Some borrowers are more equal than others: Bank funding shocks and credit reallocation*

Olivier De Jonghe† Hans Dewachter‡ Klaas Mulier§
Steven Ongena¶ Glenn Schepens‖

Abstract

This paper provides evidence on the strategic lending decisions made by banks facing a negative funding shock. Using bank-firm level credit data, we show that banks reallocate credit within their domestic loan portfolio in at least three different ways. First, banks reallocate to sectors where they have high sector presence. Second, they also reallocate to sectors in which they are heavily specialized. Third, they reallocate credit towards low-risk firms. These reallocation effects are economically large. A standard deviation improvement in sector presence, sector specialization or firm risk reduces the transmission of the funding shock to credit supply by 20, 13 and 10%, respectively. We also provide insight in the timing of these reallocation decisions. Reallocation to sectors in which a bank has a high sector presence is almost instantaneous, while sector specialization starts playing a role four to five months after the shock.

Keywords: Credit reallocation, bank funding shock, domestic credit, sector specialization, firm risk

JEL classification: G01 G21

*The authors would like to thank Thorsten Beck, Tobias Berg, Lamont Black, Emilia Bonaccorsi di Patti, Martin Brown, Manuel Buchholz, Giovanni Dell'Ariccia, Hans Degryse, Ralph De Haas, Florian Heider, Sanja Jakovljevic, Marco Machiavelli, Ralf Meisenzahl, Lars Norden, Marco Pagano, Andrea Presbitero, Rui Silva, Hirofumi Uchida, Gregg Udell as well as seminar and conference participants at Tilburg University, the National Bank of Belgium, the Finest Workshop (Rome), the European Central Bank, the Central Bank of Ireland, the European Banking Authority, the Ghent Corporate Finance Day, VU Amsterdam, Université de Limoges, the Swiss Winter Conference on Financial Intermediation (Lenzerheide), the CEPR First Annual Spring symposium on Financial Economics (Imperial College London), the Belgian Financial Research Forum, the 5^{th} MoFiR Workshop on Banking, the EFA meetings (Oslo), the 16^{th} FDIC Bank Research Conference and the 2^{nd} IWH Halle FIN FIRE workshop. The views expressed are solely those of the authors and do not necessarily represent the views of the European Central Bank or the National Bank of Belgium.

†CentER, European Banking Center, Tilburg University, e-mail: o.dejonghe@uvt.nl

‡National Bank of Belgium, e-mail: hans.dewachter@nbb.be

§Ghent University, e-mail: klaas.mulier@ugent.be

¶University of Zurich, SFI and CEPR, e-mail: steven.ongena@bf.uzh.ch

‖European Central Bank, e-mail: glenn.schepens@ecb.europa.eu

1 Introduction

The collapse of Lehman Brothers in September 2008 was an unprecedented shock to Western banks' funding opportunities. Several papers show that banks transmitted this funding shock to both their domestic and their foreign borrowers.[1] However, recent evidence suggests that banks did not curtail credit equally across the board. For example, Giannetti and Laeven (2012) show that global banks rebalance their portfolio towards their domestic borrowers in spite of their foreign borrowers when hit by a banking crisis in their home country. De Haas and Van Horen (2012) find that banks retrenched more from foreign countries that are more distant from the bank's headquarters during the recent crisis. Liberti and Sturgess (2016) investigate the effect of a credit supply shock in the foreign credit portfolio of a large international bank and find that the bank curtailed credit more to foreign borrowers that are smaller, riskier, or that have a weaker relationship with the bank. These papers thus indicate that there is significant heterogeneity in the reallocation decisions of banks, both between their foreign and domestic credit portfolio and within their foreign credit portfolio.

While many researchers have analyzed the role that geographical specialization plays for credit reallocation after a funding shock, very few have focused on the impact of other types of lending specialization.[2] This is somewhat surprising, given the important role that loan portfolio allocation and diversification plays in many theoretical banking models (Diamond, 1984; Boyd and Prescott, 1986; Winton, 1999) and given the severe consequences that credit reallocation after a funding shock might have for the real economy (Ongena et al., 2016). Furthermore, bank regulators are often concerned about the trade-off between reducing portfolio concentration risk and having sufficient information about borrowers (See, e.g., Basel Committee on Banking Supervision, 2006). Yet, despite these considerations, it remains an open question whether reallocation effects pertain to the domestic credit portfolio of banks and, if so, what determines this reallocation.

This paper aims to fill this gap in the literature by providing a comprehensive and detailed analysis of the reallocation that banks registered in Belgium pursue within their domestic credit portfolio

[1] See Puri et al. (2011); Iyer et al. (2014) for evidence on domestic borrowers and Cetorelli and Goldberg (2011, 2012); Claessens and van Horen (2013); Cull and Martinez Peria (2013); Albertazzi and Bottero (2014); Allen et al. (2014); Bertay (2014); De Haas and van Lelyveld (2014) for evidence on foreign borrowers.

[2] Some recent papers show that bank-firm relationships shield firms from the curtailing of credit (Puri et al., 2011; Liberti and Sturgess, 2016), and that banks reallocate credit to less risky borrowers (Liberti and Sturgess, 2016) or less risky sector-region combinations (Ongena et al., 2015) after a liquidity shock.

after a negative shock to their funding. The bankruptcy of Lehman Brothers and the subsequent collapse of the interbank wholesale market had a strong impact on the Belgian financial system. As can be seen in Figure 1, the aggregate volume of interbank liabilities and bank deposits of banks active in Belgium dropped from EUR 1,000 bn in August 2008, to slightly above EUR 700 bn thirteen months after the Lehman Brothers collapse.[3] However, important for our analysis, the crisis of the Belgian financial sector did not originate from domestic shocks (e.g., a real estate shock or a collapse of the credit cycle), but originated primarily from the over-reliance on short-term funding in the international interbank market and partly from the over-exposure of some of the large Belgian banks to structured finance products (see for instance National Bank of Belgium (2009)). To identify the reallocation in the supply of credit following these funding problems, we rely on 160,224 fully documented bank-firm combinations for nearly all banks and non-financial firms active in Belgium. We combine monthly bank-firm level data from a comprehensive credit register that contains all credit granted in Belgium by all financial institutions, monthly balance sheets of these financial institutions, and annual balance sheets of all registered firms. The richness of our data allows us to study various measures of credit growth (at both the intensive and extensive margin of credit granting) and makes it possible to disentangle credit supply from demand.[4] The latter is done by saturating the corresponding loan growth specifications with a comprehensive set of fixed effects in order to control for credit demand (Khwaja and Mian, 2008; Jimenez et al., 2014).

FIGURE 1 around HERE

Using this detailed dataset, we identify reallocation effects along three different lines.[5] First, banks reallocate credit after a negative funding shock towards sectors in which they have a high sector presence (defined as the bank's share in the total credit granted to a sector). We find that a one standard deviation increase in sector presence reduces the negative impact of the funding shock on credit supply by 20% for the average firm. The explanation for this finding is that banks direct

[3] Interbank liabilities include overnight deposits, deposits redeemable at notice and term accounts of other financial institutions as well as repurchase agreements. Deposits include all deposits by households, non-financial corporations and government institutions.

[4] Importantly, we define credit as the total amount of *authorized* credit. For credit lines this implies that we look at the total amount of credit that is available, and not at the portion that is taken up by the borrower. In this way, we make sure that any changes in credit are not driven by a sudden draw down of a credit line by a borrower.

[5] The focus of the paper is on the reallocation effects, i.e., the heterogeneous transmission of a funding shock. However, we also show the average (homogeneous) effect of the funding shock on bank credit supply.

their attention to sectors where they can more easily extract rents. If lending to a sector defines a market for credit, and a higher share in a market yields market power (Winton, 1999), then high presence of a bank in a sector may make it possible to charge higher contracted interest rates (Klein, 1971; Monti, 1972).[6] As the main focus of banks during a crisis is likely on staying afloat and surviving, it makes sense to focus on sectors where they can exploit their high sector presence and extract higher rents.

Second, we find that banks reallocate credit towards sectors in which they are specialized, defined as how important a sector is for a bank (measured as the sector's share in the total credit granted by a bank). A one standard deviation increase in sector specialization reduces the negative impact of the funding shock on credit supply by 13% for the average firm. A potential explanation for this is that banks will typically have gathered more sector-specific knowledge in sectors where they are specialized, improving their screening abilities and reducing the need for costly monitoring in these sectors (Carey et al., 1998; Boot and Thakor, 2000). In order to be able to keep exploiting this information advantage –which may positively affect the probability of repayment (Boot and Thakor, 2000) and negatively affect the loss given default– banks prefer to stay more active in these sectors. This result is reminiscent of the 'flight to captivity effect' described by Dell'Ariccia and Marquez (2004), who show that banks reduce lending less in sectors where they do not have an information advantage when they are forced to curtail their loan portfolio.[7]

Third, banks hit by a funding shock reallocate credit towards safe firms. We find that banks transmit a funding shock significantly less to firms with low debt levels, high available collateral, and high interest coverage ratios. A one standard deviation decrease in firm risk (for any of these measures) reduces the negative impact of the funding shock on credit supply by on average 10%. This flight-to-quality is consistent with an increased risk-aversion during bad times (Cohn et al., 2015) and coexists with the two aforementioned reallocation effects. This again is very much in line with the theoretical work of Dell'Ariccia and Marquez (2004), who show that banks do not only reallocate credit towards more captured borrowers (i.e., borrowers in sectors in which the bank has an information advantage), but at the same time also reallocate credit towards safe firms. We do

[6] Unfortunately, interest rates are not available in the credit register. Nevertheless, we find indirect evidence of pricing power by banks with high sector presence. Firms borrowing from banks with a high sector presence have a larger pre-shock debt-burden (controlling for firm and bank characteristics).

[7] The information advantage in Dell'Ariccia and Marquez (2004) is defined as the share of borrowers in a market whose type (good vs. bad project outcome) is known by the bank. Our measure relates to this given that it is likely that you are better informed about a large share of borrowers in a sector when a large share of credit that you are granting is going that sector.

not find that banks transmit the funding shock more to smaller or younger firms.

The impact of these three reallocation effects is robust to a number of alternative explanations that might be driving loan portfolio allocation decisions. Specifically, we show that our results are not driven by geographical diversification choices, bank-specific recapitalizations or any other bank-specific, non-funding related shocks that took place during the crisis. Additionally, we show that it is unlikely that our results are driven by bank-firm specific soft information which banks might have gathered through previous interactions with a specific firm. As such, our findings indicate that sector presence, sector specialization and firm risk play a more important role than firm-specific relations when it comes to the reallocation choices of banks during a funding shock.

After documenting these three reallocation channels, we investigate whether the magnitude of the impact of funding shocks changes over time and whether the impact persists.[8] We show that the moderating impact of bank sector presence is instantaneous and stays significant until more than thirty months after the shock. Bank sector specialization on the other hand becomes important for the reallocation of credit after about five to six months, reaches a maximum after about a year, and stays significant until two years after the shock. The moderating effect of firm risk becomes significant two to three months after the shock. The effect of firms' debt levels and the interest coverage ratio stays relatively constant over time, while the effect of firms' available collateral tends to decrease slightly over time.

Finally, we also analyze the impact of the funding shock on firm investments and asset growth. Firms borrowing from banks that experience a larger funding outflow have a lower investment rate and grow slower than other firms. Importantly, this negative impact is partially offset for firms that are borrowing from banks with a high sector presence and for large firms. In economic terms, however, the real effects of the shock are rather moderate.

In sum, our main results suggest that, when faced with a negative funding shock, banks will swiftly reallocate credit according to their sector presence and specialization, and reallocate credit towards safer firms. Regarding the timing of these effects, our results indicate that banks hit by a funding shock are at first more concerned with staying afloat in the short run by focusing on

[8] The detailed timing of the reallocative impact of market-wide, bank -or borrower specific events is rarely investigated due to a lack of granular data, except in selected settings such as bank runs (Iyer et al., 2012), bank mergers and acquisitions (See, e.g., Sapienza, 2002; Focarelli and Panetta, 2003; Degryse et al., 2011) or borrower lock-in (Ioannidou and Ongena, 2010).

loans that ensure larger cash inflows (in the form of relatively high interest payments), while only being interested in long term profitability (and hence focusing on protecting their sector specific knowledge) and firm risk once these short term inflows are safe. Finally, we find some evidence that firms borrowing from affected banks have a lower investment and growth rate after the funding shock than other firms and that this effect is more moderate for firms borrowing from banks with a high sector presence and for large firms.

Our paper adds to the literature in a number of ways. First, our analysis contributes to the rapidly expanding literature on bank funding shock transmission. The existing work on funding shocks and bank lending mainly focuses on cross-border effects through global banks (Peek and Rosengren, 1997, 2000; Cetorelli and Goldberg, 2011, 2012; Claessens and van Horen, 2013; Albertazzi and Bottero, 2014; Bertay, 2014; De Haas and van Lelyveld, 2014; Liberti and Sturgess, 2016). Others have focused on the average reduction in credit induced by funding shocks (Puri et al., 2011; Iyer et al., 2014) or on the real effects of funding shocks (Ongena et al., 2016; Chodorow-Reich, 2014; Paravisini et al., 2014). We add to this literature by documenting the domestic reallocation of credit across sectors and firms.

Furthermore, by showing that banks reallocate credit according to their sector presence, this paper relates to a vast empirical literature on bank market share, market power and credit which finds not only that a higher market share recurrently leads to higher interest rates and lower credit volumes (see, e.g., Degryse et al. (2009) for a review), but also that bank market power may facilitate intertemporal subsidization and hence access to credit by small and young firms (Petersen and Rajan, 1995) or poorly performing firms, spurring their performance if they actually obtain the credit (Delis et al., 2016). We contribute to this literature by documenting that when banks face severe funding shocks, firms borrowing from banks with a higher sector presence are better protected against credit supply shocks. This finding entails important information for bank competition regulators, as it illustrates a potential benefit of bank concentration within a sector. Additionally, by showing that sector concentration matters, this result indirectly questions the strong focus of bank competition regulators and researchers on indicators that solely focus on the geographical dimension of bank competition.

