,t} \qquad (2)$$

Again, $y_{i,t}$ corresponds to investment or employment decisions of firm i in period t. $X_{i,t-1}$ is the vector of firm-specific variables at $t-1$, while z_i corresponds to firm time-invariant characteristics. w_t corresponds to year dummy variables. $LI_{i,t-1}$ is the indicator that characterizes lenders of firm i at period $t-1$. $LI_{i,t-1} \times w_t$ corresponds to the interaction term between lenders' characteristics and the year dummies. $\mu_{i,t}$ represents the error term.

In this specification we are interested in the sign and path of $\beta_{2,t}$ coefficients. These coefficients, in line with the previous specification, allow us to identify the impact of firms' lenders' position on firms' decisions. Additionally, we can check to see if this effect changed over the sample period. The results for this specification are presented in Tables A.5 and A.6 in the Appendix Section of this Chapter, for investment and employment decisions, respectively.

i) Investment decisions

For investment, we confirm the relevance of firm's lenders' funding structure indicators, mainly interbank and market funding. Based on the dependence on interbank funding, the coefficients of some interaction terms are negative and statistically significant. The negative coefficient in 2009 should reflect the tensions in financial markets following the Lehman Brothers' bankruptcy, which implied a collapse of the interbank market worldwide. The coefficients are also negative and statistically significant in 2011 and 2012, showing higher magnitudes. This suggests an intensification of this lenders' characteristic during the sovereign crisis. In turn, looking at market funding, the interaction terms are statistically significant, with negative coefficients, only in 2011 and 2012, when tensions spread to several financial markets. These results are in line with the constraints that banks faced in that period after the onset of the sovereign debt crisis. The sovereign debt securities portfolios and the prudential capital positions remain statistically non-significant in this approach.

ii) Employment decisions

For employment, the results also confirm the relevance of lenders' liabilities structure. Based on the interbank indicator, all the coefficients are statistically significant. This suggests that this dependence could have been stricter to banks as the crisis lasts. A similar effect is observed for the market funding indicator. In this analysis, deposits-to-assets is also statistically significant, with positive

coefficients, in the last year under analysis. This may be related to significant changes recorded in this period, in particular active policies adopted by banks to capture customers' deposits, in line the guidelines defined in the Programme to the loan-to-deposits ratio. Indeed, in the beginning of the Portuguese Programme, there was a sizable decrease of this ratio through deposits effects, rather than a significant cut in lending activity. The sovereign exposures present statistically and significant coefficients in 2012, with a positive sign. The capital ratios' coefficients are positive and statistically significant in 2009 and 2012.

7. Alternative Approach

In this Section we intend to answer the same research question: are firm's decisions conditioned on their lenders' vulnerabilities to the sovereign debt crisis? However, we adopt an alternative empirical approach to estimate the impact of the negative shock due to the unexpected bailout of a euro area country, and its the spillovers to other countries and financial markets. In particular, in this section we explore the firm-lenders relationships at the moment precisely before the onset of the sovereign debt crisis, namely at the end of 2009. In turn, for firms' outcomes, we focus the analysis on the investment and employment average figures, before and after the onset of the crisis.

7.1. Alternative empirical specification

The empirical procedure of this alternative approach is similar to that followed in previous sections. Therefore, taking into account firm-bank relationships and lenders' position at the end of 2009, we compute the weighted indicator for each firm. Then, based on firms' lenders' heterogeneity, we compare the path of average investment and employment changes in the period before the outbreak of the crisis and the period after it (pre-crisis *versus* crisis). For the period before the sovereign debt shock we considered the average investment and employment based on 2008 and 2009 figures, while for the period after the shock the average variables are based on 2011 and 2012 figures.

In this section we run the following specification:

$$y_{i,t} = c + \alpha X_{i,t-1} + \delta z_i + \varphi Crisis + \beta LI_{i,09} \times Crisis + \mu_{i,t} \qquad (3)$$

where $y_{i,t}$ corresponds to the average investment or average employment of firm i in the period t: 2008/2009 and 2011/2012. $X_{i,t-1}$ is a vector of firm-specific variables that may affect the firm's decisions evaluated at $t-1$ (namely 2007 and 2010). z_i corresponds to the firm's time-invariant components, while $Crisis$ is a time dummy variable that takes the value one for the period after 2009. In this specification $LI_{i,09}$ is the *Lenders' Indicator* that characterizes all lenders' positions of firm i at the end of 2009. Finally, $\mu_{i,t}$ corresponds to the error term.

In this framework the coefficient of interest is β, which corresponds to the interaction term between the *Lenders' Indicator* and the time dummy *Crisis*. The sign and significance of the β coefficient allows us to check if there were differences in the firm's decisions depending on its lenders' vulnerabilities to the negative shock recorded in mid-2010. So, we test if firms whose pre-crisis lenders were more vulnerable presented higher or lower changes from the period before to the period after the onset of the sovereign debt crisis.

Given that the key coefficient reflects the interaction between the time dummy and the *Lenders' Indicator*, which is a continuous variable, we can find some similarities between this specification and those that exploit treatment intensity variables. Exploring firms variation, the set of firms whose lenders present better indicators (*i.e.* lower vulnerability to the crisis) can be defined, by analogy, as the control group. In some way, this approach is in line to the analysis conducted by Acemoglu and Lyle (2004) about the impact of World War II on the women's labor market in the US. The authors explored the *"mobilization rate"* of men to the war as the key differential variable, given that this rate was not uniform across states (*i.e.* the share of men recruited in each state). So, they explored a continuous treatment variable rather than the usual binary variable approach.[24]

In this framework, it is worth highlighting some facts. As mentioned, the key variable under analysis is defined based on lenders' positions at the end of 2009 ($LI_{i,09}$). This position is defined after some firms' decisions had taken place. However, this fact should not invalidate the results as long as the events were unexpected at the time. In other words, before 2010 firms could not anticipate the onset of the sovereign debt crisis and the tensions in the international financial markets, or the consequences of these developments to their lenders. The same applies to financial institutions, *i.e.* institutions' decisions and financial positions at the end of 2009 did not reflect the coming events. Both arguments seem reasonable in the setup under analysis. Actually, the Greek bailout, *i.e.* the bailout of one country in the euro area, was not expected by agents and it changed considerably the assessment of sovereign credit risk by investors and the dynamics in international financial markets. Moreover, this approach allows us to exclude from the analysis potential effects related to lenders' decisions driven by the changes in the economic and financial environment, following the Greek bailout.

Lenders' characteristics

In this approach, we continue exploring the indicators used in the previous section to characterize banking institutions. However, as we characterize firm's lenders only at the end of 2009, we include some additional indicators in the

24. For additional details and discussion about treatment intensity variables, see the Chapter "Parallel worlds: fixed effects, differences-in-differences, and panel data" in Angrist, Joshua D and Pischke, Jörn-Steffen (2008).

analysis. These indicators allow us to explore other dimensions that may help to characterize banks' vulnerability to the crisis or their potential ability to overcome the adverse market conditions.

