Bank shocks and firm performance: New evidence from the sovereign debt crisis*

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Abstract

Empirical investigation of corporate failures has considered the effects of macroeconomic conditions and financial healthiness, but there is limited evidence about the real effects of bank shocks caused by the sovereign debt crisis. Using a rich source of high-quality firm-bank matched data over the period 2005-14, this paper examines the real effects of various bank shocks on firms' survival prospects in Portugal. We first present evidence that a funding outflow is associated with a reduction in credit supply. We further show that firms borrowing from banks that were exposed to the funding outflow are more likely to fail. In addition, we uncover significant heterogeneity in firms' financial positions and document that firms that have drowned down their lines of credit, younger firms and those of high risk exhibit a higher sensitivity of firm failure to bank shocks compared to their counterparts. Finally, we consider alternative channels of transmission of shocks from the financial to the real sector such as banks' exposure on sovereign debt and a capital enhancement exercise.

Key words: Firm survival, Bank shocks, Sovereign debt crisis, Financial constraints
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1 Introduction

It is well accepted that financial healthiness matters for company failures both according to the theory and to the existing empirical evidence. The theoretical model of Clementi and Hopenhayn (2006) predicts that financial constraints are important for survival and shows that the failure rate decreases with size and age.[1] Empirically, a large number of studies examine firm survival from a financial perspective and conclude that firms' chances of survival respond strongly to a number of balance sheet indicators (Zingales (1998); Bunn and Redwood (2003); Bridges and Guariglia (2008) and Huynh et al. (2010)).[2] What is less researched, however, is whether shocks that impact strongly on financial intermediaries can translate into real effects with emphasis on survival prospects.[3] Investigating the effect of bank shocks at the extensive margin is a key issue to understand which types of firms are more exposed to extreme financial shocks. Such evidence is valuable both for policy-makers and academic researchers. Specifically, if efficient firms may still have to exit if they do not have adequate access to finance, this suggests an effect beyond the mechanism through which creative destruction works. Hence, it is important to inform the debate on whether access to finance is likely to hinder successful operations of non-financial firms.

Our study aims to fill this gap by providing for the first time a systematic empirical analysis of the impact of various bank shocks on firms' chances of survival. Our empirical approach proceeds in two steps. First, we assess the response of banks exposed to funding shocks to the supply of credit to firms. Second, we investigate the consequences of deteriorating credit conditions for firms' survival prospects. Our premise is that firms borrowing from banks exposed to shocks should display a higher probability of failure. Drawing on a large matched firm-bank dataset from Portugal, we initially focus on a bank funding shock, measured by

[1] Conversely, the conditional probability of survival increases with the value of the firm's equity.

[2] For example, Zingales (1998) using data for the US tracking industry, shows that highly leveraged firms are less likely to survive. Similar evidence has been produced for other industries and countries, see, for example, Bunn and Redwood (2003); Bridges and Guariglia (2008) for UK manufacturing and services industries, Musso and Schiavo (2008) for French manufacturing firms and Tsoukas (2011) for Asian companies.

[3] Throughout the paper, we use the terms survival and failure interchangeably.

interbank liabilities and deposit funding. In further empirical tests, we exploit alternative shocks based on banks' holdings of risky sovereign debt and a quasi–experimental variation in banks' capital requirements. In doing so, we explore alternative channels of transmission from banks to firms that may be helpful in identifying banks more vulnerable to adverse financial events. Moreover, we do not expect all firms to be affected in a proportional manner. We argue that heterogeneity in firms' financial positions is likely to play a critical role in amplifying the bank shocks. That is, we assess whether the effect of bank funding shocks on firm survival depends upon firm characteristics such as credit lines drawdown activity, probability of default and age.

Portugal is an ideal laboratory to study the impact of bank shocks on firms' closures for three considerations. First, the Portuguese banking system was hit by a large unanticipated shock. Portugal has been severely affected by the sovereign debt crisis and it witnessed a substantial drop in the lending volume of new loans by 45% over the period 2008–2013 (see Acharya et al. (2016)).[4] Second, Small and Medium Enterprises (SMEs) in Portugal are heavily bank dependent, so that firms included in our sample are unlikely to substitute bank credit from shocked banks for market finance. If anything, this is likely to intensify the real effects of the funding shocks. Finally, we have access to a rich source of high-quality firm-bank matched data. Our work draws on a unique data set combining firm-bank matched data from the Portuguese Credit Register with balance-sheet information available for around 500,000 nonfinancial firms (and for all their lenders). Credit register data are essential for the analysis: they allow us to recover all existing bank–firm relationships and the corresponding amount of credit that flows over time. Therefore we are able to show that the bank funding shock is uncorrelated with banks' ex-ante credit supply and that the analysis is not driven by demand considerations for bank loans.

Our work contributes to the literature in three ways. First, we consider the transmission of funding shocks to firms' survival prospects. In this way, we speak directly to the literature

[4]The reduction in the loan supply in Europe was particularly severe in the later part of the sovereign debt crisis (Becker and Ivashina (2017)).

on firm survival which typically includes a set of financial variables in equations modelling firm exit (see Zingales (1998); Bunn and Redwood (2003); Bridges and Guariglia (2008) and Huynh et al. (2010)). Our approach also complements the existing empirical literature on firm outcomes and lending shocks (see Chodorow-Reich (2014); Bottero et al. (2015); Acharya et al. (2016); Cingano et al. (2016); Balduzzi et al. (2017); Bentolila et al. (2017); Dwenger et al. (2017) and Popov and Rocholl (2017)), which highlights the role of real effects of bank balance sheet shocks at the firm level. The above studies focus on exogenous shocks and their impact on real activities such as investment, asset growth and employment. Our study completes the picture by looking at firm closures. This is an important consideration as firm closures were a major concern during the recent financial crisis, since survival and growth of firms are important aspects of industry dynamics, forming the competitive landscape in an economy. Moreover, we extend the existing line of work by considering a number of different bank shocks to investigate different channels of transmission of shocks from the financial to the real sector. Specifically, we account for a funding outflow, the banks' exposure on risky sovereign debt and the deleveraging of the financial sector through the reinforcement of the banks' capital positions.

The second main contribution is that we uncover significant heterogeneity in firms' financial positions. An extensive literature on firm heterogeneity posits that firms which are constrained on some financial markets are more likely to be associated with the higher degree of information asymmetry and therefore may find it difficult to access external finance. The importance of size, age, and dividend payouts in firms' real activities was emphasized in the empirical financing constraints literature.[5] In the financial intermediation literature, high risk firms and those with fewer tangible assets are relatively more sensitive to bank capital shocks (Popov and Udell (2012)).[6] Size and age are employed by Balduzzi et al.

[5]Size is the key proxy for capital market access by manufacturing firms in Gertler and Gilchrist (1994) because small firms are more vulnerable to capital market imperfections and thus more likely to be financially constrained. In summary, corporate policies of financially constrained firms are severely affected compared to their unconstrained counterparts.

[6]Iyer et al. (2013) and Bentolila et al. (2017) provide evidence for micro-level heterogeneity for Portugal and Spain, respectively.

(2017) to disentangle the effects of banks' financial market valuations on firms' decisions across different groups of firms. We build on this line of work by employing three indicators, namely credit lines drawdown, probability of default and firms' age, to assess whether firms of various types respond to bank shocks in a different way.

Finally, we employ a rich, but relatively unexploited, source of firm-bank matched data for Portugal. This is a much broader sample of firms than other studies in the literature, which consists of annual balance-sheet information on registered companies over the period 2005-14 and their lenders' detailed monthly bank-firm level data from a comprehensive credit register, which records all commercial and industrial loans by all financial institutions operating in Portugal. An appealing characteristic of the data-set is that it covers mainly micro and small firms, which are more likely to suffer from loan disruptions and hence will be affected the most during large financial shocks. In addition, this rich data-set covers the universe of non-financial firms matched with the universe of banks and therefore our study does not suffer from concerns regarding the representativeness of the data.