The finding that banks reallocate credit according to sector specialization connects the bank funding shock transmission literature with the literature on bank lending concentration, which mainly

analyzes the link between concentration, bank performance and risk taking (Acharya et al., 2006; Degryse and Ongena, 2007; Tabak et al., 2011; Beck and De Jonghe, 2013; Jahn et al., 2013). These papers suggest that the diversification of bank assets seemingly does not guarantee to produce superior performance and/or greater safety for banks, a finding consistent with papers documenting the existence of a diversification discount in the market value of financial conglomerates (See, e.g., Laeven and Levine, 2007; Kuppuswamy and Villalonga, 2010). So far none of these papers comprehensively assesses if and how banks will reallocate credit according to sector specialization when faced with a funding shock. Similarly, previous work on this topic does not focus on the potential benefits or dangers of bank lending concentration for firms. We add to this literature by revealing a positive aspect of lending concentration, as we show that firms that are borrowing from specialized banks are less impacted by a bank funding shock. Related to this, our results emphasize that not only systemic risk and financial stability issues should be taken into account when studying the welfare implications of bank portfolio diversification (e.g., Acharya, 2009; Wagner, 2010), but that it could also be relevant to consider the impact on firm credit supply. This is also useful information for bank regulators when deciding on lending concentration limits.

The reallocation effect based on sector specialization also relates to the theoretical and empirical literature on the organization of banks (Stein, 2002) and the functioning of their internal capital markets (Stein, 1997; Inderst and Laux, 2005; Cremers et al., 2011). While these papers focus on the impact of asymmetric information on capital allocation within the bank, we focus on the role that asymmetric information plays when allocating credit across sectors and firms in a bank's loan portfolio.

Finally, our paper also relates to the literature on firm characteristics and credit constraints. Researchers have proposed various classification schemes to identify financing constraints based on firm size and age (Beck et al., 2006; Hadlock and Pierce, 2010), asset tangibility (Almeida and Campello, 2007) or leverage and cash flows (Lamont et al., 2001; Whited and Wu, 2006). We add to this literature by showing that collateral availability, leverage and interest coverage matter for loan supply when bank funding is under stress. However, we do not find any evidence that banks tighten credit supply disproportionately more for smaller or younger borrowers when their funding is under stress. We do find that a given credit supply shock matters more for investment and growth for small firms than for large firms, likely because the former have fewer alternative credit sources available.

The remainder of our paper is organized as follows. First, we discuss the data and the various measures of loan growth, bank sector presence and specialization in Section 2. Section 3 introduces the methodology, Section 4 provides the main results and robustness checks on the reallocation effects, while Section 5 provides some insights in the timing of funding shock impact and the timing of the reallocation channels. Finally, Section 6 investigates whether the funding shock has real effects on firm investment and growth and Section 7 concludes.

2 Data

We use data from the National Bank of Belgium (Belgium's central bank, henceforth NBB) and combine information from three databases: the central corporate credit register, bank balance sheets and income statements, and firm balance sheets and income statements.

2.1 Central corporate credit register

The corporate credit register compiles information on credit granted by credit institutions and other types of institutions (leasing companies, factoring companies and insurance companies) to legal entities (i.e., enterprises) and natural persons (i.e., individuals) granted in connection with their business activity. We only include credit institutions established in Belgium and licensed by the NBB. This includes both branches incorporated under foreign law established in Belgium and institutions incorporated under Belgian law. A credit institution needs to provide information to the credit register on a monthly basis on all debtors to which they have an aggregate exposure exceeding 25,000 euro. Our final sample consists of 39 credit institutions. The Belgian banking market is quite concentrated; in 2007 the share of the largest five credit institutions in total banking assets was 83 % (ECB, 2008).[9] We extract all available credit data at the bank-firm-month level but exclude firms operating in the financial or insurance sector, public administration, education, household activities or activities of extraterritorial entities. The final sample includes firms from

[9] In our empirical analysis we ensure that the absolute market shares of the banks do not impact our reallocation results by including bank fixed effects. In additional robustness checks, we also show that the banks with the largest market share are not driving our reallocation findings by dropping them from the sample.

sixteen sectors of which the five most important ones are wholesale and retail trade, construction, professional activities, real estate, and manufacturing.

2.1.1 Measures of bank-firm level credit growth

From the credit register, we calculate four different credit growth measures capturing both the intensive and extensive margins of credit. First of all, we compute a credit growth variable at the bank-firm level. Credit growth is computed as the logarithmic difference between the post-shock averaged and the pre-shock averaged values of the granted amount by a bank (b) to a firm (f), labeled Δ % Credit$_{bf}$.[10] The shock we exploit corresponds in timing with the collapse of the investment bank Lehman Brothers in September 2008 ('the shock'). We limit the pre-shock window to thirteen months to use the maximum amount of information available without interference from other shocks used in the literature (e.g., the turmoil in the ABCP market starting at the end of July 2007, as in Iyer et al. (2014)). Initially, we use symmetric windows and hence also use a thirteen month post-shock period. However, in some parts of the analysis (Section 5), we also use expanding post-shock windows varying in length between one month and 30 months to analyze the timing and time-varying magnitude of the reallocation behavior. Secondly, we create a dummy variable (Increase in credit$_{bf}$) which takes the value of one if credit growth was strictly positive and zero otherwise. Doing so, this variable emphasizes the effect on the propensity to grant extra credit. Thirdly, we create a dummy (Large decrease in credit$_{bf}$) which equals one if the firm's credit growth is in the lowest quartile of credit growth of all the bank-firm observations in the sample (corresponding with a reduction of 15.37% or more). Likewise, this variable proxies for granted amounts that have been reduced substantially, or matured without having been rolled over. These measures provide information on the intensive margin of bank-firm relationships. Our fourth measure is a dummy (New relationships$_{bf}$) that equals one if a firm has credit granted from a bank at the end of the post-shock period and did not have credit granted from that bank the month prior to the Lehman default. In sum, we will not only test the impact of interbank funding shocks on actual loan growth and two related discrete measures of loan growth, but we will also investigate the impact of funding shocks on banks' propensity to generate new bank-firm credit relationships. Information on the construction of the variables is reported in Table 1, whereas summary statistics

[10] To avoid serial correlation in the standard errors, we first average the monthly data to obtain one pre-shock observation and one-post shock observation at the bank-firm level (Bertrand et al., 2004). The empirical approach is also similar in setup to Khwaja and Mian (2008).

are reported in Table 2.

TABLES 1 and 2 around HERE

The average growth in credit granted is slightly negative at -2.37%, mainly due to amortizations. However, there is substantial cross-sectional variation, with a standard deviation of 27.8%, indicating that some firms witness substantial drops in their credit exposures (due to outright cuts or lower likelihood of renewals or roll-overs), whereas other bank-firm exposures grow substantially. Almost 30% of the pre-crisis bank-firm credit exposures increase after the Lehman collapse. Regarding the extensive margin of credit, we find that 14.4% of the bank-firm relationships that exist at the end of the post-shock window, did not exist before the shock.

Our full sample consists of 160,224 bank-firm observations involving 134,368 firms. More than 84% of the 134,368 firms borrow from only one bank. Firms borrowing from more than one bank typically borrow from two banks, with a maximum of eight banks. This makes that the average (median) firm in our sample has 1.19 (1) bank relationships borrowing an average total amount of 230,960 euro.

2.1.2 Bank sector presence and bank sector specialization

The credit register also allows us to compute bank-sector specific measures of market presence and portfolio specialization. More specifically, we construct two measures from the bank's perspective: *sector presence* and *sector specialization*. The sector presence of bank b in sector s in (1) is defined as the ratio of all credit granted from bank b to sector s relative to credit granted by all banks to sector s. The higher the bank sector presence, the more dominant a bank is in a given sector.

$$Bank\ sector\ presence_{bs} = \frac{\sum_{f=1}^{F} L_{bfs}}{\sum_{b=1}^{B}\sum_{f=1}^{F} L_{bfs}} \tag{1}$$

where L_{bfs} is the credit granted by bank b to firm f in sector s and F (B) is the total number of firms (banks).

The sector specialization of bank b to sector s is defined as the ratio of all credit granted from bank b to sector s relative to bank b's total credit granted. The higher the bank sector specialization, the more important a sector is for a given bank and the more likely that the bank will invest a lot of monitoring skills in that sector.

$$Bank\ sector\ specialization_{bs} = \frac{\sum_{f=1}^{F} L_{bfs}}{\sum_{s=1}^{S}\sum_{f=1}^{F} L_{bfs}} \tag{2}$$

Bank sector presence is thus the importance of a bank for a sector, while bank sector specialization is the importance of a sector for a bank. Note that both variables vary at the bank-sector level. In our empirical set up the bank sector presence and the bank sector specialization are time averaged, in line with the treatment of the credit supply measures. Moreover, we take the pre-shock time averaged values which are denoted as Bank sector presence$_{bs}$ and Bank sector specialization$_{bs}$.

The average bank sector presence in the sample is 0.185 which is consistent with the observation that the four biggest banks in Belgium grant the large majority of credits. The average bank in the sample is active in eight sectors as can be seen in Table 2 for bank sector specialization (0.130). The average bank sector specialization at the bank-sector level, however, is a bit lower (0.094) indicating that the biggest banks in the sample tend to be characterized by a higher degree of bank sector specialization even though they are active in all sixteen sectors. The correlation between sector presence and sector specialization is small and insignificant (-0.023).

2.2 Bank balance sheet and income statement

Credit institutions established in Belgium report to the NBB on their financial position via the so-called 'Schema A'. We use the unconsolidated statements to include only the Belgian activities and operations of Belgian and foreign banks. We gather monthly data for the 39 banks active in our sample. Akin to the treatment of the credit register data, we average this bank level data over time to obtain a pre-shock and post-shock average. The funding shock is defined as the average value of interbank liabilities plus deposits post-shock minus the average value pre-shock, scaled by the average total assets pre-shock. We choose to include both interbank liabilities and deposits in our funding shock measure. The reason for this is that the Lehmann collapse did not only cause turmoil in interbank markets all around the world, but also caused a general confidence shock for banks. The increased uncertainty about the stability of banks may thus also have caused a contemporaneous outflow of deposits. This is closely related to what Dornbusch et al. (2000) and Wiggins and Metrick (2015) describe as the 'correlated information channel'. Hence, by including deposits we allow for a broader impact of the Lehman event on bank funding conditions. Importantly, robustness tests

where we solely focus on the change in interbank liabilities lead to very similar results. The average borrower's bank experienced a funding outflow (relative to pre-shock total assets) of 9.2% (See Table 2). The worst funding shock corresponds with an outflow of 19.9%, but many banks also witness a funding inflow. There is thus a substantial cross-sectional variation in the funding shock which we can exploit.

The control variables obtained from the banks' balance sheet and income statement capture banks' pre-crisis characteristics (i.e., pre-crisis time-average). The bank characteristics we consider are banks' reliance on interbank funding (interbank liabilities to total assets), bank capitalization (common equity to total assets), bank profitability (return on average equity), credit risk (write-offs to total loans), interbank lending (interbank assets to total assets), stable deposit funding (demand and savings deposits to total assets) and bank size (natural logarithm of total assets).

2.3 Firm balance sheet and income statement

Belgian corporations file their balance sheets and income statements to the NBB, which collects all the information and performs a number of consistency checks on the reported balance sheets and income statements. Almost all Belgian firms incorporated under limited liability (irrespective of their size) are obliged to make this information public and report to the NBB. The most notable exceptions are sole traders or corporations whose legal situation implies an unlimited liability for the owner in case these corporations are not large.

We match the last available firm balance sheet and income statement data prior to the shock with bank-firm credit exposures and bank balance sheets. From the $134,368$ firms that are present in the credit register, 119,407 file balance sheets. Table 2 shows that the average firm filing a balance sheet in our sample is thirteen years old, with 545,796 euro assets and a total credit of 185,350 euro. The average leverage ratio in the sample is 72.6%. The average coverage ratio shows that total interest payments take up 73.2% of EBIT. Finally, Table 2 shows that the median pledged collateral is zero, but the average pledged collateral amounts to 39.5% of the value of the fixed assets.

3 Bank funding shocks and domestic credit supply

The main contribution of this paper is the analysis of the heterogeneity in the transmission of a funding shock to domestic firms, due to bank sector presence, bank sector specialization and firm riskiness. However, for comparison with other papers, we first document how the funding shock affects domestic credit supply. We introduce the methodology in subsection 3.1 and focus in particular on how we control for firm demand in a context where the majority of firms borrow from only one bank. In subsection 3.2, we present and discuss the results for the full sample of bank-firm pairs as well as the subsample of firms that borrow from multiple banks.

3.1 Methodology

To analyze the impact of the bank funding shock on domestic credit supply, we first run a baseline regression of our four different credit growth measures on the bank funding shock as well as pre-shock bank characteristics. In particular, we estimate the following equation:

$$Credit_{bf} \quad = \quad \beta_1 \ \Delta\%Funding_b + \gamma \ Bank \ controls_b + \alpha_f + \epsilon_{bf} \tag{3}$$

Where β_1 shows the effect of a shock to bank funding ($\Delta\%$ Funding$_b$) on credit supply, while controlling for important time-averaged predetermined bank level covariates which are defined in subsection 2.2. Next to including the funding shock and bank-specific controls, we control for all observed and unobserved firm heterogeneity (including changes in firm-specific credit demand) by means of a set of firm fixed effects, α_f. As such, we isolate credit supply (from credit demand) by investigating how banks with different degrees of funding outflow changed their lending towards the same firm. Since Khwaja and Mian (2008), it has become common practice in such setups to include firm fixed effects. However, this implies that one can only include firms that have at least two bank relationships. As mentioned before, 84% of the firms in Belgium borrow from only one bank. Hence, including firm fixed effects substantially reduces the sample size and creates a bias towards larger firms. Moreover, it also means that we are potentially missing part of the reallocation effects across sectors, which is the main focus of our paper.