Based on the prudential liquidity reports, we obtain information about the liquidity position of each institution, such as the liquidity gap. This indicator takes into account the maturity (mis)match between assets and liabilities for different time windows. In this analysis we consider the liquidity gap for 6 to 12 months. This indicator therefore identifies the funding needs for the second half of 2010, the semester following the Greek rescue.

As financial markets dried up for Portuguese institutions during 2010, funding from the central bank, the lender of last resort, was crucial for some institutions to overcome liquidity shocks during this period. As presented in Figure A.3, in the Appendix Section, a sizable increase in credit from ECB operations occurred in mid-2010. However, gaining access to these operations requires pledging collateral. Therefore, we include in the analysis a variable related to the availability of assets eligible for monetary operations, *i.e.* assets that could be pledged as collateral in monetary operations conducted by the ECB, if needed.[25]

A negative liquidity gap, LIQUIDITY GAP, means that liabilities with maturity between 6 and 12 months are higher than the assets with similar maturity. The indicator ELIGIBLE ASSETS was defined as the share of assets that can be pledged as collateral in monetary operations over total assets. Based on these indicators, we expect that institutions showing higher indicators should be in a better position to face the negative shock recorded in 2010.

Table 7 presents some descriptive statistics for *Lenders' Indicators* (in line with the analysis of Table 4), assessed at the end of 2009 and including the additional variables.

25. This key indicator is available only since 2009, with the introduction of new items in the prudential liquidity report.

	Nr.	Mean	Sd	p10	p25	p50	p75	p90
Funding structure:								
CENTRAL BANK	36,408	0.04	0.01	0.02	0.03	0.04	0.04	0.05
INTERBANK MARKET	36,408	0.11	0.10	0.04	0.06	0.08	0.12	0.21
MARKET FUNDING	36,408	0.31	0.12	0.18	0.26	0.30	0.38	0.46
DEPOSITS_A	36,408	0.43	0.13	0.29	0.34	0.42	0.49	0.54
LOAN-TO-DEPOSIT	36,408	1.42	2.47	0.91	1.16	1.33	1.50	1.79
LIQUIDITY GAP	36,408	-10.00	11.27	-19.60	-12.43	-9.66	-6.34	-1.99
Debt securities portfolio:								
PT SOVEREIGN	36,408	0.02	0.02	0.00	0.01	0.02	0.03	0.04
SOVEREIGN	36,408	0.03	0.02	0.01	0.02	0.03	0.04	0.05
Collateral:								
ELIGIBLE ASSETS	36,408	0.10	0.04	0.06	0.07	0.10	0.11	0.17
Solvency:								
TIER 1 CAPITAL	36,408	0.07	0.05	0.04	0.07	0.08	0.09	0.10
TOTAL CAPITAL	36,408	0.09	0.05	0.06	0.09	0.11	0.11	0.12

Note: sd stands for standard deviation, while p10, p25, p50, p75, and p90 stand for the percentiles 10, 25, 50, 75, and 90, respectively, of the distribution of each indicator. The *Lenders' Indicator* corresponds to a weighted indicator at firm level, based on share of each lender on firm's total bank debt.

TABLE 7. Descriptive statistics - Lenders' Indicators at end-2009

7.2. Econometric results

Tables 8 and 9 present the results of this alternative approach for firms' investment and employment decisions, respectively. The new indicators are presented in the last two columns of each table.

As mentioned, the β coefficient in equation 3 is the key variable in this approach. Due to the characteristics of the data set, the econometrics procedure includes robust standard errors.

i) Investment decisions

Looking at funding structure, only the specifications with interbank and market funding indicators present statistically significant coefficients, with negative signs. These results suggest that firms whose lenders were more dependent on these funding sources at the end of 2009 presented lower (average) investment after 2010. The sovereign exposures and solvency indicators remained statistically non-significant in this set up.

Looking at the new indicators, the coefficient of the variable related to liquidity gap, presented in column 10, is not statistically significant. The availability of assets eligible as collateral, column 11, presents a positive and statistically significant coefficient for the interaction term with the crisis dummy. This suggests higher average investment for firms whose lenders showed greater ability, assessed at the end of 2009, to gain access to the ECB operations.

According to the results obtained, a one standard deviation increase in lenders' market funding corresponds to a reduction of 0.7 percentage points in average investment between the period before and after the onset of the sovereign crisis. A change of similar magnitude in lenders' eligible assets indicator has approximately the inverse impact.

ii) Employment decisions

Concerning employment decisions, and looking at lenders' liabilities structure, interbank lending, market funding, and the deposits-to-assets ratio are statistically significant. The last presents a positive coefficient while the other two indicators show negative signs. Therefore, average employment changes show less favorable path for firms whose lenders were more dependent on financial markets (or with lower share of customers' deposits) at the end of 2009.

Under this framework the indicators related to banks' exposure to sovereign debt securities continue presenting positive coefficients, *i.e.* firms whose lenders have higher sovereign debt securities holdings at the end of 2009 tend to reveal more favorable employment changes over time. Looking at capital adequacy ratios, the results do not suggest an impact on the average employment changes.

In line with the results observed for investment, the liquidity gap is not statistically significant. The variable eligible assets presents a positive coefficient. This suggests that banks with greater capacity to borrow from the Central Bank, measured by the assets available to pledge as collateral in monetary operations, are in a more favorable position to overcome adverse financial market developments.

The results indicate that firm's average employment change decreases by around 0.2 percentage points for a one standard-deviation increase in lenders' market funding. In turn, a one standard-deviation increase in lenders' sovereign securities portfolio or in eligible assets indicator implies an increase by around 0.24 percentage points in firm's average employment change.