To preview our results, we present evidence that a negative bank funding shock is associated with a reduction in credit supply. In other words, banks that are exposed to funding outflows subsequently tighten credit conditions more relative to less affected banks to the same borrower. At the next stage, we provide evidence that this shock is transmitted to the real sector, paying special attention to firm closures. We show that firms that maintain a pre-crisis relationship with banks that experience a larger funding outflow are more likely to fail, all else equal. In addition, we find that other shocks such as banks' exposure to sovereign debt and the deleveraging of the financial sector through the reinforcement of the banks' capital positions are also important drivers of firm exits.

Another important finding of our paper is that there is a noticeable negative effect of being financially constrained on the probability of firm exit. When we consider firm heterogeneity we find the degree of financial constraints faced by firms to be a critical determinant of real responses to funding shocks. We interact funding shocks with a set of firm characteristics

and document that the negative effect of the various shocks on the hazard of exit is more potent for firms that have used their lines of credit, display higher probability of default and are younger. Overall, our evidence provides a key contribution to the literature on firm survival, bank lending and financial shocks.

The remainder of the paper is structured as follows. Section 2 presents a brief summary of the relevant literature. Sections 3 and 4 contain our methodology and data-set description, respectively. Section 5 presents the empirical results. Section 6 reports robustness tests. Section 7 provides conclusions.

2 Related literature

Models of firm finance typically assume that at the onset of a recession, firms with poorer indicators of creditworthiness on their balance sheets should receive a relatively lower share of external credit. On the other hand, firms that are established on the credit markets will have unimpeded access to credit markets. This phenomenon was described as "flight to quality" by Bernanke et al. (1996). The experience of the global financial crisis and the European sovereign debt crisis suggest that the financial system can generate an endogenous cycle (the accelerator) that propagates the initial shock over time c.f. Bernanke et al. (1996). Firms that initially are regarded as risky and are refused external finance on this basis can find that their creditworthiness deteriorates further, putting future external finance further out of reach. This is a key mechanism in the financial accelerator, and is critical to the orientation of the credit channel of monetary transmission (see Bernanke et al. (1996, 1999)).

Another form of this lending channel - the bank-lending channel - postulates that contractionary monetary policy will lead to a reduction in bank lending (Mishkin (1995)). Given that particular segments of firms will find it difficult to substitute from loans to other sources of funding (Bernanke and Blinder (1988)), loan supply disruptions lead to an increase in the external finance premium, and hence to a further reduction of real activity. Therefore, shocks

to banks' balance sheets can have important effects on the credit supply. The challenge, however, in identifying the real effects of the bank lending channel, is to take into account the firm-level credit supply effects of a bank shock.

The literature on the identification of bank lending channel was initiated by Gan (2007) and Khwaja and Mian (2008) using bank-firm matched loan data to disentangle credit demand from credit supply. A number of studies investigate changes in bank lending. For instance, Jiménez et al. (2012) use monthly loan application data from the Spanish credit register, which are matched with firm and bank characteristics, and find that fewer loan applications were granted in times of higher short-term policy rates or low GDP growth. Moreover, this effect is stronger for banks with low capitalization or liquidity levels. The transmission of supply-related shocks to lending was investigated by Iyer et al. (2013) using Portuguese data. The authors show that higher pre-crisis interbank exposure led to larger drops in growth rates of corporate loans in the case of Portugal.

In a similar vein, Bonaccorsi and Sette (2016) find that banks' access to the interbank market and securitization play a role in the growth of credit and pricing in the pre-crisis period. Other previous studies document a significant negative effect from the euro area sovereign debt crisis on bank lending to the private sector (Allen and Moessner (2012); Correa et al. (2012) and Bonfondi et al. (2017)). Specifically, Bonfondi et al. (2017) focus on the Italian sovereign debt crisis and find that domestic banks reduced their supply of credit more than foreign banks, both at the intensive and extensive margin. Finally, DeJonghe et al. (2016) show that banks in Belgium that face a negative funding shock reduce credit to firms and reallocate credit within their domestic loan portfolio.

This is a fast and growing line of work that attempts to investigate the impact of recent crises on firms' real decisions. Existing evidence on this area is relatively scarce due to detailed data requirements at the firm bank relationships as well as financial information for both firms and banks. The real effects of credit-supply were identified initially at the aggregate level or on sub-samples of listed companies (see Peek and Rosengren (2000);

Campello et al. (2010); Almeida et al. (2012) and Amiti and Weinstein (2017)).

At the firm-level, Bentolila et al. (2017) show that firms attached to weaker banks, that were eventually bailed out by the Spanish government, suffered a larger fall in employment. Bottero et al. (2015) find that following the Greek bailout in 2010, financial intermediaries exposed to government securities, reduced credit affecting smaller Italian firms' investment and employment decisions. Acharya et al. (2016) investigate the impact of the sovereign debt crisis on corporate policies using syndicated loans data. The evidence suggests that the loan supply contraction of GIIPS banks depresses investment, job creation, and sales growth of European borrowers that have a significant business relationship with these banks.

In the context of the global financial crisis, Chodorow-Reich (2014) shows that U.S. bank exposure to the Lehman bankruptcy had a sizable influence on employment for medium and small firms which had pre-crisis relationships with less healthy lenders. Cingano et al. (2016) exploit the 2007 liquidity drought in interbank markets and document that the credit shock that followed this crisis affected Italian firms' investment spending and employment. In addition the effect proved to be stronger among small and young firms as well as those that are heavily bank dependent. Moreover, DeJonghe et al. (2016) show a moderate drop in investment and asset growth for firms in Belgium that are borrowing from banks affected by a funding shock.

Balduzzi et al. (2017) analyse the effects of banks' financial market valuations on firms' decisions such as investment and employment. They study both the financial and sovereign debt crises and find evidence of significant adverse credit-channel effects of the two crises. Finally, there is evidence that labour decisions are affected by exogenous funding shocks as evinced by Popov and Rocholl (2017) and Dwenger et al. (2017). Both studies focus on Germany and conclude that firms associated with banks affected by the U.S. subprime mortgage crisis experience a significant decline in employment.

3 Empirical implementation

Our main goal in this study is to identify how bank shocks affect firms' performance. We tackle this issue by first assessing the response of banks exposed to a funding shock to the supply of credit to firms. At the next stage, we quantify the real effects of the funding shock on firms' hazard of exit. For identification, we exploit the shock at the start of the sovereign debt crisis and use comprehensive loan-level data to isolate the credit supply channel. We discuss these issues in the subsection below.

3.1 Identification issues

Our purpose is to isolate credit supply effects from other economy-wide trends. The identifying assumption for the research design is based on two important requirements. First, the bank funding shock must be uncorrelated with banks' ex-ante credit supply. Second, to correctly identify credit supply effects one has to rule out the possibility that the analysis is driven by demand considerations for bank loans.

To begin with the first requirement, we argue that the sovereign debt crisis was an unanticipated shock that hit the Portuguese banking system. The Greek events fundamentally and unexpectedly changed market participants' risk appetite for sovereigns and made them more cautious about the quality of their fundamentals. This led to a sharp increase in spreads of bond yields in peripheral European countries. The lack of confidence and the uncertain economic climate surrounding Greece's financial situation raised concerns regarding the economic stability of Europe and the possibility of a contagion in other European economies. As a consequence, Portuguese banks suddenly lost access to international medium and long term wholesale debt markets, which represented an important source of their funding (Alves et al. (2016)). Importantly, the crisis of the Portuguese banking system did not originate from a domestic real estate bubble. Therefore banks were not adversely affected by loses on mortgages and firms did not witness substantial reductions in commercial property prices.