Therefore, we take a two-pronged approach. First, we work with the sample of firms that borrow from at least two banks and include firm fixed effects to control for firm-specific credit demand, and we thus estimate Equation (3). Second, we use the full set of bank-firm pairs and use a 'group' fixed effect to control for credit demand. The group is defined as the firm itself, in case of a firm with multiple bank relationships. The single bank firms are grouped on the basis of firm location, sector affiliation and size (defined LSS, location-sector-size, henceforth). More specifically, these firms are grouped according to the deciles of loan size in the credit register, the two-digit NACE code and the two-digit postal code (which broadly coincides with the district level). A similar approach is used by Edgerton (2012), Morais et al. (2015) and Degryse et al. (2016).[11] In this second approach we thus estimate Equation (4). We will show that this model allows us to simultaneously control for firm demand and to study the full universe of borrowers in Belgium, which is crucial for identifying the actual reallocation effects.

$$Credit_{bf} \quad = \quad \beta_1 \ \Delta\%Funding_b + \gamma \ Bank \ controls_b + \alpha_{LSS} + \epsilon_{bf} \tag{4}$$

The full sample consists of 160,224 observations from 134,368 firms borrowing from 39 banks and grouped together in 34,639 LSS-groups. In both approaches, we cluster the standard errors at the bank level. The subsample of firms borrowing simultaneously from multiple banks consists of 47,205 observations covering 21,349 firms.

3.2 Results: full sample vs multiple borrowers

Table 3 shows the the impact of the bank funding shock on domestic credit supply. We present the results using the four different credit growth indicators as dependent variable. They are $\Delta\%$ Credit$_{bf}$, Increase in credit$_{bf}$, Large decrease in credit$_{bf}$ and New relationships$_{bf}$, respectively.

TABLE 3 around HERE

[11] To be precise, Edgerton (2012) uses county times size times industry fixed effects when analyzing the impact of funding shocks on firm investments, while Morais et al. (2015) use industry times state fixed effects when analyzing the international monetary policy pass-through in Mexico. Degryse et al. (2016) use similar fixed effects as the ones used here.

The table has three panels. In the first panel, we present the results for the full sample of firms, while controlling for firm demand by including dummies based on firm location-sector-size triples. We find that the funding shock has a statistically significant effect in each of the four specifications. Firms borrowing from banks facing a larger funding outflow will face a tighter credit supply, mirrored by a lower credit growth (column 1), a lower likelihood of seeing an increase in their exposure (column 2) and a higher likelihood to experience a large drop in the granted loan amount (column 3). Overall, funding shocks play a significant role for the intensive margin of credit extension to firms operating in Belgium. Regarding the extensive margin of credit, we find that banks with larger positive (negative) changes in their funding are more (less) likely to originate loans to new clients (column 4).

The results are not only statistically significant, but also economically meaningful. For example, what does a point estimate of 0.250 in column 1 of Table 3 imply in economic terms? The total amount of granted credit prior to the shock to all firms in the sample is 100 billion euro. The average firm's bank experiences a funding shock of 9.2%. A point estimate of 0.250 thus implies that the average firm's supply-induced drop in credit availability is -2.3%. Our results thus indicate that the supply-shock induced 'missing credit' in the Belgian credit market is 2.3 billion euro. The other coefficients can be interpreted as changes in probabilities. A firm borrowing from a bank hit by a funding shock of -9.2% has a 2.91 percentage points lower probability of seeing an increase in granted credit (sample mean is 28.9%), a 4.42 percentage points higher probability of seeing a large decrease in granted credit (sample mean is 25%, by construction), and a 2.15 percentage points reduced probability of starting a relationship with another bank (sample mean is 14.4%).

One, potentially crucial, difference with the common practice in this literature is the set of fixed effects we include. In the aforementioned results, we control for firm demand by including dummies based on firm location-sector-size triples. In panel B of Table 3 we document the robustness of our results when using the smaller sample of multiple bank-relationship firms using firm fixed effects, an approach introduced by Khwaja and Mian (2008). When focusing on the smaller sample of multiple bank borrowers, we find results that are qualitatively and quantitatively similar to the results in panel A of Table 3. The funding shock has a statistically significant effect on both the intensive and extensive margin of credit and the coefficients have a similar magnitude as in the full sample. This is a first indication that our baseline results are not biased by unobserved changes in demand. More importantly, panel C of Table 3 indicates that including location-sector-size

dummies instead of firm fixed effects in this reduced sample gives quantitatively and qualitatively very similar results. We see this as a strong indication that including location-sector-size triples is sufficient to control for credit demand in our setup. Hence, given the fact that (i) we loose 84% of the firms in our sample when only including firms that borrow from more than one bank, potentially causing a selection bias, (ii) these firms might matter when investigating the reallocation effects across sectors and (iii) panel B and C of Table 3 indicate that location-sector-size dummies are sufficient to control for credit demand, we choose to focus on the larger sample in the subsequent analyses of the paper. However, for the sake of completeness, we also report the smaller sample results in the appendix.

4 Reallocating domestic credit

The results in the previous Section document that the bank funding shock affects the supply of domestic corporate credit. This result is in line with previous literature showing that bank funding shocks matter for credit supply. However, a comprehensive and detailed analysis of the sector- and firm-specific strategies that banks follow when deciding where to reallocate credit when their own funding is affected by a negative shock is still missing from this most rapidly expanding literature. This is somewhat surprising, given that a number of papers in the banking literature have both theoretically modeled and empirically investigated the importance of bank business models, both in terms of bank orientation and (more important for our purposes) bank sector specialization.[12] In the first subsection, we analyze the importance of bank sector presence and bank sector specialization for the pass-through of bank funding shocks to firms' credit (subsection 4.1). Subsequently, we subject this contribution to a number of alternative hypotheses and robustness checks in subsections 4.2 and 4.3.

4.1 Bank sector presence and bank sector specialization

To analyze the within-bank heterogeneity in shock transmission, due to sector presence and specialization, we expand our baseline model (see Equation (4)) with measures of bank sector presence

[12] E.g., Winton (1997); Boot and Thakor (2000); Hauswald and Marquez (2003); Degryse and Ongena (2007); Paravisini et al. (2014).

(Equation (1)) and bank sector specialization (Equation (2)) and their interaction terms with the bank funding shock:

$$\begin{aligned} Credit_{bf} = {} & \beta_1\ Bank\ sector\ presence_{bs} + \beta_2\ Bank\ sector\ specialization_{bs} + \\ & \beta_3\ Bank\ sector\ presence_{bs} * \Delta\%Funding_b + \beta_4\ Bank\ sector\ specialization_{bs} * \Delta\%Funding_b + \\ & \alpha_{LSS} + \upsilon_b + \epsilon_{bf} \end{aligned} \tag{5}$$

An attractive feature of the presence and the specialization measure is that they vary at the bank-sector level. Hence, in this specification, we can include bank fixed effects (υ_b). We could not do that in the analysis in subsection 3.2 as they would subsume the funding shock. The advantage is that we now fully control for observed and unobserved bank-specific heterogeneity. For example, in this setup we do not have to worry that bank-specific state support (which is not necessarily observable or measurable) affects our estimated coefficients.[13] As before, credit demand is again controlled for by using location-sector-size fixed effects (LSS), while standard errors are clustered at the bank level. The results are reported in Table 4.

TABLE 4 around HERE

The results in Table 4 first of all show that the pass through of the funding shock is less severe in sectors where the bank has a large sector presence. Focusing on the actual growth of granted credit (column 1), the coefficient of the interaction term between the funding shock and sector presence is negative and significant, indicating that banks shield firms in sectors in which they have a larger market presence. The impact is also economically important. For example, the point estimates in the first column imply that a one standard deviation increase in sector presence (0.082, see Table 2) reduces the negative impact on credit growth of a 9.2% reduction in bank funding from 2.3 to 1.84% (i.e., a reduction of 0.46 percentage points or 20%).[14] Similarly, the

[13] As a consequence of the financial crisis, the Belgian State had to intervene by providing capital to support the major financial institutions in Belgium (Dexia, BNP Fortis and KBC). In addition, to comply with the state-aid conditions imposed by the European Commission, the Belgian banks involved were forced to restructure. By including bank fixed effects, we abstract from these effects by focusing on reallocation effects within banks in a specific time period.

[14] The impact of a 9.2% reduction is based on the results in Table 3 : -9.2% * 0.250 = -2.3%. Based on the results in Table 4, a one standard deviation increase in sector presence of 0.082 leads to an impact of -9.2% * (0.250 - 0.612 * 0.082) = -1.84%.

second and third column illustrate that the impact of a negative funding shock on the probability of increasing granted credit (column 2) or having a large drop in granted credit (column 3) is less severe for firms operating in sectors where the bank has more market presence. The only exception on this moderating impact of sectoral market presence is the starting of new relationships (column 4), where the impact goes in the opposite direction. This is in line with recent theoretical and empirical findings of DeYoung et al. (2015), who show that during crisis times constrained banks might reject new lending opportunities if their returns co-vary positively with existing loans.

Apart from sector presence, sector specialization also plays an important role for the pass through of bank funding shocks. Our results indicate that, after a negative funding shock, credit growth is less affected in sectors that make up a relatively larger share of a bank's portfolio. More precisely, the results in the first column of Table 4 imply that a one standard deviation increase in sector specialization (0.15) reduces the negative impact of a 9.2% reduction in bank funding from 2.3 to 2% (i.e., a reduction in impact of 0.3 percentage points or 13%). The impact of sector specialization on the probability of increasing granted credit (column 2) and on the probability of a large drop in granted credit (column 3) confirm that banks reallocate credit after a funding shock towards firms operating in sectors in which the bank is specialized. The impact on new credit, however, is insignificant.

Overall, the results in Table 4 indicate that sector presence and specialization matter for the pass-through of bank funding shocks to firms. Banks prefer to shield firms in sectors in which they have a high market presence or in which they are heavily specialized. A potential explanation for the first finding is that banks prefer to focus on sectors where they can more easily attract higher returns when being under severe stress.[15] Unfortunately, the credit register does not contain contractual interest rates. However, from the firms' balance sheet we compute the debt burden, computed as interest expenses over financial debt, which is an approximation of the cost of debt.[16] Focusing on a firms' debt burden during the year before the Lehman collapse, we find that firms borrowing from banks with a larger sector presence have a higher debt burden, holding constant other firm and bank characteristics (see Table 5), which further supports the rent extraction explanation. The

[15]Boot et al. (1993), for example, show that banks are more likely to exploit their monopoly power by reneging their implicit commitments (e.g. loan rates) when faced with capital structure reforms.

[16]We only focus on firms borrowing from one bank, as for these firms the debt burden variable is more likely to be a good proxy for the actual cost of credit. For firms that borrow from more than one banks, it is impossible to know which bank is charging higher or lower rates to the firm.

impact of sector specialization can be explained by the fact that banks will typically have invested more in monitoring firms and gathering sector-specific knowledge and expertise in sectors in which they are specialized. Hence, in order to be able to keep exploiting this information advantage, banks prefer to stay more active in these sectors.

TABLE 5 around HERE

All results in Table 4 also survive when dropping the set of bank-time fixed effects and instead control for bank balance sheet characteristics or when further expanding equation 5 with additional interaction terms between the funding shock and either bank capital or bank liquidity, in order to further control for potential heterogeneity in the funding shock pass through (see Appendix, Table A1). The results are also largely robust to altering the definition of the funding shock and/or reducing the sample to multiple-bank borrowers and thus using firm fixed effects to control for firm demand (see Appendix, Tables A2 and A3). Additionally, in Table A4 in Appendix, we drop the large banks one by one to show that our results are not driven by one particular bank. These results are further proof that our results are not driven by the large market share of the four largest banks in our sample. Note that we already were controlling for differences in market share between banks by including bank fixed effects in all our reallocation regressions.

4.2 Firm risk

Both theoretical and empirical work has indicated that smaller firms (size), firms without track record (age) or firms with weaker balance sheets or less collateral (risk) are more likely to be financially constrained, due to asymmetric information between the bank and the firm. This holds in general and is expected to be particularly relevant during periods characterized by adverse economic shocks (e.g., tight monetary policy, economic recession, banking crisis). If the degree of bank sector presence or specialization is correlated with the characteristics of firms that banks lend to, it might be that the above-documented reallocation channel is not caused by the banks' presence or specialization, but instead by the specific type of the borrowers in those sectors where the bank is more present or specialized. In this Section, we exploit the heterogeneity in firm characteristics to explore whether banks differentially transmit a funding shock to firms in excess of the reallocation due to bank sector presence and specialization.

We augment Equation (5) with firm characteristics and an interaction between the funding shock and these firm characteristics, leading to the following specification:

$$\begin{aligned}\Delta\%Credit_{bf} =& \beta_1\ Bank\ sector\ presence_{bs} * \Delta\%Funding_b + \beta_2\ Bank\ sector\ specialization_{bs} * \Delta\%Funding_b + \\ & \sum_{x=1}^{5} \beta_{x+2}\ Firm\ variable_f^x * \Delta\%Funding_b + \beta_8\ Bank\ sector\ presence_{bs} + \\ & \beta_9\ Bank\ sector\ specialization_{bs} + \sum_{x=1}^{5} \beta_{x+9}\ Firm\ variable_f^x + \alpha_{LSS} + \upsilon_b + \epsilon_{bf} \end{aligned} \quad (6)$$

$Firm\ variable_f^x$ represents a firm specific characteristic. We consider five characteristics, which we first include one-by-one and then all together. More specifically, we proxy for firm size (pre-shock total assets), age (pre-shock number of years since incorporation), leverage (pre-shock total debt to pre-shock total assets), financial pressure (pre-shock interest payments to pre-shock EBIT) and collateral availability (pre-shock pledged collateral to pre-shock tangible fixed assets). Hence, using Equation (6), we test if banks that faced a funding shock after the Lehman collapse, transmitted the shock more to their smaller, younger and or riskier borrowers, while simultaneously shielding borrowers in sectors where they are more present or more specialized. β_{10} to β_{14} capture the direct effect of the firm characteristic on credit growth. The main coefficients of interest, β_3 to β_7, capture whether the impact of the funding shock on credit supply varies across different firm characteristics. The average impact of the bank funding shock on growth in granted credit is again subsumed in the bank fixed effects υ_b, together with all other observed and unobserved bank characteristics. The results are shown in Table 6.