	Funding structure					Sovereign exposure		Solvency		Funding	Collateral
	1	2	3	4	5	6	7	8	9	10	11
LI_{09}:	Central bank	Interbank	Market	Dep_A	LTD	PT Sovereign	Sovereign	Tier 1 Capital	Total capital	Liq. Gap	Elegible A
LI_{09}*CRISIS	0.2729	-0.0811**	-0.0604**	-0.0124	-0.0016	0.1716	0.3287	-0.0493	-0.0613	-0.0002	0.1570*
	(1.08)	(-2.35)	(-2.08)	(-0.47)	(-0.77)	(0.84)	(1.57)	(-0.66)	(-0.88)	(-0.59)	(1.92)
PROFITABILITYt-1	-0.0116	-0.0110	-0.0114	-0.0116	-0.0116	-0.0122	-0.0126	-0.0113	-0.0112	-0.0114	-0.0131
	(-0.35)	(-0.33)	(-0.34)	(-0.34)	(-0.34)	(-0.36)	(-0.37)	(-0.34)	(-0.33)	(-0.34)	(-0.39)
SALES GROWTHt-1	0.0917***	0.0918***	0.0920***	0.0917***	0.0917***	0.0918***	0.0918***	0.0918***	0.0918***	0.0918***	0.0916***
	(8.08)	(8.08)	(8.10)	(8.08)	(8.08)	(8.08)	(8.09)	(8.08)	(8.08)	(8.08)	(8.07)
SIZEt-1	-0.4301***	-0.4303***	-0.4307***	-0.4305***	-0.4304***	-0.4303***	-0.4299***	-0.4305***	-0.4305***	-0.4303***	-0.4299***
	(-37.43)	(-37.47)	(-37.51)	(-37.46)	(-37.49)	(-37.48)	(-37.43)	(-37.48)	(-37.49)	(-37.48)	(-37.42)
BANK DEBTt-1	-0.4284***	-0.4278***	-0.4278***	-0.4288***	-0.4282***	-0.4278***	-0.4273***	-0.4280***	-0.4281***	-0.4278***	-0.4284***
	(-20.33)	(-20.34)	(-20.33)	(-20.19)	(-20.34)	(-20.34)	(-20.32)	(-20.34)	(-20.35)	(-20.33)	(-20.36)
Constant	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Crisis dummy	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Firm-fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Nr.	86,102	86,102	86,102	86,102	86,102	86,102	86,102	86,102	86,102	86,102	86,102
R^2	0.0913	0.0914	0.0913	0.0912	0.0913	0.0913	0.0913	0.0912	0.0913	0.0912	0.0913

Note: ***, **, and * denote statistical significance levels at 1, 5, and 10 per cent, respectively. The t-statistics are in parentheses. The econometric models include firm-fixed effects and robust standard errors. All regressions include a constant term. Each column corresponds to an alternative criterion to classify firms' lenders as more vulnerable to sovereign debt crisis and its consequences (*i.e.* weaker institutions). The dependent variable is INVESTMENT, defined as the flow of investment in tangible and intangible assets for each firm in a year over the total of those assets at the end of the previous year. Looking at the independent variables, PROFITABILITY is defined as net earnings before provisions and depreciation over total assets; SALES GROWTH is defined as year-on-year change rate of sales; SIZE is based on the natural logarithm of real total assets; BANK DEBT defined as debt over total assets. $LI_{i,09}$ is the interaction term between the firm-lenders indicator under analysis in each column and the weight of each lender in firm's debt at end-2009. $LI_{i,09} \times Crisis$ corresponds to the interaction between the previous variable and the dummy variable that identifies the period after 2010.

TABLE 8. Alternative approach: Firms' investment

	Funding structure					Sovereign exposure		Solvency		Funding	Collateral
	1	2	3	4	5	6	7	8	9	10	11
LI_{09}:	Central bank	Interbank	Market	Dep_A	LTD	PT Sovereign	Sovereign	Tier 1 Capital	Total capital	Liq. Gap	Elegible A
LI_{09}*CRISIS	0.0244	-0.0227***	-0.0157**	0.0140**	0.0002	0.1428***	0.1448***	-0.0176	-0.0255	0.0001	0.0539***
	(0.42)	(-2.72)	(-2.18)	(2.07)	(0.63)	(2.84)	(2.78)	(-0.97)	(-1.52)	(0.87)	(2.71)
PROFITABILITYt-1	0.0321***	0.0323***	0.0322***	0.0321***	0.0321***	0.0316***	0.0317***	0.0322***	0.0323***	0.0320***	0.0316***
	(3.87)	(3.89)	(3.88)	(3.87)	(3.87)	(3.81)	(3.81)	(3.88)	(3.89)	(3.86)	(3.80)
SALES GROWTHt-1	0.0492***	0.0493***	0.0493***	0.0493***	0.0493***	0.0493***	0.0493***	0.0493***	0.0493***	0.0493***	0.0492***
	(16.00)	(16.00)	(16.01)	(16.01)	(16.00)	(16.01)	(16.01)	(16.00)	(16.00)	(16.00)	(15.98)
SIZEt-1	-0.0625***	-0.0625***	-0.0626***	-0.0624***	-0.0625***	-0.0624***	-0.0623***	-0.0626***	-0.0626***	-0.0626***	-0.0624***
	(-22.85)	(-22.87)	(-22.90)	(-22.83)	(-22.88)	(-22.84)	(-22.79)	(-22.88)	(-22.89)	(-22.88)	(-22.81)
BANK DEBTt-1	-0.0444***	-0.0443***	-0.0443***	-0.0432***	-0.0443***	-0.0444***	-0.0441***	-0.0444***	-0.0444***	-0.0444***	-0.0446***
	(-8.27)	(-8.27)	(-8.27)	(-8.02)	(-8.26)	(-8.27)	(-8.23)	(-8.28)	(-8.29)	(-8.27)	(-8.31)
Constant	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Crisis dummy	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Firm-fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Nr.	86,304	86,304	86,304	86,304	86,304	86,304	86,304	86,304	86,304	86,304	86,304
R^2	0.0967	0.0969	0.0969	0.0968	0.0968	0.0969	0.0969	0.0968	0.0968	0.0968	0.0969

Note: ***, **, and * denote statistical significance levels at 1, 5, and 10 per cent, respectively. The t-statistics are in parentheses. The econometric models include firm-fixed effects and robust standard errors. All regressions include a constant term. Each column corresponds to an alternative criterion to classify firms' lenders as more vulnerable to sovereign debt crisis and its consequences (*i.e.* weaker institutions). The dependent variable is EMPLOYMENT, defined as change in the average number of employees for each firm in a year over the average number of employees at the end of the previous year. Looking at the independent variables, PROFITABILITY is defined as net earnings before provisions and depreciation over total assets; SALES GROWTH is defined as year-on-year change rate of sales; SIZE is based on the natural logarithm of real total assets; BANK DEBT defined as debt over total assets. $LI_{i,09}$ is the interaction term between the firm-lenders indicator under analysis in each column and the weight of each lender in firm's debt at end-2009. $LI_{i,09} \times Crisis$ corresponds to the interaction between the previous variable and the dummy variable that identifies the period after 2010.

TABLE 9. Alternative approach: Firms' employment

Summing up. In this analysis we explore the exposure of firms to adverse shocks through their lenders' positions defined at the end of 2009, before the onset of the sovereign debt crisis. In this Section, in particular, as the key variable is continuous and we analyze firm's outcomes in two periods (pre-crisis *versus* crisis), we can differentiate firms among those with high and low exposures to the negative market developments through their lenders' position. Thus, the interaction term between the *Lenders' Indicator* and the Crisis dummy can be compared to a treatment intensity variable. Consequently, even though the empirical approach adopted in this Section is not a "pure" differences-in-differences model, it retains the main features of that models.