The upshot is that the balance sheet of Portuguese banks was affected by an exogenous and unanticipated shock.

For identification of credit supply we use the exhaustive credit register managed by the Banco de Portugal, matched with firm- and bank-level balance-sheet data. We select firms that have a relationship with more than one banks and include firm fixed effects to control for firm-specific loan demand effects in the spirit of Khwaja and Mian (2008). In our sample, 82% of firms have multiple bank relationships which is a common feature in other comparable data-sets used in the literature both in Portugal and elsewhere (see Alves et al. (2016) and Degryse et al. (2009)).[7] [8] Finally, to further mitigate endogeneity concerns, all bank and firm variables are included at their levels prior to the bank funding shock.

3.2 Supply of credit

To identify the real effects of the bank lending channel, one needs to take into account the credit supply effects at the bank-firm level. We follow the established empirical literature on credit supply using the Khwaja and Mian (2008) technique to identify the effect of a bank liquidity shock on credit supply accounting for observed and unobserved determinants of credit demand.[9] The underlying idea behind this approach is that using detailed credit register data, one can focus on a sample of firms with bank relationships and regress credit growth at the bank-firm level on the bank funding shock and a set of bank-specific characteristics while controlling for credit demand by including a set of firm fixed effects. The estimated equation is as follows:

[7] We also employed the technique proposed by DeJonghe et al. (2016) to construct location-sector-size fixed effects which allows us to consider both single and multiple bank relationships. Our results were robust to this modification.

[8] Farinha and Santos (2002) using Portuguese data find that firms with greater growth opportunities, less liquidity, or greater bank dependence are more likely to switch to multiple bank relationships.

[9] Other studies that have used this approach include Amiti and Weinstein (2011); Degryse et al. (2016) and Cingano et al. (2016).

$$\Delta L_{ib} = \beta_1 BankShock_{ib} + \beta_2 Y_b + \alpha_i + \epsilon_{ib} \tag{3.1}$$

where the dependent variable is the firm-bank logarithmic difference between the post-shock averaged and the pre-shock averaged values of credit granted to firm i by bank b. The *Bank Shock* represents the funding shock measured at the relationship level. Following DeJonghe et al. (2016), we define the shock as the average value of interbank liabilities plus deposits in 2011 (post-shock) minus the average value in 2009 (pre-shock), scaled by the average total assets pre-shock. We calculate a weighted funding shock using the share of each bank in a firm's loan portfolio in 2009. Y is a vector of time-averaged pre-determined bank-specific covariates such as size, non-performing loans and lending relationships (see section 3.5 for detailed definitions). α_i is a firm fixed effect which controls for all observed and unobserved heterogeneity (firm-level credit demand, firm's quality, riskiness etc). In this context, we can separate credit demand from credit supply and the coefficient on β_1 indicates the extent to which banks with varying degrees of funding outflows lowered credit growth to the same borrower. Finally, we cluster the standard errors at the bank level.

3.3 Firm survival

To evaluate the effect of bank shocks on firm survival, we estimate regressions of firm survival as a function of the funding shock as well as firm and bank financial variables. We initially estimate the following model:

$$Pr(Fail_i = 1) = F(a_0 + a_1 BankShock_{ib} + a_2 X_i + a_3 Y_b + v_s + \epsilon_i) \tag{3.2}$$

where *Fail* is a dummy variable that equals 1 if firm i exits between 2009 and 2011, and 0 otherwise. We follow the empirical literature on firm survival and identify a firm exit as a firm closure. The time of exit is found by identifying the moment in which firms cease to report IES information. We require that a firm is absent from the survey for at least two

years in order to identify an exit because temporary non-reporting may occur for a number of reasons other than cessation of activity.[10] $F(.)$ denotes the standard normal distribution function. Vectors X and Y denote a set of firm and bank control variables, respectively, that are likely to be influential in firms' chances of survival. v_s is a set of industry fixed effects to control for industry-specific changes. The standard errors are clustered at the bank level. In addition, we control for all observed and unobserved firm heterogeneity (including changes in firm-specific credit demand) by employing a set of estimates of firm fixed effects (α_i) from Model (3.1), as in Bonaccorsi and Sette (2016) and Cingano et al. (2016).

3.4 Firm characteristics

As noted above, in vector X we control for a number of firm-specific characteristics that were found important in influencing firm survival. It is recognised that a firm's size plays an important role in determining firm performance, (Clementi and Hopenhayn (2006)), and is expected to decrease the incidence of failure. Large firms tend to face lower barriers in accessing the capital markets, while smaller firms with more severe information problems tend to face a higher risk of insolvency and illiquidity and consequently a higher risk of failure (Mata and Portugal (1994); Audretsch and Mahmood (1995) and Dunne et al. (1998)). Hence, we introduce size ($Size$) measured as the logarithm of the firm's real total assets.[11]

Firm Age is measured by the number of years since the date of incorporation. Firms with an established track record are more likely to perform better than those that are younger because they are usually more able to withstand past economic and financial downturns and therefore face a smaller liquidation risk.[12]

Considering the likely response of leverage ($Leverage$), as measured by the firm's long-

[10] While we are unable to distinguish exits from mergers and acquisitions (M&A) due to the nature of the data, we note that the latter represents a very small fraction in the data. According to Banco de Portugal statistics, M&A over the sample period range from 0.8% to 2% of all firm exits. Given that M&A are typically observed for larger firms (Moeller et al. (2004)) and our data is made up mainly by micro and SMEs, we expect to cover a negligible fraction of M&A in our data.

[11] We have considered to incorporate its square to allow for non-linearities but the results remain unchanged.

[12] In untabulated regressions we employed AGE^2 to control for nonlinear effects without any changes to our main findings.

term debt to total assets, we remark that high levels of existing debt are associated with a worse balance sheet situation, which would increase moral hazard and adverse selection problems, and lead to the inability of firms to obtain external finance at a reasonable cost (see Levin et al. (2004)). Zingales (1998), Bridges and Guariglia (2008); Huynh et al. (2010) and Tsoukas (2011) show that highly leveraged carriers, start-ups and domestic firms are less likely to survive. We expect therefore a negative relationship between leverage and firms' probability of survival.

As an additional financial indicator we include a measure of tangible assets, which indicates the firm's ability to pledge collateral for debt finance ($Collateral$). Firms can raise external finance by pledging the underlying productive assets as collateral. In the event that the firm reneges on its debt, creditors will seize those assets. Collateral has also been found to affect firms' chances of survival. Bridges and Guariglia (2008) and Tsoukas (2011) document that firms with a larger fraction of tangibles in their balance sheets are more likely to survive for a longer period of time. Thus, we expect a negative relationship between collateral and the incidence of failure.

The coverage ratio ($Coverage$) is defined as earnings before interests and taxes and depreciation over interest paid to measure a firm's ability to meet interest rate obligations using profits. It is widely recognized that internal funds can serve as a buffer to absorb unexpected losses, reducing the probability of insolvency and, therefore, the expected bankruptcy cost (see Bunn and Redwood (2003) and Bridges and Guariglia (2008)). We therefore expect to find coverage to decrease the probability of failure.

3.5 Bank characteristics

We follow the literature and control for several bank-specific characteristics in vector Y. We define *bank size* as the logarithm of the total assets of the bank. Next, we control for non-performing loans (NPL) by taking the fraction of loans that are in default as a fraction of the bank's total assets. Jiménez et al. (2011) and Iyer et al. (2013) find that heterogeneity

in bank balance sheet strength affects credit supply especially during crisis periods. Low liquid and small banks or banks with high NPL are more likely to cut credit. We expect to see a negative relationship between bank size and firms' chances of failure, while a positive association between NPL and firms' propensity to fail.