TABLE 6 around HERE

Columns 1 and 2 of Table 6 show interactions based on size and age as commonly used in the literature to proxy for firm opacity. In contrast to Khwaja and Mian (2008), Iyer et al. (2014) and Liberti and Sturgess (2016), who take a similar approach using credit data, we do not find evidence that banks transmit liquidity shocks more to small firms (column 1). [17] The results in column 2 indicate that banks do not transmit the funding shock differentially to young firms

[17] A potential explanation for this is that small firms in Belgium have to report relatively detailed balance sheet information. As a consequence, asymmetric information problems between (small) firms and banks are potentially much lower in Belgium than in the other (emerging) countries investigated by Khwaja and Mian (2008); Iyer et al. (2014); Liberti and Sturgess (2016).

neither.[18] Importantly, the results in columns 1 and 2 confirm that banks transmit funding shocks less to sectors in which they are more present and in which they are more specialized, even when controlling for firm opacity.

Columns 3 to 5 of Table 6 show that banks reallocate credit to safer firms. A low leverage ratio (column 3), a low amount of already pledged collateral (column 4) and a low ratio of interest payments over earnings all significantly shield firms from the transmission of the funding shock.[19] These reallocation effects are not only statistically, but also economically significant. A one standard deviation decrease in the leverage ratio, in the ratio of pledged collateral to fixed assets, or in the ratio of interest payments over earnings reduces the negative impact on credit supply of a 9.2% reduction in bank funding by 11, 7, or 10%, respectively. A change in risk characteristics thus has a mitigating effect that is roughly equal in magnitude compared to sector specialization.

The results in Table 6 also show that the sector reallocation documented in Section 4.1 is still present after taking into account heterogeneity in the shock transmission according to firm risk. Banks still reallocate credit towards sectors in which they are more present and towards sectors in which they are more specialized, over and above reallocating credit towards safer firms. Hence, it ensures that our sector reallocation results are not driven by (risk related) firm-level reallocation effects. It also alleviates the concern that our sector reallocation findings could be driven by characteristics that are typically rather sector-specific, such as having a high amount of collateral.

4.3 Robustness

We subsequently ensure that our main reallocation results are not driven by other potential reallocation effects or by underlying bank-firm specific relation characteristics. A first important concern could be that our main sector reallocation results are merely picking up other types of bank portfolio choices that happen to be related with sector choices. In columns 1 and 2 of Table 7 we test for the potential impact of two alternative reallocation scenarios based on geographical bank specialization and based on loan maturity specialization. Some banks might coincidentally be very specialized in a sector because this sector is overrepresented in the area in which the bank

[18] Unreported specifications based on other proxies for size such as the number of employees or the total credit granted of the firm, or specifications allowing for a non-linear impact of size or age, confirm this lack of statistical effect for firm size and age.

[19] Unreported specifications based on the default risk (proxied by the Altman Z-score) or the financial leverage ratio (using only debt from financial institutions instead of total debt in the numerator) confirm the reallocation towards safer firms.

is doing business. Similarly, a bank might coincidentally be specialized in a sector because firms in that sector mainly need short term credit, and the bank happens to be specialized in providing that type of credit. Additionally, short-term credit might be easier to cut (or not rolled over). If sector specialization is correlated with the share of short-term lending, we could be picking up a spurious correlation.

To ensure that this is not driving our main results, columns 1 and 2 of Table 7 show the impact of sector presence and sector specialization while controlling for geographical presence, geographical specialization and the sector specific maturity structure of a bank's portfolio. Geographical presence and specialization are calculated in a similar way as sector presence and specialization, but on the province level instead of sector level.[20] The maturity structure indicator captures the share of loans provided by a bank to a sector that matures within one year. Both geographical indicators and the maturity structure indicator have no reallocation impact. More importantly, including these measures does not alter our main results, indicating that we are indeed capturing reallocation effects based on sector presence and specialization.

Another important concern stems from the existing literature on relationship lending (see, e.g., Petersen and Rajan, 1994; Berger and Udell, 1995; Boot, 2000; Degryse and Ongena, 2005; Bolton et al., 2013). Throughout the lending process, banks can gather firm-specific soft information (e.g., management quality), through repeated contacts, which is difficult to observe for outsiders. This information advantage can allow a bank to extract monopoly rents (see, e.g., Sharpe (1990) or Rajan (1992)). If banks want to shield these rents and if at the same time banks are more likely to have better firm-specific information in sectors in which they are specialized or where they have a strong sector presence, then our main results might be driven by this firm-specific information advantage. In columns 3 and 4 of Table 7, we add two widely used relationship lending measures to our setup. In column 3, we include length of a bank-firm relation, measured by the number of months that a firm has been borrowing from a bank before September 2008. In column 4, we add a dummy which is equal to one if the bank is the main bank of the firm, where the main bank is defined as the bank with the largest share in the total amount borrowed by a firm. Both indicators have no impact on the distribution of the funding shock, while we still find a strong reallocation effect based on sector presence and specialization. This may indicate that, when making reallocation choices during crisis times, banks seem to rely more on sector specific knowledge and firm risk characteristics than on

[20]Belgium consists of ten provinces. On average, a province has one million inhabitants and spans 3,000 squared meters.

the strength of a bank-firm relation.

5 Expanding post-shock windows

In Sections 3 and 4, we reported the results of an analysis using a pre- and post-event window of equal length (thirteen months). The shock we exploit corresponds in timing with the collapse of the investment bank Lehman Brothers in September 2008. The thirteen month pre-Lehman horizon is chosen to avoid interference with other shocks used in the literature, such as the turmoil in the ABCP market starting at the end of July 2007 (see, e.g., Iyer et al., 2014), which did, however, not lead to an interbank or deposit funding outflow at banks operating in Belgium. In this Section, we present results using expanding post-shock windows to analyze the timing of the impact of the funding shock. The purpose is twofold. First of all, such an analysis can reveal time variation in the magnitude of the impact of a funding shock on domestic credit supply, and possibly also differences in time variation along the intensive and extensive margin, as well as in the credit reallocation channels. Secondly, it also serves the purpose of simply showing robustness for alternative post-event horizons. We do this expanding window analysis both on the baseline regression (as reported in panel A of Table 3) and on the reallocation specification with sector presence, sector specialization and firm characteristics (column 6 of Table 6).

5.1 Dynamics: baseline

The regression specifications in the expanding windows analysis remain similar to Equation (4). However, by expanding the post-event window, we alter the construction of the funding shock as well as the dependent variable. We now estimate 30 different specifications that differ from each other in the length of the post-shock period. We gradually expand the post-shock period month by month, going from one to 30 months, and estimate model (4) each time to test which factor is important at each horizon. The pre-shock period is always the same time average over the thirteen months preceding the Lehman shock. Hence, when the post-crisis event window length is for example four, we compute the growth in lending (or change in interbank and deposit funding) as the difference in the four-month post-shock average and the thirteen month pre-shock average. In Figure 2, we graphically present our results on time variation in the point estimate of interest,

i.e., β_1 of model (4), for the four different dependent variables. In each subplot, we depict the point estimate on the funding shock variable, β_1 of model (4) as well as a 90% confidence bound (dotted lines).

FIGURE 2 around HERE

This expanding window analysis yields a number of interesting and complementary insights. First, the four plots of Figure 2 indicate that the results presented in Table 3 are robust to varying the length of the post-event period, except for very short window lengths. It takes four to five months before the funding shock starts to have a significant impact on credit growth, on the likelihood of a large drop in granted credit or on the start of a new bank-firm relationship. Statistically, the point estimates reported in Table 3 for the full sample using a thirteen month post-event window (indicated with a vertical line in the graph) are almost always within the confidence bounds obtained using alternative post-shock window lengths. The build-up of the effects in the first five months following the shock can be explained by at least two factors. On the one hand it could indicate that credit supply responds sluggishly to bank funding shocks. On the other hand it could also be attributed to the fact that the bank funding outflow hits banks gradually with the largest reductions in October 2008 and December 2008 (see Figure 1).

5.2 Dynamics: the impact of bank sector presence and specialization

The results in Tables 4 and 6 show the average impact of sector presence and specialization thirteen months after the start of the financial crisis in September 2008, relative to a thirteen month pre-shock window. In this subsection, we focus on the time variation in the impact of sector presence and specialization on the pass-through of the funding shock, using a regression specification similar to column 6 of Table 6. This allows us to analyze whether the initial choice of the time frame has an impact on our results and whether both types of reallocation happen at the same point in time. In order to do so, Figure 3 illustrates the impact of the interaction term of the shock in bank funding with either sector presence (upper panel) or specialization (lower panel) for every month starting from one month after the shock until thirty months after the shock. For example, the

impact after thirteen months in the upper panel corresponds with the coefficient on the interaction term between sector specialization and the funding shock in column 6 of Table 6.

FIGURE 3 around HERE

The moderating impact of sector presence is instantaneous and twice as large during the first three months compared to the impact after three months. In the first three months, the coefficient hoovers around minus one. Recall that we find that the average effect, reported in Figure 2, is positive, but insignificant in the first three months. Tying these two results together, this implies that, during the first three months, the impact of an average funding shock of 9.2% is non-existing for firms operating in sectors in which a bank has a high sector presence. On the other hand, the impact of the funding shock will be transmitted immediately, and significantly so, if a firm borrows from a bank with a substantially lower sector presence. After three months, the effect gradually diminishes but stays relative stable until eighteen months after the shock. Subsequently, the heterogeneous impact of sector presence remains statistically significant but becomes smaller in economic magnitude. Sector specialization exhibits different dynamics. The effect is insignificant in the first months after the initial shock, but gradually becomes more important. As soon as the post-event window exceeds four months, it becomes economically and statistically significant, until 24 months following the Lehman collapse after which it becomes borderline insignificant. Tying the results of both figures together, we find that the magnitude of the pass-through of the funding shock to the average borrower is similar across different event windows. However, the source of heterogeneity in the pass-through varies across firms. During the first months following the shock, banks try to be more accommodating in the shock transmission to those firms where they expect to have pricing power because of their dominant sector presence. Hence, they tend to screen more on the price component of the expected loan pay-off. Subsequently, they start differentiating between firms in sectors where they are specialized, indicating that their sector specific knowledge becomes more important. Alternatively, one can interpret this difference in reaction as banks being at first more concerned with staying afloat in the short run by focusing on loans that ensure larger cash inflows (in the form of relatively high interest payments), while only being interested in long term profitability (and hence focusing on protecting their sector specific knowledge) once these short term inflows are safe.

5.3 Dynamics: the role of firm risk

Next, we present evidence on the time-variation of the impact of firm characteristics on the funding shock transmission. Figure 4 shows 30 point estimates of the most extended specification, each corresponding to an estimation of model (6) (including all firm characteristics jointly) where the post shock period is gradually expanded from one month to 30 months post shock. First of all, the insignificant findings on firm size (columns 1 and 6 of Table 6) and firm age (columns 2 and 6 of Table 6) in our main analysis are not related to the choice of the post-shock time window. We do not find an immediate nor a long-term effect of firm size or age on the pass-through of the funding shock. Second, Figure 4 shows that the amplifying effect of firm risk is a very robust result across risk measures and post-event window length. Firm leverage and financial pressure have a constant and significant impact from three months after the shock, while the effect of pledged collateral to fixed assets tends to decrease slightly over time, but not statistically so.

FIGURE 4 around HERE

6 Real effects: firm investments and growth

We have shown that banks operating in Belgium transmit funding shocks to their borrowers according to their sector presence and specialization as well as by differentiating between firms with different risk profiles. In this section, we investigate how this reduction in bank loan supply affects firm investments and firm growth. We analyze this in the following setup:

$$\begin{aligned} Real\ Effect_f = & \beta_1\ \Delta\%Funding_b + \beta_2\ Bank\ Sector\ Presence_{bs} * \Delta\%Funding_b + \\ & \beta_3\ Bank\ Sector\ Specialization_{bs} * \Delta\%Funding_b + \sum_{x=1}^{5} \beta_{x+3}\ Firm\ Variable_f^x * \Delta\%Funding_b + \\ & \beta_9\ Bank\ Sector\ Presence_{bs} + \beta_{10}\ Bank\ Sector\ Specialization_{bs} + \sum_{x=1}^{5} \beta_{x+10}\ Firm\ Variable_f^x + \\ & \gamma\ Control\ Variables_f + \upsilon_s + \epsilon_f \end{aligned} \tag{7}$$

The dependent variable, $Real\ Effect_f$, is a growth rate. The growth rate is computed as the difference between the last available value of the variable two years post-shock (i.e., end of 2010)

and the last available value of the variable pre-shock relative to the last available value of total assets pre-shock. We look at a two year post-shock horizon as changes in firms' strategies following credit constraints usually take time to materialize and show impact. The two dependent variables we are interested in, are growth in tangible fixed assets (net investment rate) and growth in total assets. β_1 captures the extent to which the funding shock affects firms' real outcomes. If firms borrow from multiple banks, we compute a weighted funding shock, with weights resembling the pre-shock bank-firm credit exposure. β_2 and β_3 capture whether the firm-level impact of the funding shock varies with bank sector presence and specialization. Additionally, we interact the funding shock with firm-specific risk, size and age variables, similar to the setup in Table 6, which allows us to test whether or not reallocation of credit due to firm riskiness has an impact on firm investments and growth. Finally, we also include a set of control variables to control for accommodating sources of credit and investment or growth opportunities. This includes a measure of whether the firm received a new loan from a bank with which it had no prior relationship (weighted by the importance of the new loan in the post-crisis period), a measure whether a bank has terminated a loan with the firm (if the firm had loans from multiple banks in the pre-crisis period, weighted by the importance of the terminated loan in the pre-crisis period), a dummy measuring whether the firm has loans with multiple banks, a measure of the change in the ratio of utilized over authorized credit, the change in the firm's reliance on trade credit, the firm's sales growth and a set of sector fixed effects.