Broadly, the main findings discussed in the previous sections continue to be valid under this empirical approach, such as the importance of lenders' funding positions. Additionally, the results highlight the relevance of collateral to overcome tensions in the financial markets, through the ECB monetary operations.

8. Robustness

In this study, we analyzed firms' outcomes exploring the heterogeneity on firm's lenders' exposure to the adverse developments in financial markets, in the context of the sovereign debt crisis. The variable of interest was *Lenders' Indicator*, measured by several alternative criteria. Following the specification presented in Section 7.1, we run some additional regressions, in order to assess how the results change due to some adopted hypotheses.

First, we replace the firm-fixed effects component (z_i), in equation 3, with interaction terms between firms' business sector and the time dimension. These variables allow us to control, in some way, changes in firms' activity sector over time, which may influence firms' credit demand and decisions. In particular, we run the following specification:

$$y_{i,t} = c + \alpha X_{i,t-1} + \varphi Crisis + \beta LI_{i,09} \times Crisis + \delta S_i \times Crisis + \mu_{i,t} + \mu_{i,t} \tag{4}$$

where $S_i \times Crisis$ corresponds to the interaction term between firm i's business sector, S_i, and the time dummy *Crisis*. The remaining variables, both on right-hand and left-hand sides in the equation, are defined as described in Section 7.1, namely: $y_{i,t}$ corresponds to the average investment or average employment of firm i in the period t (2008/2009 and 2011/2012); $X_{i,t-1}$ is a vector of firm-specific variables evaluated at $t-1$; $LI_{i,09}$ is the *Lenders' Indicator* based on all firm's lenders i at the end of 2009; while $\mu_{i,t}$ corresponds to the error term. The results obtained under this set up are in line with those discussed above.

The next test comprises the inclusion of other lenders characteristics as explanatory variables in equation 3. Hence, in addition to the *Lenders'*

Indicator, which remains the key variable in the analysis, we include measures related to leverage, profitability, and size of firms' lenders.[26]

In this robustness exercise, we run the following specification:

$$y_{i,t} = c + \alpha X_{i,t-1} + \delta z_i + \varphi Crisis + \beta LI_{i,09} \times Crisis + \varphi LC_{i,09} + \mu_{i,t} \quad (5)$$

where $LC_{i,09}$ is the vector of additional variables for lenders of firm i, assessed at the end of 2009 (lenders' control variables). The remaining variables included in the specification preserve the same definition as described in Section 7.1.

According to results obtained, the general conclusions continue broadly to hold under this conjecture. Nevertheless, there are some adjustments in the estimated coefficients related to *Lenders' Indicator*, but they are not sizable. The results obtained under this framework are shown in Tables A.7 and A.8, in the Appendix Section of this Chapter, for firms' investment and employment outcomes, respectively.

Therefore, even replacing firm-fixed effects by other firms' controls, or including some lenders' control variables, the empirical evidence continues to identify some impact on firms' decisions related to lenders' dependence on interbank and financial markets, as well as the availability of assets eligible as collateral in ECB operations. Looking at employment changes, in addition to these lenders' features, lenders' sovereign debt securities portfolios have also impact on firms' outcomes.

9. Final Remarks

Recent years have seen unprecedented events. First, the financial crisis related to the US sub-prime mortgage market, the collapse of Lehman Brothers, and the severe worldwide economic recession in 2009. Afterwards, the euro area faced several challenges due to the onset of the sovereign debt crisis in mid-2010. Those events dramatically affected the international financial markets and had consequences for financial systems. Indeed, following those events, financial intermediaries were forced to revise their funding and business strategies, taking into account a new and more demanding regulatory framework. Simultaneously, financial systems in some countries recorded additional constraints imposed by the international rescue programs. Against this background, the discussion on the transmission of the financial position of intermediary institutions to the real economy, in particular the corporate sector, became a topical issue in the economic and financial literature for academics and policy-makers.

26. The procedure adopted to compute lenders control variables at firm level followed the approach of *Lenders' Indicator*, *i.e.* a weighted average of firm's lenders' characteristics. The definitions of the control variables are presented in Table A.3 in the Appendix Section.

Portugal was one of the countries especially affected by the sovereign debt crisis, which led to the International Financial Assistance Programme in April 2011. The sovereign-bank link also had significant negative spillovers to the Portuguese banking institutions, which play a crucial role as financial intermediary for the Portuguese economy.

This study investigates the potential differences in firms' investment and employment decisions, taking into account all firm-bank relationships and the vulnerability of firms' lenders to the adverse financial market developments, in the context of the sovereign debt crisis. We compute the *Lenders' Indicator*, which is a weighted indicator for each firm based on lenders' characteristics and the share of each lender in the firm's total bank debt. Higher and lower *Lenders' Indicators* represent different vulnerabilities to the negative shock. In other words, we compare the path of investment and employment for the period 2007-2012, exploring firm's lenders' heterogeneity. The results obtained highlight the relevance lenders' funding structure. In particular, firms whose lenders depend more on market funding present a poorer investment and employment path. This suggests that there was some transmission of lenders' vulnerabilities to the corporate sector. This result is reinforced when we assess lenders' positions at the end of 2009, before the unexpected negative shock on sovereign debt markets. The results also show the relevance of eligible assets to pledge as collateral in monetary operations, measured at end-2009, in overcoming negative shocks. We found a positive impact of this indicator on average investment and employment decisions after 2010. However, based on other lenders' characteristics, namely the sovereign debt securities portfolios or even solvency position, the results are not so conclusive. While the results suggest that there was no impact on firms' investment decisions, there is some evidence of the impact of lenders' sovereign securities exposures on employment outcomes.

The different results observed in the investment and employment analysis may be related to the fact that investment reacts more quickly to the economic activity, uncertainty, or agents' confidence. Investment was already affected by the financial crisis and the economic recession in 2009. In turn, employment tends to present a higher lag of adjustment to adverse environments.

The empirical findings of this study suggest that the linkage of banking institutions and sovereigns could play an important role for corporate activity, and consequently for economic developments. The results also illustrate the need to improve the general economic analytical tools, taking into account the link between economic agents, financial system, and sovereigns. This is especially important for a small and open economy, mainly when it is highly dependent on international savings flows, such as the Portuguese case, which may amplify its exposure to international shocks.

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Appendix

FIGURE A.1: PT sovereign bonds (10 years)

Source: Thomson Reuters.
This figure presents the Portuguese 10 year bond yields and the respective spread against comparable German bonds.