Following Iyer et al. (2013) we examine the role of firm-bank relationships through the inclusion of the following dummy variables: The *New lending* relationship, and *Term. lending* which captures termination of an existing relationship. To start with the former measure, evidence shows that firms' access to new credit in the banking system is worsened by bank liquidity problems. We should expect an increase in new credit to be interpreted as a good signal for the creditworthiness of the firm which in turn might have a positive impact on firm performance. Further, small and illiquid banks and those with high NPL are more likely to terminate an existing relationship with a company. Thus, a rise in the level of lending termination should have a negative effect on our dependent variable.

3.6 The role of firm heterogeneity

In this section we explore how firm heterogeneity is likely to affect the impact of funding shocks on firm exits. We hypothesise that banks may allocate credit to firms according to their overall performance and therefore non-linearities may be present. Put differently, banks can be selective in credit supply, with low performing firms receiving little or no funding at all. To test for this hypothesis we split our firms using three sorting devices. First, we rely on credit lines to study credit line drawdown activity. We are able to identify firms that have outstanding and undrawn credit lines on a monthly basis. The literature on credit lines suggests that bank credit lines can work as substitutes for internal funds by allowing firms to access pre-committed financing up to a certain quantity in exchange for the payment of a commitment fee (see Almeida et al. (2014)). Credit lines can be thought of as a source of liquidity (Lins et al. (2010) and Tsoukalas et al. (2017)) as they can help firms to weather adverse economic events (Campello et al. (2011)). In our context, credit lines drawdown

is likely to reflect firm demand for credit. Hence, we argue that firms that have used their credit lines are less likely to preform well compared to those which have undrawn bank credit lines. As such, line drawdown activity can be considered as an additional layer of exogeneity that can provide a clean identification in our models.

Next, we split firms according to their probability of default, as measured by the z-score. This is a bankruptcy risk indicator developed by the Bank of Portugal using information from the central credit register and comprehensive balance sheet data (Antunes et al. (2016)). As a rule, higher values of the z-score indicate a higher level of the firm's risk. By employing the z-score, we not only assess whether there is a differential effect of bank funding shocks on firm exits based on riskiness, but we also control for loan evergreening. In particular, there are examples of banks that provide credit to "bad" firms to avoid the case of loan defaults, even if these firms are considered as the weakest borrowers (see for example Albertazzi and Marchetti (2010)).

We also sort firms based on their age, which is defined as the time elapsed since the incorporation date of the company. The extant literature on financial constraints has focused its attention on younger firms which may be more vulnerable to credit shocks due to lower transparency, lack of track record reputation or limited ability to pledge collateral (Gertler and Gilchrist (1994)).

The above considerations motivate regressions including interactions for the credit lines, z-score and age dummies. Therefore, we interact our bank shock indicator as follows: $Bank\ Shock{*}Dummy$ and $Bank\ Shock{*}(1 - Dummy)$, where $Dummy$ is a dummy variable indicating in turn firms which have maxed out their lines of credit, high risk or young firms. For the credit lines, the dummy takes the value one if a firm has taken all the credit available before the shock. For the z-score, the dummy for riskier firms takes the value one if the pre-shock z-score is above the median z-score of all the firms in that particular industry and year. For age, the dummy for younger firms takes the value one if the pre-shock age is below

the median age of all the firms in that particular industry and year.[13] All these variables are set in the pre-shock period (i.e the are predetermined with respect to the 2010 sovereign debt crisis). We augment model (3.2) as follows:

$$Pr(Fail_i = 1) = F(a_0 + a_1 BankShock_{ib} * Dummy_i + a_2 BankShock_{ib} * (1 - Dummy_i) + a_3 X_i + a_4 Y_b + v_s + \epsilon_i) \tag{3.3}$$

If our hypothesis were true, when a banking funding shock takes place, we should expect high risk, young firms and those that have drawn down their credit lines to be more severely affected than their counterparts. Therefore, the coefficients associated with $Shock*(1 - Dummy)$ should be smaller than those associated with $Shock*Dummy$.

4 Data and summary statistics

4.1 Data description

We use proprietary administrative data from the Portuguese central bank containing detailed, high-quality matched firm-bank information. We have data on credit relationships and balance sheets for both firms and banks before and after the sovereign debt crisis. The data-set is made up by three main sources which are briefly illustrated below.

We rely on the Central Credit Register (CRC) of Banco de Portugal in order to get information on the loan level for the period 2005 to 2014. This comprehensive data-set records all commercial and industrial loans granted to nonfinancial publicly limited and limited liability companies by all banks operating in Portugal. The threshold for reporting loan information is 50 euros, hence the credit register records the universe of outstanding loans to corporations and individuals.[14] This database contains information about the type

[13] All our results were robust to using different cut-off points both for criteria

[14] It is a requirement for all financial institutions granting credit in Portugal to report all loans above 50 euros to CRC on a monthly basis. This is an appealing characteristic of the data-set as we sidestep potential problems of bank credit provision, especially for entrepreneurial finance (see Iyer et al. (2013)).

of loan, the debtor and the amount, while also including information on loan defaults and renegotiations, as well as potential credit liabilities associated with irrevocable commitments.

We use the Monthly Financial Statistics data to match all loans with the corresponding bank-specific characteristics. This database reports banks' balance sheet and income statements for financial institutions operating in Portugal. We mainly rely on the following bank balance sheet variables bank size, profits, liquidity, nonperforming loans, credit relationships, and interbank borrowing. The bank-level data are reported on a monthly frequency.

Balance sheet and income statements are taken from the Informcao Empresarial Simplicada (IES) which covers the entire universe of Portuguese non-financial firms. The firm-level data are reported on an annual frequency. Following normal selection criteria used in the literature, we excluded companies that did not have complete records on our explanatory variables and firm-years with negative sales. To control for the potential influence of outliers, we excluded observations in the one percent from upper and lower tails of the distribution of the regression variables. Our panel includes 1,590,203 firm-bank observations with 492,208 firms. Finally, there are 24 financial institutions that were active in the loan market.

4.2 Sample analysis

By way of preliminary analysis we present in Table 1 descriptive statistics for the variables used in the regression models. We report these values for the whole sample. We have 1,590,203 bank-firm-year observations. Over the sample period, the statistics show that the average bank shock is equal to -3.9% indicating an outflow, while the average growth in credit granted is positive at 0.3% with a cross-sectional variation as evidenced by the standard deviation equal to 4.79%. The latter statistic indicates that some firms experienced a substantial drop in their credit exposures, while other increased their uptake of credit. Moving to the extensive margin of credit, we observe that 36.3% of the bank-firm relationships were new, meaning that they did not exist before the shock. We also observe that 24% of the bank-firm relationships were terminated before the shock.

The middle panel of Table 1 reports bank-level summary statistics and shows that our sample is made up by 24 credit institutions. The bottom panel reports firm-level statistics. At the firm-level, our data-set consists of more than 330,000 firm-year observations. We find that the exit rate for firms in Portugal takes the value 27%, implying a relatively high number of exits.[15]. In addition, the average firm in our sample is sixteen years old, with a median of thirteen years. The mean leverage ratio is 24.6% with a median of 20.2%. Finally, the average firm is well collateralised with a ratio of 28%.

To provide a simple visual account of the trend of outflows in the Portuguese banking sector we present Figure 1. We observe that bank funding (measured by interbank liabilities and deposit funding) was approximately 2200 billion euro in year 2009 and dropped to its lowest point in the sample period in year 2011 (1600 billion euro). Therefore, taking the year 2010 as the shock period, which corresponds to the beginning of the sovereign debt crisis, we can see that the gap before and after the shock is substantial.

Figure 2 illustrates the evolution of firm exits over the sample period distinguishing between firms with above and below-median exposure to the bank shock. It shows that firms exposed to the funding outflow experienced consistently higher number of failures compared to their counterparts. Moreover, the gap between the two groups further widened from 2010 onwards.