Table 8 shows the corresponding results. The first 2 columns focus on the net investment rate (proxied by the growth in tangible fixed assets). In the first column, we leave out the interaction effects of the funding shock with the bank sector variables and the firm characteristics. Both are added in the second column. The results first of all indicate that firms borrowing from banks with a larger funding outflow experience a statistically significant, though economically small, reduction in the investment rate. The point estimate of 0.043 for the funding shock variable in column 1 of Table 8 indicates that the average firm in our sample which borrowed from a bank that experienced a funding shock of -9.2%, reduced its net investment rate by 0.4 percentage points. Interestingly, this small average result hides some important underlying heterogeneity. Column 2 indicates that both bank sector presence and firm size plays an important role. Firms borrowing from banks that have a high sector presence and large firms reduce their investment rate less than others. Based on the results in column 2, the impact of an average funding shock of -9.2% leads to a reduction of the investment rate by 0.49 percentage points for a firm of average size that is borrowing from

a bank with average sector presence.[21] A firm of average size but borrowing from a bank with an average funding shock of -9.2% for which the sector presence is one standard deviation lower, however, reduces its net investment rate by about 0.93 percentage point. Similarly, a firm that is borrowing from a bank with an average funding shock of -9.2% and an average sector presence but that is a standard deviation smaller than the average firm will reduce its investment growth slightly less than 1 percentage point. The last two columns show the impact of the funding shock on asset growth. As with investments, firms that borrow from a bank with a more negative funding shock grow slower than other firms. Reallocation effects based on firm size are similar to the effects found for fixed assets.

TABLE 8 around HERE

Overall, we find a moderate reduction in investments and asset growth for firms that are borrowing from banks that were hit harder by the funding shock. Borrowing from a bank with high sector presence helps to offset this negative impact on investments. While the result on asset growth with respect to bank sector presence is similar, it is not statistically significant. Additionally, large firms are better able to limit the reduction in investments after a funding shock. Given that Table 6 showed that there are no significant differences between small and large firms in terms of the credit supply shock they both receive, the smaller impact in terms of real effects for large firms might indicate that these firms have more alternative funding sources available, over and above those controlled for.

7 Conclusion

We conduct a comprehensive and detailed analysis of the sector- and firm-specific strategies that banks follow when their own funding is affected by a negative shock. While the current literature documents that there is an impact of funding shocks on the volume of bank lending, to the best of

[21] We use the summary statistics reported in Table 1 to calculate the impact. The average firm size is 13.2 and the average firm borrows from a bank which has a sector presence of 0.185 in its sector. As such, the impact of an average funding shock of -9.2% equals -0.092*[0.730+(0.185*-0.517)+(13.2*-0.044)] = -0.49 percentage points. We do not take into account the remaining interaction terms given that their impact is not statistically different from 0.

our knowledge, we are the first to investigate the reallocation that occurs across sectors and firms and its persistence over time.

To identify the reallocation in the supply of credit that follows from the difficulties for banks to obtain funding, we rely on a unique combination of data sets. We employ monthly bank-firm level credit data from a comprehensive credit register that contains all credit granted in Belgium by financial institutions, monthly balance sheet data of these financial institutions, and annual balance sheets of all registered firms. We start by benchmarking our study with related studies. The average firm in our sample borrows from a bank that experiences a contraction in funding equivalent to 9.2% of its total assets. We estimate that the average firm, as a direct consequence of this funding outflow, faces a decline in the supply of credit by 2.3%. An investigation of the timing and duration of this effect reveals that the funding shock significantly impacts credit supply already four months after the shock started, reaches a maximum impact after seventeen months, and remains significant and high up to 30 months after the shock.

Our main results indicate that a bank's business model, as reflected in its *sector presence* and *sector specialization*, determines the reallocation of credit when a bank is hit by a negative funding shock. Sector presence measures how important a bank is for a particular (non-financial) sector while sector specialization measures how important a (non-financial) sector is for a bank. We find that a standard deviation increase in sector presence reduces the negative impact of the funding shock on credit supply by 20% for the average firm (i.e., a reduction of the average effect from 2.3 to 1.84%). Similarly, a standard deviation increase in sector specialization reduces the negative impact of the funding shock on credit supply by 13% for the average firm (i.e., a reduction of the average effect from 2.3 to 2%). Hence, banks direct their attention to sectors where they can more easily extract rents (higher sector presence) or where they have built up superior knowledge (higher sector specialization). Additionally, we document the existence of a flight to quality. Banks reallocate credit towards firms with low debt levels, low default risk, high available collateral, and a high interest coverage ratios. Importantly, this flight-to-quality coexists with the two aforementioned reallocation effects. All these reallocation effects are also robust to a number of alternative explanations, such as reallocation effects due to geographical specialization, due to the maturity structure of a banks' loan portfolio or due to bank-firm relationship characteristics. On the real side, we find a moderate reduction in investments and asset growth for firms borrowing from banks that were hit harder by the funding shock. The average firm borrowing from a bank that experienced an

average funding shock reduced its net investment rate by 0.62 percentage points. Importantly, we show that firms that are borrowing from a bank with high sector presence can partially offset this negative impact on investment rates.

Bank credit is a vital source of funding for firms all around the world, in particular for small and medium-sized firms. Our results provide useful information for policy makers that want to ensure access to finance for non-financial corporations during crisis times, as we show that riskier firms and firms borrowing from banks that have low sector presence and specialization in the sector where the firm is active, may be more vulnerable to shocks in the banking sector. Related to this, firms may prefer matching with banks with a larger sector presence as the implied higher cost of borrowing during good times also acts as an insurance premium that guarantees access to finance when the bank faces a funding shock. Additionally, our findings contain interesting information for bank regulators that are typically concerned about the trade-off between reducing portfolio concentration risk and having sufficient information about borrowers, as we reveal a bright sight of lending concentration during crisis times. Finally, our results suggest that not only systemic risk and financial stability issues should be taken into account when studying the welfare implications of portfolio diversification but that it could also be relevant to consider the potentially beneficial impact of lending concentration on firm credit supply.

References

Acharya, V. V. (2009). A theory of systemic risk and design of prudential bank regulation. *Journal of Financial Stability 5*(3), 224–255.

Acharya, V. V., I. Hasan, and A. Saunders (2006). Should banks be diversified? Evidence from individual bank loan portfolios. *Journal of Business 79*, 1355–1412.

Albertazzi, U. and M. Bottero (2014). The procyclicality of foreign bank lending: Evidence from the global financial crisis. *Journal of International Economics 92*, S22–S35.

Allen, F., A. Hryckiewicz, O. Kowalewski, and G. Tumer-Alkan (2014). Transmission of financial shocks in loan and deposit markets: The role of interbank borrowing and market monitoring. *Journal of Financial Stability 15*, 112–126.

Almeida, H. and M. Campello (2007). Financial constraints, asset tangibility, and corporate investment. *Review of Finacial Studies 20*, 1429–1460.

Basel Committee on Banking Supervision (2006). Studies on credit risk risk concentration. *BCBS Working Papers 15*.

Beck, T. and O. De Jonghe (2013). Lending concentration, bank performance and systemic risk: Exploring cross-country variation. *World Bank Policy Research Working Paper 6604*.

Beck, T., A. Demirguc-Kunt, L. Laeven, and V. Maksimovic (2006). The determinants of financing obstacles. *Journal of International Money and Finance 25*, 932–952.

Berger, A. N. and G. F. Udell (1995). Relationship lending and lines of credit in small firm finance. *Journal of Business*, 351–381.

Bertay, A. (2014). The transmission of real estate shocks through multinational banks. *CentER Discussion Paper Series 11*.

Bertrand, M., E. Duflo, and S. Mullainathan (2004). How much should we trust differences-in-differences estimates? *Quarterly Journal of Economics 119*(1), 249–275.

Bolton, P., X. Freixas, L. Gambacorta, and P. E. Mistrulli (2013). Relationship and transaction lending in a crisis. *working paper, National Bureau of Economic Research, Cambridge, MA 19467*.

Boot, A. and A. Thakor (2000). Can relationship banking survive competition? *Journal of Finance 55*, 679–713.

Boot, A. W. (2000). Relationship banking: What do we know? *Journal of Financial Intermediation 9*(1), 7–25.

Boot, A. W., S. I. Greenbaum, and A. V. Thakor (1993). Reputation and discretion in financial contracting. *American Economic Review*, 1165–1183.

Boyd, J. H. and E. C. Prescott (1986). Financial intermediary-coalitions. *Journal of Economic Theory 38*(2), 211–232.

Carey, M., M. Post, and S. A. Sharpe (1998). Does corporate lending by banks and finance companies differ? Evidence on specialization in private debt contracting. *Journal of Finance*, 845–878.

Cetorelli, N. and L. Goldberg (2011). Global banks and international shock transmission: Evidence from the crisis. *IMF Economic Review 59*, 41–76.

Cetorelli, N. and L. Goldberg (2012). Follow the money: Quantifying domestic effects of foreign bank shocks in the great recession. *American Economic Review: Papers and Proceedings 102*, 213–218.

Chodorow-Reich, G. (2014). The employment effects of credit market disruptions: Firm-level evidence from the 2008-09 financial crisis. *Quarterly Journal of Economics 129*, 1–59.

Claessens, S. and N. van Horen (2013). Impact of foreign banks. *Journal of Financial Perspectives 1*, 1–18.

Cohn, A., J. Engelmann, E. Fehr, and M. Marï¿½chal (2015). Evidence for countercyclical risk aversion: An expiriment with financial professionals. *Amercan Economic Review 150(2)*, 860–885.

Cremers, K. M., R. Huang, and Z. Sautner (2011). Internal capital markets and corporate politics in a banking group. *Review of Financial Studies 24*(2), 358–401.

Cull, R. and M. Martinez Peria (2013). Bank ownership and lending patterns during the 2008-2009 financial crisis: Evidence from latin america and eastern europe. *Journal of Banking and Finance 37*, 4861–4878.

De Haas, R. and N. Van Horen (2012). Running for the exit? International bank lending during a financial crisis. *Review of Financial Studies*, 244–285.

De Haas, R. and I. van Lelyveld (2014). Multinational banks and the global financial crisis: Weathering the perfect storm? *Journal of Money, Credit and Banking 46*, 333–364.

Degryse, H., O. De Jonghe, S. Jakovljevic, K. Mulier, and G. Schepens (2016). The effect of bank shocks on bank risk-taking and firm-level outcomes. *Mimeo*.

Degryse, H., M. Kim, and S. Ongena (2009). *Microeconometrics of banking: methods, applications, and results*. Oxford University Press.

Degryse, H., N. Masschelein, and J. Mitchell (2011). Staying, dropping, or switching: The impact of bank mergers on small firms. *Review of Financial Studies 24*(4), 1102–1140.

Degryse, H. and S. Ongena (2005). Distance, lending relationships, and competition. *Journal of Finance 60*(1), 231–266.

Degryse, H. and S. Ongena (2007). The impact of competition on bank orientation. *Journal of Financial Intermediation 16*, 399–424.

Delis, M. D., S. Kokas, and S. Ongena (2016). Bank market power and firm performance. *Review of Finance, forthcoming*.

Dell'Ariccia, G. and R. Marquez (2004). Information and bank credit allocation. *Journal of Financial Economics 72*(1), 185–214.

DeYoung, R., A. Gron, G. Torna, and A. Winton (2015). Risk overhang and loan portfolio decisions: Small business loan supply before and during the financial crisis. *Journal of Finance 70*, 2451–2488.

Diamond, D. W. (1984). Financial intermediation and delegated monitoring. *Review of Economic Studies 51*(3), 393–414.

Dornbusch, R., Y. C. Park, and S. Claessens (2000). Contagion: Understanding how it spreads. *The World Bank Research Observer 15*(2), 177–197.

ECB (2008). EU banking structures report.

Edgerton, J. (2012). Credit supply and business investment during the great recession: Evidence from public records of equipment financing. *Working paper, Available at SSRN: http://ssrn.com/abstract=2183379*.

Focarelli, D. and F. Panetta (2003). Are mergers beneficial to consumers? Evidence from the market for bank deposits. *American Economic Review*, 1152–1172.

Giannetti, M. and L. Laeven (2012). The flight home effect: Evidence from the syndicated loan market during financial crises. *Journal of Financial Economics 104*(1), 23–43.

Hadlock, C. J. and J. Pierce (2010). New evidence on measuring financial constraints: Moving beyond the KZ index. *Review of Financial Studies 23(5)*, 1909–1940.

Hauswald, R. and R. Marquez (2003). Information technology and financial services competition. *Review of Financial Studies 16*, 921–948.

Inderst, R. and C. Laux (2005). Incentives in internal capital markets: Capital constraints, competition, and investment opportunities. *RAND Journal of Economics 36*(1), 215–228.

Ioannidou, V. and S. Ongena (2010). Time for a change: Loan conditions and bank behavior when firms switch banks. *Journal of Finance 65*(5), 1847–1877.

Iyer, R., J.-L. Peydro, S. da Rocha-Lopes, and A. Schoar (2014). Interbank liquidity crunch and the firm credit crunch: Evidence from the 2007-2009 crisis. *Review of Financial Studies 27*, 347–372.

Iyer, R., M. Puri, and N. Ryan (2012). Understanding bank runs: Do depositors monitor banks? *The American Economic Review 102*(4), 1414–1445.

Jahn, N., C. Memmel, and A. Pfingsten (2013). *Banks' concentration versus diversification in the loan portfolio: New evidence from Germany.* Number 53. Discussion Paper, Deutsche Bundesbank.

Jimenez, G., S. Ongena, J.-L. Peydro, and J. Saurina (2014). 'Credit demand forever?' on the strengths of bank and firm balance-sheet channels in good and crisis times. *Working paper, available at SSRN: http://ssrn.com/abstract=1980139*.

Khwaja, A. and A. Mian (2008). Tracing the impact of bank liquidity shocks: Evidence from an emerging market. *American Economic Review 98:4*, 1413–1442.

Klein, M. A. (1971). A theory of the banking firm. *Journal of Money, Credit and Banking 3*(2), 205–218.

Kuppuswamy, V. and B. Villalonga (2010). Does diversification create value in the presence of external financing constraints? Evidence from the 2007-2009 financial crisis. *Harvard Business School Finance Working Paper 10*(101).

Laeven, L. and R. Levine (2007). Is there a diversification discount in financial conglomerates? *Journal of Financial Economics 85*(2), 331–367.

Lamont, O., C. Polk, and J. Saa-Requejo (2001). Financial constraints and stock returns. *Review of Financial Studies 14(2)*, 529–554.