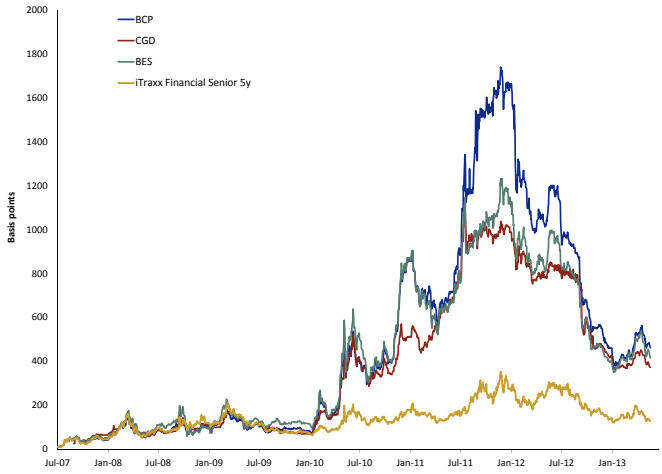

FIGURE A.2: Credit default swap spreads of Portuguese banks (5 years senior)

Sources: Bloomberg and Thomson Reuters.
This figure shows the CDS spreads of some major Portuguese banks, and the comparison with the CDS spread of iTraxx, that includes other banking institutions.

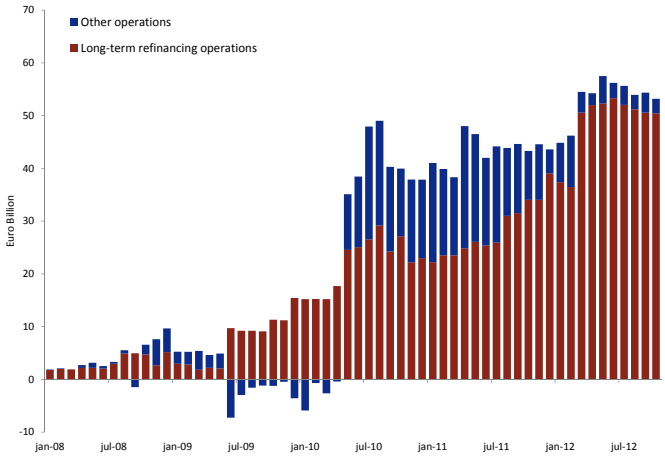

FIGURE A.3: Outstanding amounts of monetary policy operations of resident banks

Source: Banco de Portugal.
This figure shows the credit obtained by resident banks in ECB monetary operations since 2008 and the first years of the sovereign debt crisis in the euro zone.

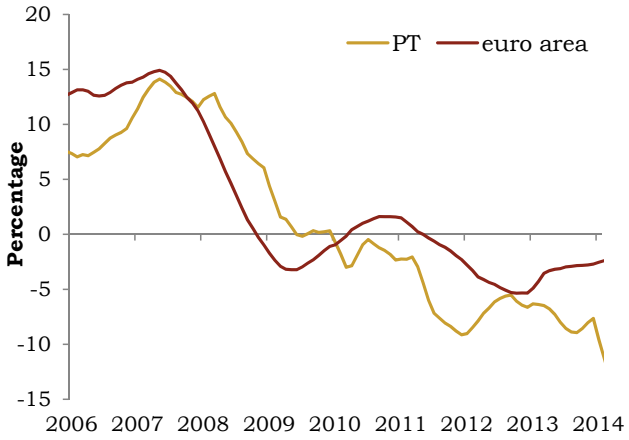

FIGURE A.4: Credit growth rate (year-on-year)

Source: Banco de Portugal.
This figure shows annual growth rate of bank loans granted to non-financial private sector from 2006 to 2014.

Variables	Definition
Dependent variables	
INVESTMENT GROWTH	Flow of investment in tangible and intangible assets for each firm in a year over the total of those assets at the end of the previous year
EMPLOYMENT GROWTH	Change in the average number of employees of each firm in a year over the average number in the previous year
Firm's characteristics	
PROFITABILITY	Net earnings before provisions and depreciation over total assets
BANK CREDIT	Bank debt over total assets
SALES GROWTH	Year-on-year change rate of sales
SIZE	Natural logarithm of real total assets
NUMBER RELATIONSHIPS	Number of banking relationships defined at the banking group level, based on the weight of each group in firm's total bank debt
Lenders' Indicator	
LI - LENDERS' INDICATOR	Interaction term between all firm-lenders' characteristics (based on indicators present below) and the respective weight in firm's total bank debt.

TABLE A.1. Variables definition - Firms

	Nr.	Mean	Sd	p10	p25	p50	p75	p90
SIZE	211,741	13.78	1.45	12.11	12.82	13.63	14.58	15.63
PROFITABILITY	211,752	0.09	0.12	-0.01	0.04	0.09	0.14	0.22
SALES GROWTH	211,747	-0.03	0.26	-0.32	-0.14	-0.02	0.09	0.24
BANK CREDIT	211,752	0.66	0.31	0.30	0.47	0.66	0.81	0.93
ASSETS GROWTH	211,752	0.04	0.23	-0.18	-0.08	0.01	0.12	0.30
WORKING CAPITAL	211,752	0.16	0.35	-0.26	-0.02	0.18	0.39	0.57
ACCOUNTS PAYABLE	211,752	0.19	0.16	0.02	0.06	0.16	0.28	0.42
ACCOUNTS RECEIVABLE	211,752	0.28	0.22	0.00	0.08	0.25	0.43	0.59
TANGIBILITY	211,752	0.28	0.23	0.03	0.09	0.23	0.42	0.64
INVENTORIES	211,752	0.18	0.21	0.00	0.01	0.10	0.27	0.49
ASSET TURNOVER	211,752	1.33	1.01	0.41	0.70	1.09	1.65	2.47
CASHFLOW	211,752	0.06	0.26	-0.20	-0.03	0.07	0.18	0.33
CASH AND EQUIVALENTS	211,752	0.29	0.62	0.01	0.02	0.08	0.26	0.72
AGE	211,752	19.72	13.31	7.00	10.00	17.00	25.00	35.00
NUMBER RELATIONSHIPS	211,752	3.24	2.24	1.00	2.00	3.00	4.00	6.00

TABLE A.2. Sample summary statistics - Firm characteristics

Note: sd stands for standard deviation, while p10, p25, p50, p75, and p90 stand for the percentiles 10, 25, 50, 75, and 90, respectively, of the distribution of each variable, for observations included in the econometric analysis. Looking at the variables presented, SIZE is the natural logarithm of real total assets; PROFITABILITY is defined as net earnings before provisions and depreciation over total assets; BANK CREDIT is defined as bank debt over total assets; SALES GROWTH is defined as Year-on-year change rate of sales; ASSETS GROWTH corresponds to the growth rate of total assets; WORKING CAPITAL is defined as current assets net of short term liabilities over total assets; ACCOUNTS PAYABLE is defined as accounts payable over total assets; ACCOUNTS RECEIVABLE is defined as accounts receivable over total assets; TANGIBILITY corresponds to tangible assets over total assets; INVENTORIES is defined as inventories over total assets; ASSET TURNOVER is defined as sales over total assets; CASHFLOW corresponds to the ratio of cashflow over total assets; CASH AND EQUIVALENTS is defined as cash and equivalents over total assets; AGE is defined in years. NUMBER RELATIONSHIPS reflects the number of banking relationships defined at the banking group level, based on the weight of each group in firm's total bank debt.