5 Results

5.1 Supply of credit

A basic premise of this study is that the European (sovereign) debt crisis has created significant loan disruptions in Portugal. To assess this claim, we begin our inquiry by estimating models of credit supply growth at the bank-firm level. In other words, we evaluate the

[15]The evolution of failure rates, however, as shown in Figure 1 below, is in line with those presented in Bulletin (2017)

variation in credit growth from banks with different exposure to the funding shock to the same firm. Table 2 reports findings about the effect of a funding outflow on credit growth. As mentioned above, we separate credit demand from credit supply using firm fixed effects following Khwaja and Mian (2008).

We present results when the funding shock is included on its own (column 1) and when the model is augmented with bank-specific characteristics (column 2). The findings point to a strong reduction of credit growth following a funding outflow since the coefficients on both models are statistically significant at the one percent level. Specifically, firms that borrow from banks affected by a funding outflow face a tighter credit supply. This finding is not only statistically but also economically important: given that the total amount of credit granted before the shock was 82 billion euro, the point estimate of 1.47, implies a reduction of credit to the average firm by 5.7 percent. Hence, this translates to a drop in credit availability of 4.7 billion euro. This finding is in line with DeJonghe et al. (2016), who show a similar reduction of credit growth in Belgium following the collapse of Lehman brothers. However, our analysis is based on a much broader sample compared to the above mentioned study and includes micro and small firms, which are likely to be bank-dependent. In sum, we show that highly affected banks, which experience a funding outflow, reduce lending more relative to less affected banks to the same borrower. Therefore, consistent with our expectations, and previous literature, negative funding shocks adversely affect banks' supply of credit.

5.2 Firm performance

Having documented a significant reduction of credit to firms (controlling for firm demand) following the funding outflow, we now shift our attention to the real effects of the bank funding shock.

We first estimate a baseline model of business failure as shown in Equation (3.2). The results are shown in Table 3. In column 1, we report results without controlling for credit demand, while in column 2 we follow Bonaccorsi and Sette (2016) and Cingano et al. (2016)

and control for credit demand by incorporating firm-level dummies estimated in the credit supply regressions reported in Table 2. As can be seen, our results remain unchanged after including a control for credit demand. The point estimates on bank shock suggest a robust relationship between funding shocks and the chances of firm failure. The bank shock attracts a positive and highly significant coefficient for both models reported in the Table, which enables us to assess the impact of a ceteris paribus increase in bank shock on the hazard of exit. The results show that firms borrowing from banks that experience a funding shock are more likely to face a higher probability of exit. In terms of economic magnitude, let us consider the marginal effect obtained from the coefficient on bank funding shock as shown in column 2 of Table 3. It indicates that the average firm in our sample which borrowed from a bank that experienced an outflow of 3.9%, faced an increase in the probability of failure by 1.72 percentage points. This finding lends support to our hypothesis that an exogenous shock to the bank supply, such as the European sovereign debt crisis, negatively affects firms' chances of survival. Put differently, firms borrowing from banks exposed to a funding outflow are more likely to fail.

Next, we focus on the firm-specific control variables used in the models. We find that the coefficients of *Size*, *Age*, and *Leverage* are all mostly significant and precisely determined. Larger and older firms are less likely to exit consistent with Mata and Portugal (1994); Audretsch and Mahmood (1995) and Dunne et al. (1998). We also document that leverage is negatively associated with the probability of exit, implying that firms with high debt capacity have improved chances of survival. These findings, overall, show that firm healthiness plays a crucial role, and are in line with several studies that highlight the role of balance sheet healthiness in corporate outcomes (see for example Zingales (1998); Clementi and Hopenhayn (2006) and Tsoukas (2011)).

Moving to the bank-specific characteristics, we find that firms that terminated their lending relationships as of 2009, are associated with higher chances of firm failure. There is also evidence that firms which have established a new lending relationship before the shock

are more likely to fail.

5.3 Are firms affected in a proportional manner?

We now consider the impact of financial constraints on the response to bank shocks in Table 4. This question has not yet been addressed using firm-bank data for firms' survival prospects. We use three different categorization methods for determining whether a firm is constrained or unconstrained based on bank credit lines, default probability and age. We interact the funding shock with the dummies capturing firm-level heterogeneity. This test allows us to disentangle the impact of the funding shock on firms' chances of closure between different types of firms. Our results are remarkably consistent across these categories.

Table 4 presents estimates for the interaction terms between bank shock and financial constraint dummies. The results reveal the heterogeneity between firms that is masked in the estimates for the full sample. In the first column we report point estimates using bank credit lines a sorting device, while in subsequent columns we rely on z-score and age. Bank shock negatively influences survival chances for constrained firms, but not for unconstrained firms, where in fact an insignificant relationship is estimated. In other words, we find that experiencing a bank shock is likely to increase the chances of exit proportionally more for firms that have maxed out their credit lines, are riskier and younger compared to their counterparts. Based on the extracted marginal effects, the impact of a funding shock of 3.9% leads to an increased probability of failure by 0.95 percentage points for firms that used their credit lines or by 1.22 percentage points for young companies.[16] This can be justified since financially constrained firms are associated with the higher degree of information asymmetry and are less able to find alternative sources of finance when they borrow from banks that are strongly affected by a funding shock.

We conclude that the hazard of exit raises for financially constrained firms when they borrow from banks exposed to funding shocks, but unconstrained firms remain unaffected.

[16] We do not calculate the economic importance for the interaction terms with the unconstrained group of firms as they are not statistically different from zero.

In addition, the point estimates across the interaction terms are significantly different from each other for all three classification methods. Lastly, other variables show the expected signs and retain their significance in most cases.

To sum up, we provide new evidence, that firms which are more likely to be financially constrained, by any definition we used, show greater sensitivity to bank shocks. The reported results allow us to see how clear cut this effect is in the data. Our results underline the role of firm-level heterogeneity found to be important in influencing firms' real activities such as investment, inventory and employment.[17] We find that this also the case for firm exits which are more sensitive to bank shocks for constrained firms than for unconstrained firms. This is a new result that complements the earlier work and highlights the role of capital market imperfections in analysing the real effects of the sovereign debt crisis in Portugal.

6 Alternative bank shocks

6.1 Sovereign exposure

Our findings so far indicate that the main channel through which shocks are transmitted to firms is the interbank or deposit funding outflows at banks operating in Portugal. Do these findings extend to a different channel of transmission of shocks? To answer this question, we start by exploring banks' sovereign holdings as a fraction of their total assets to measure sovereign exposure. This measure will uncover an alternative channel of transmission of shocks from the financial to the real sector, namely the sovereign debt channel. Similar measures of firm exposure to the sovereign through its lenders have been used in previous studies (Bottero et al. (2015) and Barbosa (2017)).

We re-estimate models (3.2) and (3.3) using the sovereign exposure as an alternative measure of the bank shock. The results are reported in Tables 5 and 6. To begin with the direct effect of the sovereign exposure, shown in Table 5, we find that firms borrowing from

[17] See Bond and VanReenen (2006) for a survey.

institutions with greater sovereign exposures experience a higher probability of failure. This indicates the heightened uncertainty and market tensions in the euro area sovereign debt markets and the sharp increases in sovereign bond yields have had a real impact on company failures. Further, when we split our sample to financially constrained and unconstrained groups, as shown in Table 6, we find that firm-level heterogeneity is persistent. In other words, we document an indirect effect (through interactions with dummies for financial constraints) of bank sovereign exposures on firm survival. Therefore, similar to our results for funding outflows, firms whose lenders have had higher sovereign debt securities holdings at the end of 2009 tend to perform worse and this effect is found to be stronger for the financially constrained group of firms. In summary, our main results are robust to an alternative channel of transmission of shocks from the financial to the real sector, namely the banks' holdings of sovereign debt.