Liberti, J. M. and J. Sturgess (2016). The anatomy of a credit supply Shock: Evidence from an internal credit market. *Journal of Financial and Quantitative Analysis, forthcoming*.

Monti, M. (1972). Deposit, credit, and interest rate determination under alternative bank objectives. *Mathematical Methods in Investment and Finance*, 431–454.

Morais, B., J. L. Peydro, and C. Ruiz Ortega (2015). The international bank lending channel of monetary policy rates and QE: Credit supply, reach-for-yield, and real effects. *International Finance Discussion Papers* (1137).

National Bank of Belgium (2009). Financial stability review.

Ongena, S., J. Peydro, and N. van Horen (2016). Shocks abroad, pain at home? Bank-firm level evidence on financial contagion during the recent financial crisis. *IMF Economic Review, Forthcoming*.

Ongena, S., G. Tumer-Alkan, and N. von Westernhagen (2015). Do exposures to sagging real estate, subprime or conduits abroad lead to contraction and flight to quality in bank lending at home? *Deutsche Bundesbank, mimeo*.

Paravisini, D., V. Rappoport, and P. Schnabl (2014). Comparative advantage and specialization in bank lending. *Working paper, London School of Economics and New York University*.

Paravisini, D., V. Rappoport, P. Schnabl, and D. Wolfenzon (2014). Dissecting the effect of credit supply on trade: Evidence from matched credit-export data. *Review of Economic Studies 82*, 333–359.

Peek, J. and E. Rosengren (1997). The international transmission of financial shocks: The case of Japan. *American Economic Review 87*, 495–505.

Peek, J. and E. Rosengren (2000). Collateral damage: Effects of the Japanese bank crisis on real activity in the united states. *American Economic Review 90*, 30–45.

Petersen, M. A. and R. G. Rajan (1994). The benefits of lending relationships: Evidence from small business data. *Journal of Finance 49*(1), 3–37.

Petersen, M. A. and R. G. Rajan (1995). The effect of credit market competition on lending relationships. *Quarterly Journal of Economics*, 407–443.

Puri, M., J. Rocholl, and S. Steffen (2011). Global retail lending in the aftermath of the US financial crisis: Distinguishing between supply and demand effects. *Journal of Financial Economics 100*, 556–578.

Rajan, R. G. (1992). Insiders and outsiders: The choice between informed and arm's-length debt. *Journal of Finance 47*(4), 1367–1400.

Sapienza, P. (2002). The effects of banking mergers on loan contracts. *Journal of finance 57*(1), 329–367.

Sharpe, S. A. (1990). Asymmetric information, bank lending, and implicit contracts: A stylized model of customer relationships. *Journal of Finance 45*(4), 1069–1087.

Stein, J. C. (1997). Internal capital markets and the competition for corporate resources. *Journal of Finance 52*(1), 111–133.

Stein, J. C. (2002). Information production and capital allocation: Decentralized versus hierarchical firms. *Journal of Finance 57*(5), 1891–1921.

Tabak, B. M., D. M. Fazio, and D. O. Cajueiro (2011). The effects of loan portfolio concentration on Brazilian banks's return and risk. *Journal of Banking and Finance 35*(11), 3065–3076.

Wagner, W. (2010). Diversification at financial institutions and systemic crises. *Journal of Financial Intermediation 19*(3), 373–386.

Whited, T. M. and G. Wu (2006). Financial constraints risk. *Review of Financial Studies 19*, 531–559.

Wiggins, R. Z. and A. Metrick (2015). The Lehman bankruptcy: The global contagion. *Yale program on financial stability case study*.

Winton, A. (1997). Competition among financial intermediaries when diversification matters. *Journal of Financial Intermediation 6*, 307–346.

Winton, A. (1999). Don't put all your eggs in one basket? Diversification and specialization in lending. *Working paper available at SSRN: http://ssrn.com/abstract=173615*.

Figure 1: The funding shock and its impact: aggregate statistics

This figure depicts the evolution of the aggregate volume (all banks active in Belgium, in billion euro) of bank funding (interbank liabilities + deposit funding) over the period 2006:1 - 2011:12. Interbank liabilities include overnight deposits, deposits redeemable at notice and term accounts of other financial institutions as well as repurchase agreements. Deposits include all deposits by households, non-financial corporations and government institutions. The vertical lines correspond to the estimation window (pre-shock window and post-shock-window of thirteen months) around the shock in August 2008, the month prior to the collapse of Lehman Brothers.

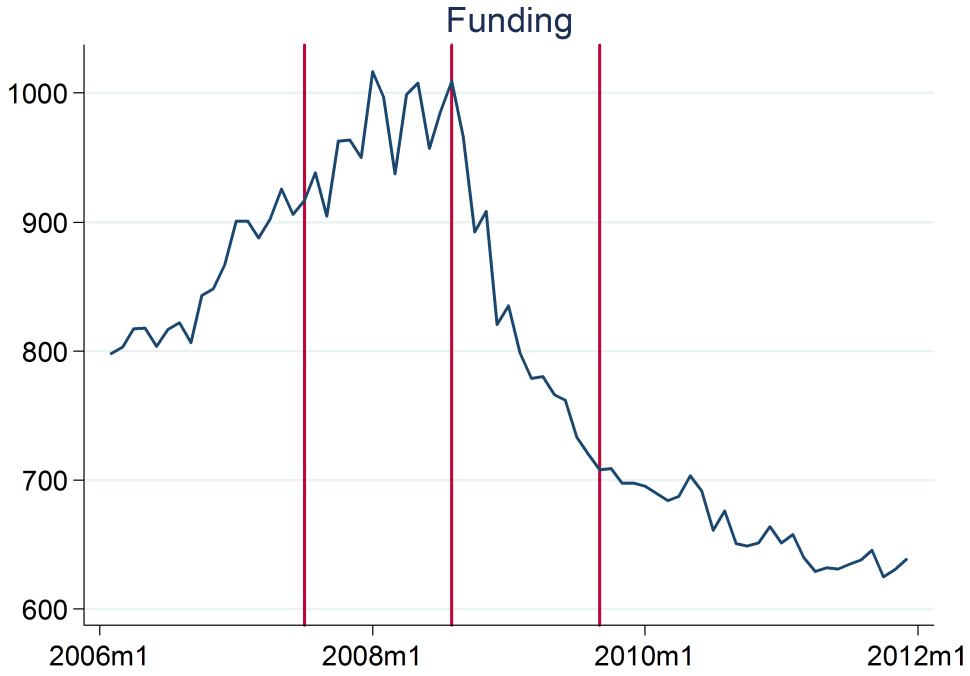

Figure 2: Timing of the funding shock pass-through

This graph illustrates the impact of the total funding shock on the four credit supply indicators: $\Delta\%$ Credit$_{bf}$, Increase in credit$_{bf}$, Large decrease in credit$_{bf}$, and New relationships$_{bf}$. We plot the coefficients and 90% confidence bounds (dashed lines) for the effect of a shock to bank funding ($\Delta\%$ Funding$_b$). The coefficients plotted are obtained from 30 separate estimations. The estimations differ from each other in terms of the length of the post-shock horizon, which expands from one to 30 months post Lehman, whereas the pre-shock horizon remains fixed at thirteen months. The x-axis indicates the sample length after the Lehman failure. The coefficients at month thirteen coincide with the results reported in panel A of Table 3.

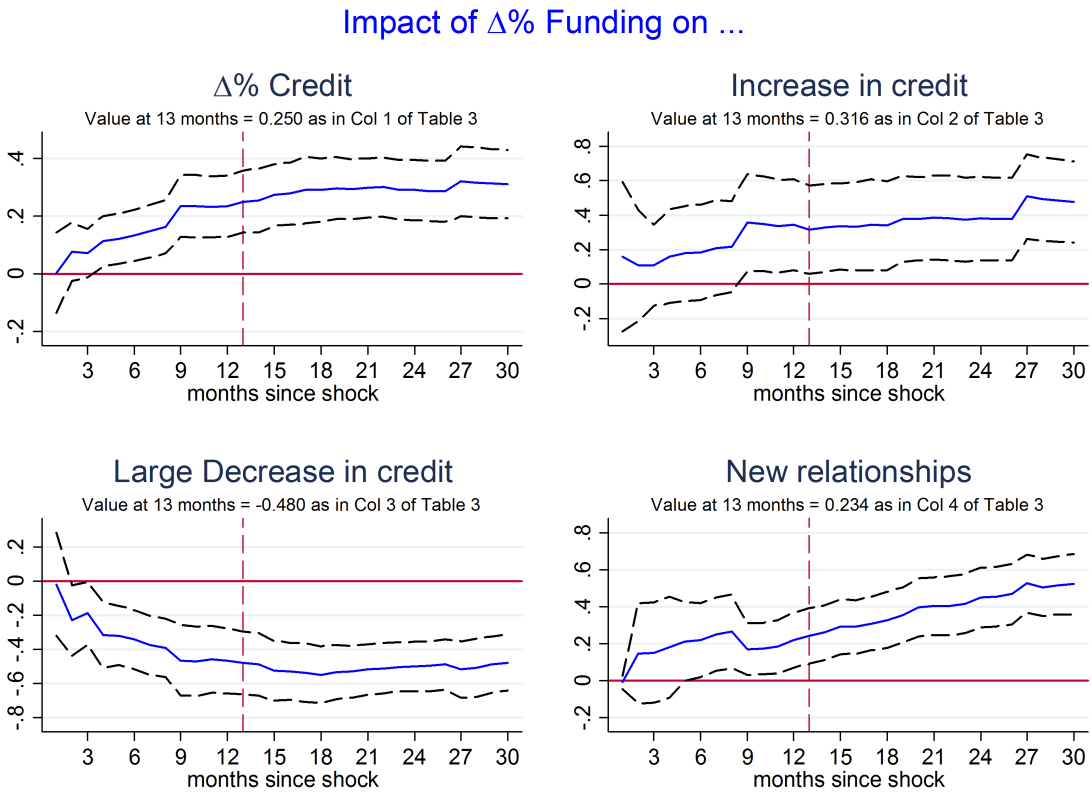

Figure 3: Timing reallocation effects: bank sector presence and specialization

This graph displays the timing and magnitude of the reallocation across sectors. The panels contain information on the interaction effect of the total funding shock and either the banks' sector presence or the banks' sector specialization. We plot the coefficients and 90% confidence bounds (dashed lines) for the interaction coefficients obtained from 30 separate estimations. The estimations differ from each other in terms of the length of the post-shock horizon, which expands from one to 30 months post Lehman, whereas the pre-shock horizon remains fixed at thirteen months. The coefficients at month thirteen coincide with the results reported in column 6 of Table 6.

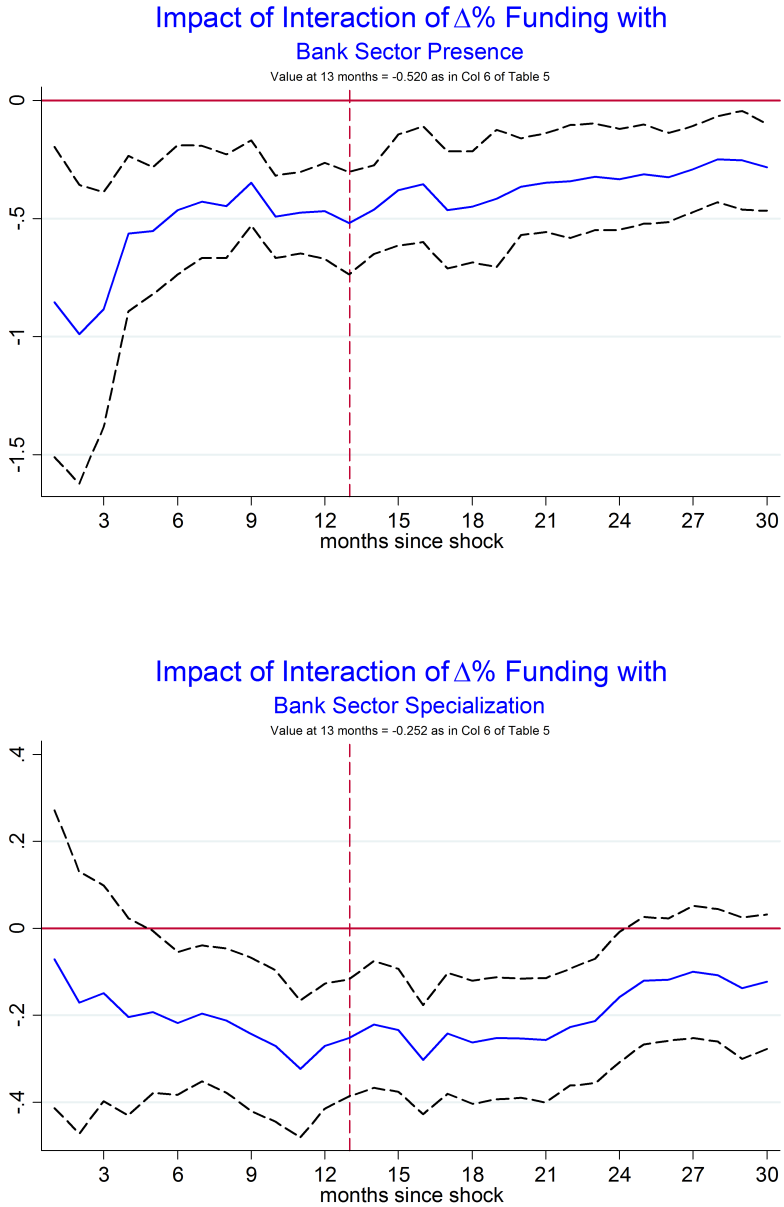

Figure 4: Timing reallocation effects:: firm size, age and risk

This graph illustrates the timing and magnitude of the reallocation based on firm size, age and firm risk. The panels contain information on the interaction effect of the interbank funding shock and the respective firm characteristic. We plot the coefficients and 90% confidence bounds (dashed lines) for the interaction coefficients obtained from 30 separate estimations. The estimations differ from each other in terms of the length of the post-shock horizon, which expands from one to 30 months post Lehman, whereas the pre-shock horizon remains fixed at thirteen months. The coefficients at month thirteen coincide with the results reported in column 6 of Table 6.