Variable	Definition
Lenders' Indicator	
Funding structure	
CENTRAL BANK	Central bank funding over total assets
INTERBANK	Interbank market over total assets
MARKET FUNDING	Wholesale and interbank markets over total assets
DEPOSITS_A	Customers' deposits over total assets
LOAN-TO-DEPOSIT	Loans over customers' deposits
LIQUIDITY GAP	Gap between assets and liabilities mismatch for 6-12 months
Debt Securities Portfolio	
PT SOVEREIGN	Portuguese sovereign debt securities over total assets
SOVEREIGN	Total sovereign debt securities over total assets
Collateral	
ELIGIBLE ASSETS	Assets eligible as collateral in monetary operations with central banks
Solvency	
TIER 1 RATIO	Tier 1 capital over risk weighted assets
CAPITAL RATIO	Total regular capital over risk weighted assets
Control variables	
LEVERAGE	Capital over total assets
PROFITABILITY	Returns on total assets
SIZE	Natural logarithm of total assets

TABLE A.3. Variables definition - Lenders

	INVEST.	EMPL.	CENTRAL B.	INTER B.	MARKET	LIQ. GAP	PT SOV.	SOV.	EL. ASSETS	R_TIER1	R_CAPITAL	DEP_A	LOAN-TO-DEP
INVESTMENT	1.000												
EMPLOYMENT	0.145	1.000											
CENTRAL BANK	-0.053	-0.112	1.000										
INTER BANK	-0.015	-0.026	0.012	1.000									
MARKET	-0.026	-0.050	0.184	0.764	1.000								
LIQ. GAP	0.008	0.051	-0.264	-0.269	-0.338	1.000							
PT SOVEREIGN	-0.045	-0.100	0.608	-0.016	-0.024	-0.040	1.000						
SOVEREIGN	-0.049	-0.105	0.608	-0.016	0.059	-0.067	0.962	1.000					
EL. ASSETS	-0.037	-0.115	0.733	-0.001	0.073	-0.307	0.788	0.746	1.000				
R_TIER1	-0.031	-0.055	0.299	0.032	0.187	0.242	0.404	0.470	0.379	1.000			
R_CAPITAL	-0.028	-0.046	0.255	0.052	0.284	0.230	0.320	0.414	0.285	0.972	1.000		
DEPOSITS_A	-0.059	-0.099	0.331	0.062	0.307	0.011	0.488	0.608	0.337	0.489	0.559	1.000	
LOAN-TO-DEP	-0.008	-0.006	0.007	0.263	0.197	-0.019	-0.007	-0.007	-0.003	0.078	0.079	-0.011	1.000

TABLE A.4. Correlation Matrix: Investment, employment, and lenders' characteristics

Note: INVESTMENT is defined as the flow of investment in tangible and intangible assets for each firm in a year over the total of those assets at the end of the previous year. EMPLOYMENT is defined as change in the average number of employees for each firm in a year over the average number of employees at the end of the previous year. The remaining variables characterize several dimensions on firm's lenders, namely: CENTRAL BANK is defined as the central bank funding over total assets; INTERBANK is defined as interbank funding over total assets; MARKET is defined as Wholesale and interbank markets over total assets; LIQ. GAP is defined as the gap between assets and liabilities mismatch for 6-12 months; SOV. PT is defined as the Portuguese sovereign debt securities over total assets; SOVEREIGN is defined as the total sovereign debt securities over total assets; EMPLOYMENT EL. ASSETS is defined as Assets eligible as collateral in monetary operations with central banks; R_TIER1 corresponds to the Tier 1 capital over risk weighted assets; R_CAPITAL corresponds to the Total regular capital over risk weighted assets; DEPOSITS_A is defined as customers' deposits over total assets; LOAN-TO-DEP is defined as loans over customers' deposits.

	Funding structure						Sovereign exposure		Solvency
	1	2	3	4	5	6	7	8	9
LI:	Central bank	Interbank	Market	Dep_A	LTD	Sovereign	PT Sovereign	Tier 1 Capital	Total capital
LI_{t-1}	-0.0641	-0.0204	-0.0340	0.0170	-0.0004	0.2234	-0.1334	-0.0406	-0.0512
	(-0.22)	(-0.48)	(-0.98)	(0.49)	(-0.50)	(0.54)	(-0.37)	(-0.21)	(-0.24)
LI_{t-1}*2009	0.3183	-0.0837*	-0.0562	0.0455	-0.0011	0.7531	0.1470	-0.0739	-0.0503
	(0.97)	(-1.75)	(-1.32)	(1.15)	(-1.22)	(1.28)	(0.35)	(-0.36)	(-0.23)
LI_{t-1}*2010	-0.4261	-0.0754	-0.0651	-0.0442	-0.0019	-0.4481	-0.2260	-0.1028	-0.1187
	(-1.04)	(-1.35)	(-1.40)	(-1.03)	(-1.23)	(-1.00)	(-0.56)	(-0.48)	(-0.52)
LI_{t-1}*2011	0.1132	-0.1228**	-0.1137***	-0.0642	-0.0007	-0.2676	0.0237	-0.1046	-0.1032
	(0.37)	(-2.54)	(-2.60)	(-1.55)	(-0.77)	(-0.67)	(0.07)	(-0.53)	(-0.48)
LI_{t-1}*2012	0.1889	-0.1172**	-0.1108***	0.0029	-0.0010	0.0092	0.2918	0.0002	-0.0114
	(0.62)	(-2.55)	(-2.64)	(0.07)	(-1.20)	(0.02)	(0.81)	(0.00)	(-0.05)
PROFITABILITYt-1	0.0795***	0.0807***	0.0802***	0.0792***	0.0801***	0.0795***	0.0793***	0.0794***	0.0794***
	(3.22)	(3.27)	(3.25)	(3.21)	(3.25)	(3.22)	(3.21)	(3.22)	(3.22)
SALES GROWTHt-1	0.1050***	0.1046***	0.1047***	0.1048***	0.1048***	0.1049***	0.1049***	0.1050***	0.1050***
	(14.54)	(14.48)	(14.49)	(14.51)	(14.51)	(14.51)	(14.52)	(14.54)	(14.54)
SIZEt-1	-0.5164***	-0.5152***	-0.5160***	-0.5164***	-0.5162***	-0.5163***	-0.5164***	-0.5165***	-0.5165***
	(-49.68)	(-49.57)	(-49.67)	(-49.62)	(-49.69)	(-49.68)	(-49.67)	(-49.72)	(-49.73)
BANK DEBTt-1	-0.3943***	-0.3926***	-0.3939***	-0.3962***	-0.3944***	-0.3943***	-0.3941***	-0.3946***	-0.3948***
	(-22.77)	(-22.69)	(-22.76)	(-22.78)	(-22.80)	(-22.72)	(-22.70)	(-22.79)	(-22.81)
Constant	yes	yes	yes	yes	yes	yes	yes	yes	yes
Year dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes
Firm-fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
Nr.	211,752	211,752	211,752	211,752	211,752	211,752	211,752	211,752	211,752
R^2	0.0520	0.0522	0.0521	0.0520	0.0522	0.0520	0.0520	0.0520	0.0520