6.2 The European capital enhancement exercise

We now shift our attention to a capital exercise announced by the European Banking Authority (EBA).[18] One might wonder whether the sovereign capital buffer imposed by the EBA can perhaps have a bearing on our findings. We refer to the initiative by the EBA in October 2011 to unexpectedly increase the minimum levels of the Core Tier 1 ratio to namely 9% by the end 2011 and to 10% by the end of 2012.[19] The timing of the exercise was unexpected as the EBA had carried-out a round of stress tests in July 2011 (see Gropp et al. (2016)). The objective of the exercise was to restore confidence in the EU banking sector by ensuring that banks were adequately capitalised to insure against unexpected losses. Only a sub-set of Portuguese banks were subject to the EBA intervention and had to meet these criteria. To this effect, we now investigate whether the deleveraging of the financial sector through the reinforcement of the banks' capital positions is likely to have an effect on firm

[18]The EBA is a regulatory agency of the European Union which contributes to prudential regulation and supervision across the European banking sector.

[19]In Portugal four banking groups (containing 7 banks) were affected by the EBA's rules, namely CGD, Banco BPI, BCP, and ESFG.

survival. Previous studies show that increasing the level of capital requirements is likely to contract bank lending (Brun et al. (2017) and Jiménez et al. (2017)). In our context, this exercise can be seen as a shock to banks' capital requirements that can be pass-through into the real economy.

For identification we exploit the regulatory change by the EBA. The treated group is made up by banks that were exposed to the EBA initiative and had a large capital shortfall which was determined by prior sovereign bond holdings. The remaining banks, including those not participating in the EBA regulatory change, belong to the control group. Empirically, we examine whether firms borrowing from the exposed (treated) banks were more likely to experience higher failure rates compared to firms borrowing from the unaffected (control) banks. In doing so, we estimate survival regressions in a diff-in-diff setting to tease out economic developments and policy influences. The $EBA\ Shock$ is a double interaction $treat * after$, where after is time dummy which takes a value of one for the period July 2012 onwards, and zero otherwise. The results are reported in Tables 7 and 8. We show that the introduction of the EBA policy increased the firm-level probability of exit within the treated group compared to their control counterparts. Therefore, in line with our previous findings, the probability of failure responds significantly to a bank shock such as the introduction of the EBA initiative. In addition, when we split our firms to different groups, we find that financially constrained firms affected by the policy change face an increased probability of failure compared to similar firms in the control group. Thus, we confirm our main findings using the EBA regulatory change.

7 Conclusion

Over time, both academics and policy makers have sought to understand the determinants of company closures, focusing on balance sheet characteristics and macroeconomic indicators. Considerably less attention has been given to the potential role of bank shocks that may

be transmitted to the real sector. This is somewhat surprising given the large number of firm exits during the recent financial crisis. In addition, firm exits contribute negatively to changes in the amount of debt registered in the financial institutions' balance sheet. Our paper builds on these foundations, but focuses on bank shocks and their real effect on firm exit. Using a panel for firm-bank matched data in Portugal we find that banks experiencing a negative funding shock significantly reduced credit to firms. Importantly, deteriorating credit conditions have had a real effect. We show that firms borrowing from banks that experience a funding outflow present a higher probability of exit.

At the next stage, we explore whether the effect of bank funding shocks on firm survival depends upon firm characteristics such as credit lines drawdown activity, probability of default and age. When we split our firms according to the above criteria, we uncover significant firm-level heterogeneity. In particular, the negative effect of a funding shock is stronger for young, risky and firms that have used their potential lines of bank credit. This implies that not all firms are equally affected by bank shocks, reflecting the higher risk characteristics associated with different types of firms that are financially constrained and subject to greater information asymmetries. Our results are robust to considering alternative shocks such as banks' exposure on sovereign debt and a capital enhancement exercise.

Our results have important policy implications. If access to credit is one factor that could shield firms against closure and poor performance, then promotion of policies aimed at making low cost credit readily available to financially constrained firms, should be high on the policy makers' agenda.

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8.1 Definition of the variables used

8.1.1 Firm-bank variables

- ΔL: is the natural logarithm of time averaged credit granted post shock - natural logarithm of time averaged credit granted pre shock
- *Bank Shock*: is measured as [time averaged interbank liabilities plus deposits in 2011 (post shock) - time averaged interbank liabilities and deposits in 2009 (pre shock)]/time averaged total assets in 2009 (pre shock) * the share of each bank in a firm's loan portfolio in 2009 (pre shock)

8.1.2 Firm-level variables

- *Fail*: is a dummy that equals 1 if the firm fails, and 0 otherwise
- *Size*: denotes the pre shock natural logarithm of firms' real total assets
- *Age*: measures the pre shock number of years since the date of incorporation
- *Leverage*: is the pre shock ratio of long term debt to total assets
- *Collateral*: is the pre shock ratio of tangible assets to total assets

8.1.3 Bank-level variables

- *Bank Size*: is denoted by the time averaged pre crisis natural logarithm of the bank's total assets
- *NPL*: is given by pre shock fraction of loans that are in default as a fraction of the bank's pre shock total assets
- *Term. Lending*: is a dummy equal to 1 if the bank has terminated an existing relationship pre shock and equal to 0 otherwise
- *New Lending*: is a dummy equal to 1 if the firm has a loan from a bank that it had no relationship pre shock and equal to 0 otherwise

Figure 1: The evolution of bank funding

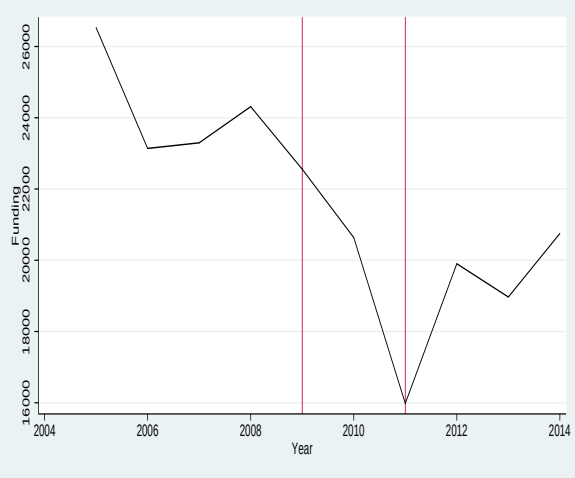

Figure 2: Number of failing firms by bank exposure

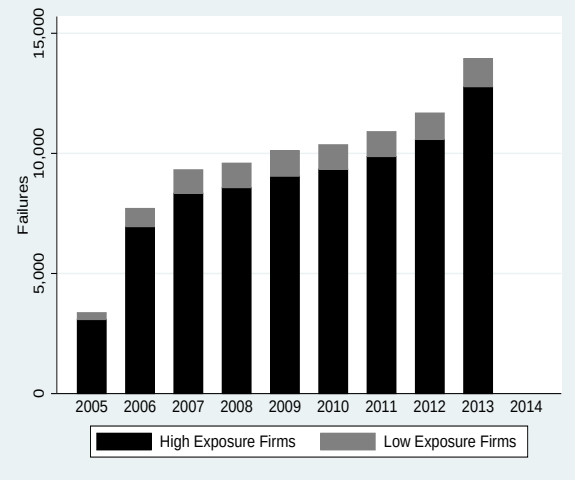

Table 1: Summary statistics

	Obs	Mean	StDev	p25	Median	p75
Bank-firm level						
Bank Shock	1,590,203	-0.039	0.075	-0.107	-0.032	0.028
ΔL	1,590,203	0.003	4.791	-6.597	0	6.940
New lending	1,590,203	0.363	0.480	0	0	1
Term. lending	1,590,203	0.240	0.427	0	0	0
NPL	1,590,203	0.004	0.006	0	0	0.004
Bank Size	1,590,203	22.680	2.317	20.927	23.179	24.623
Bank level						
New lending	24	0.416	0.147	0.401	0.378	0.431
Term. lending	24	0.224	0.053	0.217	0.200	0.251
NPL	24	0.003	0.007	0.003	0.002	0.004
Bank Size	24	22.405	0.556	22.547	22.040	22.774
Firm level						
Fail	338,644	0.270	0.443	0	0	1
Size	338,644	13.478	1.449	12.470	13.369	14.368
Age	338,644	16.392	12.885	8	13	22
Leverage	338,644	0.246	0.220	0.080	0.202	0.424
Collateral	338,644	0.279	0.226	0.089	0.225	0.359