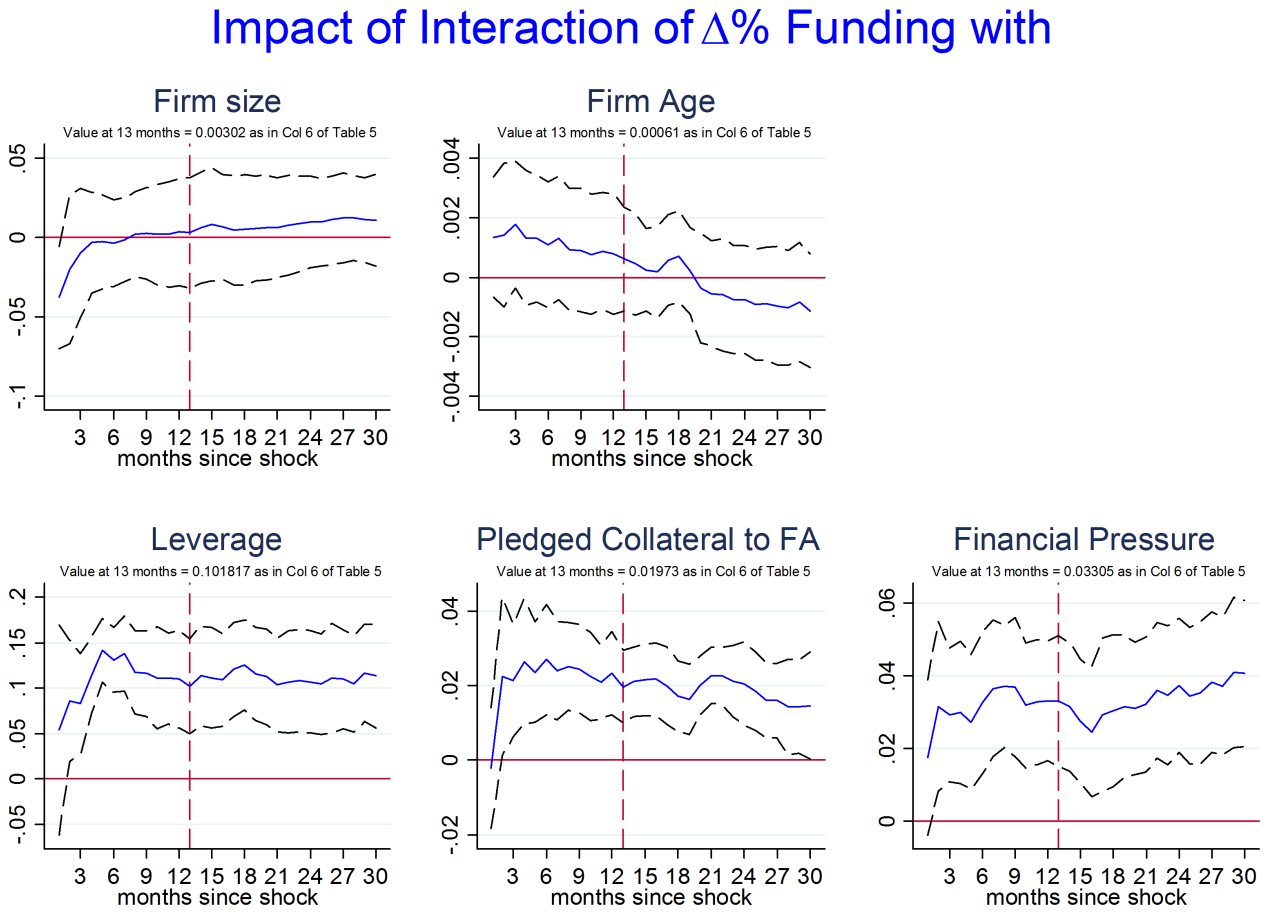

Table 1: Variable definition

CREDIT VARIABLES	
Δ% Credit$_{bf}$	natural logarithm of time averaged credit granted post shock - natural logarithm of time averaged credit granted pre shock
Increase in credit$_{bf}$	A dummy = 1 if Δ% Credit$_{bf} > 0$, and 0 otherwise
Large decrease in credit$_{bf}$	A dummy = 1 if Δ% Credit$_{bf}$ is in the lowest quartile of the distribution, and 0 otherwise
New relationships$_{bf}$	A dummy = 1 if a bank-firm pair exists in 2009m9 but not yet in 2008m8, and 0 otherwise
BANK VARIABLES	
Δ% Funding$_b$	[(time averaged interbank liabilities + deposits post shock) - (time averaged interbank liabilities + deposits pre shock)] / time averaged total assets pre shock
Capital to total assets$_b$	time averaged common equity pre shock / time averaged total assets pre shock
Return on equity$_b$	time averaged quarterly return on average equity pre shock
Provision to total loans$_b$	time averaged net flow of new impairment for credit losses expressed as a percentage of time-averaged total loans pre shock
Interbank assets to total assets$_b$	time averaged interbank assets pre shock / time averaged total assets pre shock
Deposits to total assets$_b$	time averaged demand and savings deposits pre shock / time averaged total assets pre shock
Interbank liabilities to total assets$_b$	time averaged interbank liabilities pre shock / time averaged total assets pre shock
Bank size$_b$	natural logarithm of time averaged total assets pre shock
	Demand and savings deposits include all deposits by households, non-financial corporations and government institutions. Interbank liabilities include overnight deposits, deposits redeemable at notice and term accounts of other financial institutions as well as repurchase agreements.
BANK-SECTOR VARIABLES	
Sector presence$_{bs}$	time averaged total credit granted pre shock by bank b in sector s / time averaged total credit granted pre shock in sector s
Sector specialization$_{bs}$	time averaged total credit granted pre shock by bank b in sector s / time averaged total credit granted pre shock by bank b
FIRM VARIABLES	
Total assets$_f$	pre shock natural logarithm of total assets
Age$_f$	pre shock number of years since incorporation
Leverage$_f$	pre shock total debt / pre shock total assets
Pledged collateral to fixed assets$_f$	pre shock pledged collateral / pre shock tanbible fixed assets
Financial Pressure$_f$	pre shock total interest payments / pre shock EBIT
Δ% Fixed assets$_f$	(post shock tangible fixed assets - pre shock tangible fixed assets) / pre shock total assets
Δ% Assets$_f$	(post shock total assets - pre shock total assets) / pre shock total assets

Table 2: Summary statistics

	Obs	Mean	StDev	Min	p25	p50	p75	Max
CREDIT VARIABLES								
bank-firm level								
Δ% Credit$_{bf}$	160,224	-0.024	0.278	-0.644	-0.155	-0.051	0.026	0.941
Increase in credit$_{bf}$	160,224	0.289	0.453					
Large decrease in credit$_{bf}$	160,224	0.250	0.434					
New relationships$_{bf}$	188,827	0.144	0.352					
BANK VARIABLES								
bank-firm level								
Δ% Funding$_b$	160,224	-0.092	0.106	-0.199	-0.199	-0.086	-0.063	0.590
Capital to total assets$_b$	160,224	0.045	0.021	0.001	0.041	0.041	0.056	0.356
Return on equity$_b$	160,224	0.080	0.116	-0.131	-0.072	0.106	0.172	1.009
Provision to total loans$_b$	160,224	0.026	0.025	-0.203	0.007	0.027	0.055	0.213
Interbank assets to total assets$_b$	160,224	0.241	0.086	0.016	0.231	0.263	0.279	0.741
Deposits to total assets$_b$	160,224	0.404	0.146	0.000	0.248	0.406	0.445	0.881
Interbank liabilities to total assets$_b$	160,224	0.320	0.112	0.000	0.293	0.342	0.374	0.936
Bank size$_b$	160,224	11.669	1.443	5.362	11.893	12.347	12.461	12.461
bank level								
Δ%Funding$_b$	39	0.071	0.179	-0.199	-0.045	0.043	0.129	0.590
Capital to total assets$_b$	39	0.070	0.075	0.001	0.034	0.056	0.077	0.356
Return on equity$_b$	39	0.158	0.254	-0.131	0.014	0.113	0.166	1.009
Provisions to total loans$_b$	39	0.007	0.083	-0.203	0.000	0.000	0.025	0.213
Interbank assets to total assets$_b$	39	0.262	0.243	0.016	0.063	0.160	0.416	0.741
Deposits to total assets$_b$	39	0.466	0.263	0.000	0.248	0.506	0.668	0.881
Interbank liabilities to total assets$_b$	39	0.322	0.291	0.000	0.090	0.238	0.442	0.936
Bank size$_b$	39	8.110	1.874	5.362	6.881	7.844	9.060	12.461
BANK-SECTOR VARIABLES								
bank-firm level								
Sector presence$_{bs}$	160,224	0.185	0.091	0.000	0.158	0.207	0.241	0.425
Sector specialization$_{bs}$	160,224	0.130	0.092	0.000	0.065	0.126	0.208	0.990
bank-sector level								
Sector presence$_{bs}$	403	0.039	0.082	0.000	0.001	0.003	0.017	0.425
Sector specialization$_{bs}$	403	0.094	0.149	0.000	0.011	0.043	0.111	0.990

Table 2: continued

	Obs	Mean	StDev	Min	p25	p50	p75	Max
FIRM VARIABLES								
bank-firm level								
Total assets$_f$	144,062	13.40	1.302	10.79	12.49	13.26	14.19	16.50
Age$_f$	144,062	14.17	10.24	1.000	6.000	12.15	20.00	40.00
Leverage$_f$	144,062	0.724	0.270	0.116	0.555	0.746	0.892	1.569
Pledged collateral to fixed assets$_f$	141,478	0.475	0.942	0.000	0.000	0.000	0.547	4.138
Financial pressure$_f$	143,921	0.720	0.776	0.009	0.173	0.446	0.967	3.947
firm level								
Total assets$_f$	119,407	13.21	1.22	10.79	12.36	13.08	13.92	16.50
Age$_f$	119,407	13.24	9.81	1.000	5.000	11.00	19.00	40.00
Leverage$_f$	119,407	0.726	0.279	0.116	0.546	0.748	0.899	1.569
Pledged collateral to fixed assets$_f$	117,007	0.434	0.900	0.000	0.000	0.000	0.288	4.138
Financial pressure$_f$	119,277	0.732	0.789	0.009	0.167	0.446	1.005	3.947
Δ% Fixed assets$_f$	114,436	0.078	0.410	-0.435	-0.082	-0.020	0.066	2.674
Δ% Assets$_f$	114,436	0.168	0.652	-0.681	-0.126	0.005	0.235	4.289

Table 3: Baseline: full sample

This table shows the effect of a shock to deposits and interbank liabilities (Δ% Funding$_b$) on credit growth at the bank-firm level, while controlling for time-averaged (over the thirteen months preceding the shock) bank level covariates. The dependent variable is percentage growth in the granted loan amount (column 1), an indicator variable that is one if the granted amount increases and zero otherwise (column 2), an indicator variable that is one if the growth in the granted loan amount belongs to the lowest quartile and zero otherwise (column 3), and a dummy variable that is one for new bank-firm relationships and zero otherwise (column 4). A bank-firm relationship is defined to be new if the bank-firm match does exist in September 2009 and did not exist in August 2008. For each of the measures in column 1-3, we first time-average the bank-firm exposure in the year prior to the Lehman default as well as the year following the Lehman default. We subsequently compute logarithmic growth rates of the pre versus post Lehman time-average loan amounts. The independent variable of interest is the change in the sum of interbank liabilities and deposits scaled by total assets. More specifically, it is the average value of interbank liabilities and deposits in the thirteen months post Lehman minus the average value in the thirteen months prior to the Lehman default, scaled by the average value of total assets over the thirteen months preceding 2008:09. The table consists of three panels. Panel A includes all firms and firm demand is controlled for by means of a location-sector-size fixed effect (LSS). Panel B and C only include firms that are borrowing from more than one bank. In Panel B, we control for firm demand by including firm fixed effects, while the regressions in Panel C include location-sector-size fixed effects for the multiple-bank borrower sample. Bank control variables are included, but not reported, in panel B and C. Standard errors are clustered at the bank level. ***, ** and * denote p<0.01, p<0.05 and p<0.1 respectively.

	(1)	(2)	(3)	(4)
Panel A	Δ% Credit$_{bf}$	Increase in credit$_{bf}$	Large decrease in credit$_{bf}$	New relationships$_{bf}$
Δ% Funding$_b$	0.250***	0.316*	-0.480***	0.234**
	(0.0653)	(0.156)	(0.112)	(0.0912)
Capital to total assets$_b$	-0.169	-0.350	0.374	-0.459*
	(0.190)	(0.469)	(0.267)	(0.264)
Return on equity$_b$	-0.0652	-0.0578	0.131	0.0175
	(0.0574)	(0.112)	(0.0997)	(0.0599)
Provision to total loans$_b$	0.394***	0.450	-0.579***	0.293
	(0.122)	(0.356)	(0.173)	(0.209)
Interbank assets to total assets$_b$	0.0290	-0.130	-0.128	-0.165*
	(0.0699)	(0.161)	(0.128)	(0.0909)
Deposits to total assets$_b$	-0.126	-0.370	0.134	-0.0388
	(0.0928)	(0.232)	(0.149)	(0.127)
Interbank liabilities to total assets$_b$	-0.0633	-0.238	0.0263	0.0561
	(0.0932)	(0.201)	(0.131)	(0.120)
Bank size$_b$	-0.00560	-0.00835	0.0224**	-0.0167**
	(0.00569)	(0.0114)	(0.00836)	(0.00681)
Observations	160,224	160,224	160,224	188,800
R-squared	0.295	0.276	0.289	0.244
Location-sector-size FE	Yes	Yes	Yes	Yes
Panel B	Δ% Credit$_{bf}$	Increase in credit$_{bf}$	Large decrease in credit$_{bf}$	New relationships$_{bf}$
Δ% Funding$_b$	0.259***	0.267*	-0.355***	0.218**
	(0.0806)	(0.135)	(0.130)	(0.101)
Observations	47,205	47,205	47,205	59,951
R-squared	0.455	0.463	0.481	0.489
Bank controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Panel C	Δ% Credit$_{bf}$	Increase in credit$_{bf}$	Large decrease in credit$_{bf}$	New relationships$_{bf}$
Δ% Funding$_b$	0.259***	0.254	-0.380***	0.209*
	(0.0933)	(0.167)	(0.125)	(0.106)
Observations	47,205	47,205	47,205	59,951
R-squared	0.218	0.218	0.248	0.221
Bank controls	Yes	Yes	Yes	Yes
Location-sector-size FE	Yes	Yes	Yes	Yes

Table 4: Reallocation within banks according sector presence and sector specialization

This table contains information on the estimated effect of bank funding shocks on domestic credit supply, conditional on banks' sector presence and sector specialization. We investigate both the intensive and extensive margin of credit. The dependent variable is percentage growth in the granted loan amount (column 1), an indicator variable that is one if the granted amount increases and zero otherwise (column 2), an indicator variable that is one if the growth in the granted loan amount belongs to the lowest quartile and zero otherwise (column 3), and a dummy variable that is one for new bank-firm relationships and zero otherwise(column 4). The independent variables of interest are the interaction between bank sector presence and sector specialization and the funding shock ($\Delta\%\text{Funding}_b$). Firm demand is controlled for by means of a firm fixed effect if a firm is borrowing from at least two banks and group fixed effects for single bank borrowers. Firms are pooled together in a group based on location, sector and size (LSS fixed effect). Standard errors are clustered at the bank level. ***, ** and * denote p<0.01, p<0.05 and p<0.1 respectively.