TABLE A.5. Firms' investment decisions - yearly approach

Note: ***, **, and * denote statistical significance levels at 1, 5, and 10 per cent, respectively. The t-statistics are in parentheses. The econometric models include firm-fixed effects and robust standard errors. All regressions include a constant term. Each column corresponds to an alternative criterion to classify firms' lenders as more vulnerable to sovereign debt crisis and its consequences (*i.e.* more vulnerable institutions). The dependent variable is INVESTMENT, defined as the flow of investment in tangible and intangible assets for each firm in a year over the total of those assets at the end of the previous year. Looking at the independent variables, PROFITABILITY is defined as net earnings before provisions and depreciation over total assets; SALES GROWTH is defined as year-on-year change rate of sales; SIZE is based on the natural logarithm of real total assets; BANK DEBT defined as debt over total assets. $LI_{i,t-1}$ is the interaction term between the firm-lenders indicator under analysis in each column and the respective weight of each lender. $LI\times$ year corresponds to the interaction between the previous variable and the year dummies (2008 to 2012).

	Funding structure					Sovereign exposure		Solvency	
	1	2	3	4	5	6	7	8	9
LI:	Central bank	Interbank	Market	Dep_A	LTD	Sovereign	PT Sovereign	Tier 1 Capital	Total capital
LI_{t-1}	-0.1384*	0.0274***	0.0136	-0.0209**	0.0005**	-0.1535	-0.1540	-0.0724	-0.0821
	(-1.91)	(2.61)	(1.52)	(-2.33)	(2.26)	(-1.28)	(-1.56)	(-1.34)	(-1.40)
LI_{t-1}*2009	0.1273	-0.0397***	-0.0243**	0.0163	-0.0005	0.0673	0.0906	0.1176**	0.1255**
	(1.52)	(-3.13)	(-2.12)	(1.49)	(-1.51)	(0.40)	(0.77)	(2.03)	(2.06)
LI_{t-1}*2010	0.1045	-0.0322**	-0.0346***	0.0147	-0.0001	0.1359	0.1057	0.0596	0.0638
	(1.01)	(-2.38)	(-2.99)	(1.32)	(-0.22)	(1.07)	(0.97)	(1.03)	(1.05)
LI_{t-1}*2011	0.0909	-0.0328***	-0.0315***	0.0243**	-0.0004*	0.1882	0.1679*	0.0508	0.0536
	(1.20)	(-2.66)	(-2.80)	(2.23)	(-1.73)	(1.64)	(1.75)	(0.92)	(0.91)
LI_{t-1}*2012	0.1842**	-0.0514***	-0.0436***	0.0418***	-0.0003	0.2913**	0.2972***	0.1199**	0.1216**
	(2.46)	(-4.23)	(-3.82)	(3.80)	(-1.47)	(2.49)	(3.01)	(2.18)	(2.06)
PROFITABILITYt-1	0.0809***	0.0810***	0.0811***	0.0810***	0.0808***	0.0810***	0.0810***	0.0810***	0.0810***
	(12.94)	(12.94)	(12.96)	(12.95)	(12.92)	(12.95)	(12.96)	(12.95)	(12.95)
SALES GROWTHt-1	0.0367***	0.0367***	0.0367***	0.0367***	0.0368***	0.0367***	0.0367***	0.0367***	0.0367***
	(17.35)	(17.32)	(17.33)	(17.35)	(17.37)	(17.34)	(17.33)	(17.35)	(17.35)
SIZEt-1	-0.0418***	-0.0416***	-0.0417***	-0.0417***	-0.0418***	-0.0417***	-0.0416***	-0.0417***	-0.0418***
	(-19.51)	(-19.39)	(-19.46)	(-19.41)	(-19.49)	(-19.43)	(-19.41)	(-19.48)	(-19.48)
BANK DEBTt-1	-0.0393***	-0.0385***	-0.0387***	-0.0379***	-0.0387***	-0.0380***	-0.0381***	-0.0389***	-0.0389***
	(-8.96)	(-8.80)	(-8.83)	(-8.63)	(-8.84)	(-8.67)	(-8.69)	(-8.89)	(-8.89)
Constant	yes	yes	yes	yes	yes	yes	yes	yes	yes
Year dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes
Firm-fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
N	212,288	212,288	212,288	212,288	212,288	212,288	212,288	212,288	212,288
R^2	0.0397	0.0398	0.0397	0.0397	0.0397	0.0397	0.0397	0.0398	0.0398

TABLE A.6. Firms' employment decisions - yearly approach

Note: ***, **, and * denote statistical significance levels at 1, 5, and 10 per cent, respectively. The t-statistics are in parentheses. The econometric models include firm-fixed effects and robust standard errors. All regressions include a constant term. Each column corresponds to an alternative criterion to classify firms' lenders as more vulnerable to sovereign debt crisis and its consequences (*i.e.* more vulnerable institutions). The dependent variable is EMPLOYMENT, defined as change in the average number of employees for each firm in a year over the average number of employees at the end of the previous year. Looking at the independent variables, PROFITABILITY is defined as net earnings before provisions and depreciation over total assets; SALES GROWTH is defined as year-on-year change rate of sales; SIZE is based on the natural logarithm of real total assets; BANK DEBT defined as debt over total assets. $LI_{i,t-1}$ is the interaction term between the firm-lenders indicator under analysis in each column and the respective weight of each lender. $LI\times$ year corresponds to the interaction between the previous variable and the year dummies (2008 to 2012).