Notes: The table presents summary statistics. *Bank Shock* is the average value of interbank liabilities plus deposits post-shock minus the average value pre-shock, scaled by the average total assets pre-shock and weighted by the bank-firm pre-shock lending relationship. ΔL is the firm-bank logarithmic difference between the post-shock averaged and the pre-shock averaged values of credit granted to firm i by bank b. *New lending* is a dummy variable if the firm has a loan from a bank that it had no relationship pre shock. *Term. Lending* is a dummy variable if a bank has terminated an existing relationship as of 2009. *NPL* measures the fraction of loans that are in default as a fraction of the bank's total assets pre shock. *Bank Size* is the time averaged pre crisis natural logarithm of the bank's total assets. *Fail* is a dummy that equals 1 if firm i fails, and 0 otherwise. *Size* is measured by the firm's pre shock logarithm of real total assets. *Age* is calculated as the pre shock number of years since the date of incorporation. *Leverage* is measured as the pre shock firm's total debt to assets ratio. *Collateral* is the ratio of the pre shock firm's tangible assets to its total assets. Variables are measured in thousands of euros.

Table 2: Bank shock and supply of credit

	(1)	(2)
Bank Shock	1.867**	1.473**
	(2.27)	(2.14)
New Lending		0.846***
		(8.66)
Term. Lending		-1.013***
		(-8.92)
NPL		0.070
		(1.45)
Bank Size		0.004
		(0.35)
Observations	1,590,203	1,590,203
Firm fixed effects	Yes	Yes

Notes: The Table presents OLS regressions, where the dependent variable is the change between the post-shock averaged and the pre-shock averaged values of credit. *Bank Shock* is the average value of interbank liabilities plus deposits post-shock minus the average value pre-shock, scaled by the average total assets pre-shock and weighted by the bank-firm pre-shock lending relationship. *New lending* is a dummy variable if the firm has a loan from a bank that it had no relationship pre shock. *Term. Lending* is a dummy variable if a bank has terminated an existing relationship as of 2009. *NPL* measures the fraction of loans that are in default as a fraction of the bank's total assets pre shock. *Bank Size* is the time averaged pre crisis natural logarithm of the bank's total assets. Robust t-statistics are presented in parentheses. Standard errors are clustered at the bank level. *significant at 10 %; ** significant at 5 %; *** significant at 1 %.

Table 3: The effect of bank shocks on corporate failures

	(1)	(2)
Bank Shock	-0.563**	-0.589**
	(-2.19)	(-2.26)
Size	-0.048***	-0.044***
	(-15.90)	(-12.60)
Age	-0.002***	-0.002***
	(-4.90)	(-5.02)
Leverage	-0.020	0.044***
	(-1.56)	(4.14)
Collateral	-0.005	-0.014
	(-0.57)	(-1.09)
New Lending	0.570***	0.545***
	(13.83)	(12.50)
Term. Lending	0.160***	0.200***
	(8.23)	(8.70)
NPL	0.071*	0.071*
	(1.74)	(1.70)
Bank Size	-0.007	-0.009
	(-0.57)	(-0.70)
Observations	338,644	338,644
Industry fixed effects	Yes	Yes
Credit demand	No	Yes

Notes: The Table presents probit regressions, where the dependent variable is a dummy equal to 1 if the firm fails, and 0 otherwise. *Bank Shock* is the average value of interbank liabilities plus deposits post-shock minus the average value pre-shock, scaled by the average total assets pre-shock and weighted by the bank-firm pre-shock lending relationship. *Size* is measured by the firm's pre shock logarithm of real total assets. *Age* is calculated as the pre shock number of years since the date of incorporation. *Leverage* is measured as the pre shock firm's total debt to assets ratio. *Collateral* is the pre shock ratio of the firm's tangible assets to its total assets. *New lending* is a dummy variable if the firm has a loan from a bank that it had no relationship pre shock. *Term. Lending* is a dummy variable if a bank has terminated an existing relationship as of 2009. *NPL* measures the fraction of loans that are in default as a fraction of the bank's total assets pre shock. *Bank Size* is the time averaged pre crisis natural logarithm of the bank's total assets. *Credit demand* denotes firm-level dummies estimated in the regression reported in Column 2 of Table 2. Robust z-statistics are presented in parentheses. Standard errors are clustered at the bank level. *significant at 10 %; ** significant at 5 %; *** significant at 1 %.

Table 4: Firm heterogeneity and bank shocks

	(1) Credit lines	(2) Z-score	(3) Age
*Bank Shock*Dummy*	-0.085***	-0.165***	-0.139***
	(-3.80)	(-5.75)	(-4.21)
Bank Shock(1 − Dummy)*	-0.074	0.027	0.053
	(-1.09)	(0.61)	(0.68)
Size	-0.041***	-0.042***	-0.041***
	(-5.25)	(-5.34)	(-5.12)
Age	-0.002***	-0.003***	-0.002***
	(-7.31)	(-7.67)	(-7.14)
Leverage	0.051**	0.051**	0.049**
	(2.12)	(2.12)	(1.99)
Collateral	-0.017	-0.018	-0.016
	(-1.10)	(-1.14)	(-1.05)
New Lending	0.510***	0.508***	0.509***
	(40.10)	(41.90)	(42.20)
Term. Lending	0.229***	0.229***	0.229***
	(24.41)	(23.92)	(23.92)
NPL	0.260***	0.257***	0.278***
	(9.08)	(13.48)	(16.10)
Bank Size	0.016***	0.016***	0.016***
	(9.22)	(8.56)	(8.53)
Observations	317,867	317,867	317,867
Industry fixed effects	Yes	Yes	Yes
Credit demand	Yes	Yes	Yes

Notes: The Table presents Probit regressions, where the dependent variable is a dummy equal to 1 if the firm fails, and 0 otherwise. *Bank Shock* is the average value of interbank liabilities plus deposits post-shock minus the average value pre-shock, scaled by the average total assets pre-shock and weighted by the bank-firm pre-shock lending relationship. *Dummy* is a dummy variable that takes the value 1 if the firm has used all available credit (column 1), if the firm's z-score is above the median (column 2) and if the firm's age is below the median (column 3). *Size* is measured by the firm's pre shock logarithm of real total assets. *Size* is measured by the firm's real total assets. *Age* is calculated as the number of years since the date of incorporation. *Leverage* is measured as the firm's total debt to assets ratio. *Collateral* is the ratio of the firm's tangible assets to its total assets. *New lending* is a dummy variable if the firm has a loan from a bank that it had no lending relationship as of 2009. *Term. Lending* is a dummy variable if a bank has terminated an existing relationship. *NPL* measures the fraction of loans that are in default as a fraction of the bank's total assets. *Bank Size* is the log of the total assets of the bank. Robust t-statistics are presented in parentheses. Standard errors are clustered at the bank level. *significant at 10 %; ** significant at 5 %; *** significant at 1 %.