	Funding structure					Sovereign exposure		Solvency		Funding	Collateral
	1	2	3	4	5	6	7	8	9	10	11
LI_{09}:	Central bank	Interbank	Market	Dep_A	LTD	PT Sovereign	Sovereign	Tier 1 Capital	Total capital	Liq. Gap	Elegible A
LI_{09}*CRISIS	0.2364	-0.0662*	-0.0621**	-0.0096	-0.0016	0.1549	0.3000	-0.0732	-0.0993	-0.0001	0.1485*
	(0.92)	(-1.87)	(-2.09)	(-0.36)	(-0.75)	(0.74)	(1.36)	(-0.64)	(-0.96)	(-0.31)	(1.68)
PROFITABILITYt-1	-0.0123	-0.0117	-0.0120	-0.0123	-0.0122	-0.0128	-0.0130	-0.0120	-0.0119	-0.0122	-0.0135
	(-0.36)	(-0.35)	(-0.36)	(-0.36)	(-0.36)	(-0.38)	(-0.39)	(-0.36)	(-0.35)	(-0.36)	(-0.40)
SALES GROWTHt-1	0.0917***	0.0918***	0.0919***	0.0917***	0.0917***	0.0917***	0.0918***	0.0917***	0.0917***	0.0917***	0.0916***
	(8.07)	(8.08)	(8.09)	(8.07)	(8.07)	(8.08)	(8.08)	(8.07)	(8.07)	(8.07)	(8.06)
SIZEt-1	-0.4299***	-0.4301***	-0.4305***	-0.4302***	-0.4301***	-0.4301***	-0.4298***	-0.4303***	-0.4303***	-0.4301***	-0.4298***
	(-37.41)	(-37.45)	(-37.48)	(-37.42)	(-37.45)	(-37.44)	(-37.40)	(-37.43)	(-37.44)	(-37.45)	(-37.40)
BANK DEBTt-1	-0.4282***	-0.4277***	-0.4275***	-0.4285***	-0.4281***	-0.4277***	-0.4271***	-0.4282***	-0.4285***	-0.4278***	-0.4281***
	(-20.32)	(-20.32)	(-20.31)	(-20.17)	(-20.33)	(-20.32)	(-20.29)	(-20.33)	(-20.35)	(-20.32)	(-20.34)
Constant	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Crisis dummy	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Lenders controls	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Firm-fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Nr.	86102	86102	86102	86102	86102	86102	86102	86102	86102	86102	86102
R^2	0.0915	0.0915	0.0916	0.0914	0.0915	0.0915	0.0915	0.0915	0.0915	0.0914	0.0915

TABLE A.7. Alternative approach: Firms' investment

Note: ***, **, and * denote statistical significance levels at 1, 5, and 10 per cent, respectively. The t-statistics are in parentheses. The econometric models include firm-fixed effects and robust standard errors. All regressions include a constant term. Each column corresponds to an alternative criterion to classify firms' lenders as more vulnerable to sovereign debt crisis and its consequences (*i.e.* weaker institutions). The dependent variable is EMPLOYMENT, defined as change in the average number of employees for each firm in a year over the average number of employees at the end of the previous year. Looking at the independent variables, PROFITABILITY is defined as net earnings before provisions and depreciation over total assets; SALES GROWTH is defined as year-on-year change rate of sales; SIZE is based on the natural logarithm of real total assets; BANK DEBT defined as debt over total assets. $LI_{i,09}$ is the interaction term between the firm-lenders indicator under analysis in each column and the weight of each lender in firm's debt at end-2009. $LI_{i,09} \times Crisis$ corresponds to the interaction between the previous variable and the dummy variable that identifies the period after 2010.

	Funding structure					Sovereign exposure		Solvency		Funding	Collateral
	1	2	3	4	5	6	7	8	9	10	11
LI_{09}:	Central bank	Interbank	Market	Dep_A	LTD	PT Sovereign	Sovereign	Tier 1 Capital	Total capital	Liq. Gap	Elegible A
LI_{09}*CRISIS	0.0174	-0.0254***	-0.0202***	0.0150**	0.0002	0.1573***	0.1726***	0.0408	0.0128	0.0002**	0.0699***
	(0.29)	(-2.95)	(-2.73)	(2.22)	(0.53)	(3.04)	(3.14)	(1.42)	(0.50)	(2.47)	(3.29)
PROFITABILITYt-1	0.0322***	0.0324***	0.0323***	0.0322***	0.0322***	0.0317***	0.0317***	0.0320***	0.0321***	0.0320***	0.0316***
	(3.88)	(3.90)	(3.89)	(3.87)	(3.88)	(3.82)	(3.82)	(3.85)	(3.87)	(3.85)	(3.81)
SALES GROWTHt-1	0.0493***	0.0493***	0.0494***	0.0493***	0.0493***	0.0493***	0.0493***	0.0493***	0.0493***	0.0493***	0.0492***
	(16.01)	(16.01)	(16.03)	(16.02)	(16.01)	(16.02)	(16.02)	(16.01)	(16.01)	(16.01)	(15.99)
SIZEt-1	-0.0625***	-0.0625***	-0.0626***	-0.0624***	-0.0625***	-0.0624***	-0.0623***	-0.0624***	-0.0625***	-0.0626***	-0.0623***
	(-22.85)	(-22.87)	(-22.90)	(-22.82)	(-22.87)	(-22.84)	(-22.78)	(-22.83)	(-22.85)	(-22.90)	(-22.81)
BANK DEBTt-1	-0.0442***	-0.0442***	-0.0441***	-0.0430***	-0.0441***	-0.0441***	-0.0438***	-0.0439***	-0.0441***	-0.0441***	-0.0443***
	(-8.24)	(-8.23)	(-8.23)	(-7.97)	(-8.23)	(-8.23)	(-8.17)	(-8.18)	(-8.21)	(-8.23)	(-8.27)
Constant	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Crisis dummy	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Lenders controls	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Firm-fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Nr.	86304	86304	86304	86304	86304	86304	86304	86304	86304	86304	86304
R^2	0.0969	0.0971	0.0971	0.0970	0.0969	0.0971	0.0971	0.0969	0.0969	0.0970	0.0971

TABLE A.8. Alternative approach: Firms' employment

Note: ***, **, and * denote statistical significance levels at 1, 5, and 10 per cent, respectively. The t-statistics are in parentheses. The econometric models include firm-fixed effects and robust standard errors. All regressions include a constant term. Each column corresponds to an alternative criterion to classify firms' lenders as more vulnerable to sovereign debt crisis and its consequences (*i.e.* weaker institutions). The dependent variable is EMPLOYMENT, defined as change in the average number of employees for each firm in a year over the average number of employees at the end of the previous year. Looking at the independent variables, PROFITABILITY is defined as net earnings before provisions and depreciation over total assets; SALES GROWTH is defined as year-on-year change rate of sales; SIZE is based on the natural logarithm of real total assets; BANK DEBT defined as debt over total assets. $LI_{i,09}$ is the interaction term between the firm-lenders indicator under analysis in each column and the weight of each lender in firm's debt at end-2009. $LI_{i,09} \times Crisis$ corresponds to the interaction between the previous variable and the dummy variable that identifies the period after 2010.

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