Table 5: The effect of sovereign exposure on corporate failures

	(1)	(2)
Sov Exposure	0.045***	0.046***
	(3.23)	(3.14)
Size	-0.090***	-0.091***
	(-4.99)	(-4.34)
Age	-0.001	-0.001
	(-0.79)	(-0.84)
Collateral	0.085	0.080
	(1.40)	(1.33)
Leverage	-0.075	-0.013
	(-1.00)	(-0.15)
New Lending	0.580***	0.561***
	(10.11)	(9.56)
Term. Lending	0.250***	0.311***
	(4.14)	(4.98)
NPL	0.656***	0.644***
	(3.72)	(3.30)
Bank Size	0.035	0.036
	(1.20)	(1.21)
Observations	290,419	290,419
Industry fixed effects	Yes	Yes
Credit demand	No	Yes

Notes: The Table presents probit regressions, where the dependent variable is a dummy equal to 1 if the firm fails, and 0 otherwise. *Sov Exposure* measures banks' sovereign holdings as a fraction of their total assets. *Size* is measured by the firm's pre shock logarithm of real total assets. *Age* is calculated as the pre shock number of years since the date of incorporation. *Leverage* is measured as the pre shock firm's total debt to assets ratio. *Collateral* is the pre shock ratio of the firm's tangible assets to its total assets. *New lending* is a dummy variable if the firm has a loan from a bank that it had no relationship pre shock. *Term. Lending* is a dummy variable if a bank has terminated an existing relationship as of 2009. *NPL* measures the fraction of loans that are in default as a fraction of the bank's total assets pre shock. *Bank Size* is the time averaged pre crisis natural logarithm of the bank's total assets. *Credit demand* denotes firm-level dummies estimated in the regression reported in Column 2 of Table 2. Robust z-statistics are presented in parentheses. Standard errors are clustered at the bank level. *significant at 10 %; ** significant at 5 %; *** significant at 1 %.

Table 6: Firm heterogeneity and sovereign exposure

	Credit lines	Z-score	Age
*Sov Exposure*Dummy*	0.067***	0.085***	0.062***
	(7.11)	(7.75)	(18.41)
Sov Exposure(1 − Dummy)*	0.003	0.035***	0.043***
	(0.25)	(4.43)	(4.28)
Size	-0.094***	-0.092***	-0.093***
	(-5.22)	(-5.22)	(-5.21)
Age	-0.001	-0.001	-0.001
	(-1.09)	(-1.12)	(-1.29)
Leverage	-0.010	-0.019	-0.012
	(-0.11)	(-0.21)	(-0.14)
Collateral	0.084	0.079	0.079
	(1.19)	(1.12)	(1.12)
New Lending	0.558***	0.559***	0.562***
	(13.56)	(14.10)	(14.22)
Term. Lending	0.313***	0.307***	0.312***
	(7.42)	(7.42)	(7.46)
NPL	0.580***	0.679***	0.672***
	(4.94)	(9.96)	(7.86)
Bank Size	0.038	0.035	0.036
	(1.54)	(1.43)	(1.48)
Observations	290,419	290,419	290,419
Industry fixed effects	Yes	Yes	Yes
Credit demand	Yes	Yes	Yes

Notes: The Table presents probit regressions, where the dependent variable is a dummy equal to 1 if the firm fails, and 0 otherwise. *Sov Exposure* measures banks' sovereign holdings as a fraction of their total assets. *Dummy* is a dummy variable that takes the value 1 if the firms has used all available credit (column 1), if the firm's z-score is above the median (column 2) and if the firm's age is below the median (column 3). *Size* is measured by the firm's pre shock logarithm of real total assets. *Size* is measured by the firm's real total assets. *Age* is calculated as the number of years since the date of incorporation. *Leverage* is measured as the firm's total debt to assets ratio. *Collateral* is the ratio of the firm's tangible assets to its total assets. *New lending* is a dummy variable if the firm has a loan from a bank that it had no lending relationship as of 2009. *Term. Lending* is a dummy variable if a bank has terminated an existing relationship. *NPL* measures the fraction of loans that are in default as a fraction of the bank's total assets. *Bank Size* is the log of the total assets of the bank. Robust t-statistics are presented in parentheses. Standard errors are clustered at the bank level. *significant at 10 %; ** significant at 5 %; *** significant at 1 %.

Table 7: EBA shock and corporate failures

	(1)
EBA Shock	0.057***
	(2.85)
Size	-0.014***
	(-11.45)
Age	-0.001***
	(-9.09)
Leverage	-0.005
	(-1.25)
Collateral	0.0008
	(0.19)
New Lending	0.193***
	(13.37)
Term. Lending	-0.006
	(-0.75)
NPL	0.001
	(0.77)
Bank Size	-0.005
	(-1.10))
Observations	338,644
Industry fixed effects	Yes
Credit demand	Yes

Notes: The Table presents estimates obtained using a difference-in-differences estimator, where the dependent variable is a dummy equal to 1 if the firm fails, and 0 otherwise. *EBA Shock* refers to banks affected the EBA capital enhancement exercise. *Size* is measured by the firm's pre shock logarithm of real total assets. *Age* is calculated as the number of years since the date of incorporation. *Leverage* is measured as the firm's total debt to assets ratio. *Collateral* is the ratio of the firm's tangible assets to its total assets. *New lending* is a dummy variable if the firm has a loan from a bank that it had no lending relationship as of 2009. *Term. Lending* is a dummy variable if a bank has terminated an existing relationship. *NPL* measures the fraction of loans that are in default as a fraction of the bank's total assets. *Bank Size* is the log of the total assets of the bank. Robust t-statistics are presented in parentheses. Standard errors are clustered at the bank level. *significant at 10 %; ** significant at 5 %; *** significant at 1 %.

Table 8: EBA shock and firm heterogeneity

	(1) Credit lines	(2) Z-score	(3) Age
*EBA Shock*Dummy*	0.087***	0.141***	0.173***
	(3.81)	(4.18)	(5.63)
*EBA Shock*Dummy*	0.064	0.044	0.028
	(1.03)	1.23)	(0.61)
Size	-0.042***	-0.043***	-0.041***
	(-5.26)	(-5.33)	(-5.12)
Age	-0.002***	-0.003***	-0.002***
	(-7.30)	(-7.67)	(-7.14)
Leverage	0.051**	0.051**	0.048**
	(2.12)	(2.12)	(1.99)
Collateral	-0.017	-0.018	-0.016
	(-1.12)	(-1.14)	(-1.05)
New Lending	0.509***	0.508***	0.508***
	(40.07)	(41.85)	(42.22)
Term. Lending	0.229***	0.229***	0.229***
	(24.40)	(23.92)	(23.93)
NPL	0.260***	0.257***	0.278***
	(9.08)	(13.48)	(16.10)
Bank Size	0.016***	0.016***	0.016***
	(9.21)	(8.56)	(8.53)
Observations	317,867	317,867	317,867
Industry fixed effects	Yes	Yes	Yes
Credit demand	Yes	Yes	Yes

Notes: The Table presents estimates obtained using a difference-in-differences estimator, where the dependent variable is a dummy equal to 1 if the firm fails, and 0 otherwise. *EBA Shock* refers to banks affected the EBA capital enhancement exercise. *Dummy* is a dummy variable that takes the value 1 if the firm has used all available credit (column 1), if the firm's z-score is above the median (column 2) and if the firm's age is below the median (column 3). *Size* is measured by the firm's pre shock logarithm of real total assets. *Size* is measured by the firm's real total assets. *Age* is calculated as the number of years since the date of incorporation. *Leverage* is measured as the firm's total debt to assets ratio. *Collateral* is the ratio of the firm's tangible assets to its total assets. *New lending* is a dummy variable if the firm has a loan from a bank that it had no lending relationship as of 2009. *Term. Lending* is a dummy variable if a bank has terminated an existing relationship. *NPL* measures the fraction of loans that are in default as a fraction of the bank's total assets. *Bank Size* is the log of the total assets of the bank. Robust t-statistics are presented in parentheses. Standard errors are clustered at the bank level. *significant at 10 %; ** significant at 5 %; *** significant at 1 %.