	(1)	(2)	(3)	(4)
	$\Delta\%$ Credit$_{bf}$	Increase in credit$_{bf}$	Large decrease in credit$_{bf}$	New relationships$_{bf}$
Sector presence$_{bs}$ * $\Delta\%$ Funding$_b$	-0.612***	-1.130***	1.043***	0.290**
	(0.175)	(0.237)	(0.304)	(0.134)
Sector specialization$_{bs}$ * $\Delta\%$ Funding$_b$	-0.210***	-0.529***	0.539***	0.177
	(0.0764)	(0.170)	(0.106)	(0.142)
Sector presence$_{bs}$	-0.0785*	-0.235**	0.189***	0.0330
	(0.0428)	(0.0897)	(0.0538)	(0.0495)
Sector specialization$_{bs}$	0.0209	0.137*	-0.0817*	-0.151***
	(0.0348)	(0.0789)	(0.0478)	(0.0454)
Observations	160,224	160,224	160,224	188,800
R-squared	0.298	0.282	0.292	0.248
Bank FE	Yes	Yes	Yes	Yes
Location-sector-size FE	Yes	Yes	Yes	Yes

Table 5: Sector presence, sector specialization and rent seeking

This table documents the relation between a firms' debt burden and the sector specialization and sector presence of its bank during the pre-shock period. We only include firms borrowing from one bank to improve the match between the debt burden and the actual interest rate charged by the bank. We present results for three different specifications that differ in the amount of control variables. The dependent variable in all three specifications is the debt burden of the firm prior to the collapse of Lehman Brothers. Debt burden is measured as interest expenses over financial debt. In the first specification, we regress debt burden on bank sector presence, bank sector specialization as well as a group fixed effect defined by the triple (location, sector, size). In column 2 and 3 we subsequently add firm characteristics and bank characteristics. Standard errors are clustered at the bank level. ***, ** and * denote p<0.01, p<0.05 and p<0.1 respectively.

	(1)	(2)	(3)
VARIABLES	Debt burden$_f$	Debt burden$_f$	Debt burden$_f$
Sector presence$_{bs}$	0.0444**	0.0408*	0.0347*
	(0.0218)	(0.0235)	(0.0188)
Sector specialization$_{bs}$	0.00447	-0.000661	0.0126
	(0.0296)	(0.0253)	(0.0280)
Observations	89,986	89,986	89,986
R-squared	0.186	0.221	0.222
Location-sector-size FE	Yes	Yes	Yes
Firm Controls	No	Yes	Yes
Bank Controls	No	No	Yes

Table 6: Heterogenous shock transmission: sector presence, sector specialization and the role of firm characteristics

This table shows the impact of a funding shock on domestic credit supply, conditional on banks' sector presence, banks' sector specialization and firm characteristics. In columns 1 to 5, we individually introduce firm size, age, leverage, pledged collateral to fixed assets and financial pressure, respectively. In column 6, we simultaneously include these variables and their interaction with the funding shock. The dependent variable is the percentage growth in the granted loan amount. We control for all observed and unobserved bank-specific covariates by including bank fixed effects. Firm demand is controlled for by means of a firm fixed effect if a firm is borrowing from at least two banks and a group fixed effect for single bank borrowers. Single bank borrowers are pooled together in a group based on location, sector and size (LSS fixed effect). Standard errors are clustered at the bank level. ***, ** and * denote p<0.01, p<0.05 and p<0.1 respectively.

	(1) $\Delta\%$ Credit$_{bf}$	(2) $\Delta\%$ Credit$_{bf}$	(3) $\Delta\%$ Credit$_{bf}$	(4) $\Delta\%$ Credit$_{bf}$	(5) $\Delta\%$ Credit$_{bf}$	(6) $\Delta\%$ Credit$_{bf}$
Sector presence$_{bs}$ * $\Delta\%$ Funding$_b$	-0.551***	-0.554***	-0.581***	-0.478***	-0.593***	-0.520***
	(0.138)	(0.162)	(0.147)	(0.159)	(0.145)	(0.132)
Sector specialization$_{bs}$ * $\Delta\%$ Funding$_b$	-0.251***	-0.286***	-0.264***	-0.281***	-0.277***	-0.252***
	(0.0850)	(0.0748)	(0.0927)	(0.0841)	(0.0930)	(0.0815)
Total assets$_f$ * $\Delta\%$ Funding$_b$	0.00343					0.00302
	(0.0211)					(0.0212)
Age$_f$ * $\Delta\%$ Funding$_b$		0.000717				0.000611
		(0.00186)				(0.00106)
Leverage$_f$ * $\Delta\%$ Funding$_b$			0.108***			0.102***
			(0.0269)			(0.0317)
Pledged collateral to fixed assets$_f$ * $\Delta\%$ Funding$_b$				0.0227*		0.0197***
				(0.0118)		(0.00591)
Financial pressure$_f$ * $\Delta\%$ Funding$_b$					0.0340***	0.0330***
					(0.00859)	(0.0109)
Observations	144,060	144,060	144,060	141,478	143,919	141,364
R-squared	0.349	0.314	0.315	0.321	0.316	0.368
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Location-sector-size FE	Yes	Yes	Yes	Yes	Yes	Yes

Table 7: Robustness: geographic specialization, loan maturity and relationship strength

This table investigates alternative reallocation scenarios based on geographical bank specialization, loan maturity specialization and bank-firm relationship lending. The dependent variable is the percentage growth in the granted loan amount, similar to the first column in Table 3. In column 1 we control for geographical presence and specialization. Both indicators are calculated in a similar way as sector presence and specialization, but on the province level instead of the sector level. In column 2, the maturity structure indicator captures the share of loans provided by a bank to a sector that matures within one year. In column 3 and 4 we include two relationship lending proxies to the regressions. In column 3, we include the length of a bank-firm relation, proxied by the number of months that a firm has an outstanding loan with a bank before 2008:9. In column 4, we include a dummy indicating whether a bank is the main bank of a firm, calculated as the bank from which a bank borrows its largest share of credit in the thirteen months before 2008:9. In column 5, we jointly add these variables. In each regression, we control for all observed and unobserved bank-specific characteristics by including bank fixed effects. Firm demand is controlled for by means of firm fixed effects for firms borrowing from at least two banks and group fixed effects for single bank borrowers. Single bank firms are pooled together in a group based on location, sector and size (LSS fixed effect). Standard errors are clustered at the bank level. ***, ** and * denote p<0.01, p<0.05 and p<0.1 respectively.

	(1) $\Delta\%$ Credit$_{bf}$	(2) $\Delta\%$ Credit$_{bf}$	(3) $\Delta\%$ Credit$_{bf}$	(4) $\Delta\%$ Credit$_{bf}$	(5) $\Delta\%$ Credit$_{bf}$
Sector presence$_{bs}$ * $\Delta\%$ Funding$_b$	-0.507***	-0.359**	-0.517***	-0.521***	-0.350**
	(0.135)	(0.176)	(0.119)	(0.132)	(0.171)
Sector specialization$_{bs}$ * $\Delta\%$ Funding$_b$	-0.266***	-0.370***	-0.271***	-0.252***	-0.394***
	(0.0836)	(0.116)	(0.0774)	(0.0808)	(0.123)
Total assets$_f$ * $\Delta\%$ Funding$_b$	0.00324	0.00268	0.00314	0.00372	0.00550
	(0.0211)	(0.0214)	(0.0175)	(0.0213)	(0.0172)
Age$_f$ * $\Delta\%$ Funding$_b$	0.000549	0.000438	-3.88e-05	0.000627	-0.000167
	(0.00109)	(0.00112)	(0.000977)	(0.00111)	(0.00104)
Leverage$_f$ * $\Delta\%$ Funding$_b$	0.104***	0.0998***	0.111***	0.103***	0.114***
	(0.0314)	(0.0321)	(0.0304)	(0.0306)	(0.0293)
Pledged collateral to fixed assets$_f$ * $\Delta\%$ Funding$_b$	0.0196***	0.0196***	0.0198***	0.0197***	0.0196***
	(0.00599)	(0.00594)	(0.00547)	(0.00588)	(0.00555)
Financial pressure$_f$ * $\Delta\%$ Funding$_b$	0.0332***	0.0336***	0.0307***	0.0330***	0.0311***
	(0.0109)	(0.0101)	(0.0109)	(0.0108)	(0.00992)
Geographical presence$_{bs}$ * $\Delta\%$ Funding$_b$	0.745				0.776
	(0.501)				(0.513)
Geographical specialization$_{bs}$ * $\Delta\%$ Funding$_b$	-0.0985				-0.0799
	(0.0921)				(0.0820)
Sector share with maturity > 1yr$_{bs}$ * $\Delta\%$ Funding$_b$		-0.126			-0.120
		(0.113)			(0.111)
Length of bank-firm relation$_{bf}$ * $\Delta\%$ Funding$_b$			-0.000181		-0.000260
			(0.000493)		(0.000480)
Main bank$_{bf}$ * $\Delta\%$ Funding$_b$				0.00611	0.0197
				(0.0303)	(0.0266)
Observations	141,364	141,364	141,364	141,364	141,364
R-squared	0.368	0.368	0.375	0.368	0.375
Controls	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes
Location-sector-size FE	Yes	Yes	Yes	Yes	Yes

Table 8: Real effects: firm investments and growth

This table investigates the impact of the funding shock on firm investments and firm growth. Investments are proxied by the growth in tangible fixed assets (column 1-2), firm growth is measured as the growth in total assets (column 3-4). The growth rate for both variables is computed as the difference between the last available value of the variable two years post-shock (i.e., end of 2010) and the last available value of the variable pre-shock, scaled by the last available value of total assets pre-shock. The independent variables of interest are the shock to deposits and interbank liabilities (Δ% Funding$_b$) and its interactions with bank-sector-specific and firm-specific characteristics. The set of characteristics we consider is identical to the ones in column 6 of Table 6. We include bank sector presence, bank sector specialization, firm size, firm age, leverage, pledged collateral to fixed assets and financial pressure. The regressions include further controls for whether the firm received an additional loan from a new bank, for whether a bank terminated a loan with a firm, for whether the firm is borrowing from more than one bank, for the change in the ratio of utilized over authorized credit, for whether the firm increased its reliance on trade credit and for growth opportunities by including the firm's sales growth over the period and a set of sector dummies. Standard errors are clustered at the bank level. ***, ** and * denote p<0.01, p<0.05 and p<0.1 respectively.

	(1) Δ% Fixed assets$_f$	(2) Δ% Fixed assets$_f$	(3) Δ% Assets$_f$	(4) Δ% Assets$_f$
Δ% Funding$_b$	0.043*	0.730**	0.022	0.771*
	(0.022)	(0.311)	(0.029)	(0.454)
Sector presence$_{bs}$ * Δ% Funding$_b$		-0.517*		-0.549
		(0.264)		(0.335)
Sector specialization$_{bs}$ * Δ% Funding$_b$		-0.004		0.170
		(0.106)		(0.156)
Total assets$_f$ * Δ% Funding$_b$		-0.044**		-0.053*
		(0.020)		(0.030)
Age$_f$ * Δ% Funding$_b$		-0.002		-0.001
		(0.001)		(0.001)
Leverage$_f$ * Δ% Funding$_b$		-0.108		-0.0948
		(0.089)		(0.120)
Pledged collateral to fixed assets$_f$ * Δ% Funding$_b$		-0.006		-0.012
		(0.015)		(0.016)
Financial pressure$_f$ * Δ% Funding$_b$		-0.006		-0.011
		(0.011)		(0.024)
Observations	114,436	114,436	114,436	114,436
R-squared	0.157	0.157	0.341	0.341
Control variables	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes

Appendix

Table A1: Between and within bank heterogeneity in shock transmission: bank capital and liquidity vs. sector presence and sector specialization

This table contains information on the robustness of our findings when allowing for heterogeneity in the shock transmission depending on the level of bank capitalization and bank liquidity. In column 1, we reproduce the baseline result on the impact of the funding shock on domestic credit supply (similar to column 1 of panel A of Table 3). In column 2, we add, to this specification, an interaction effect between the funding shock and bank capital as well as bank liquidity. In column 3, we report the results when adding these additional interactions to the specification reported in column 4 of Table 4). Firm demand is controlled for by means of firm fixed effects if a firm is borrowing from at least two banks and group fixed effects for single bank borrowers. Single bank borrowers are pooled together in a group based on location, sector and size (LSS fixed effect). Standard errors are clustered at the bank level.***, ** and * denote p<0.01, p<0.05 and p<0.1 respectively.

	(1) Δ% Credit$_{bf}$	(2) Δ% Credit$_{bf}$	(3) Δ% Credit$_{bf}$
Δ% Funding$_b$	0.250***	0.668***	0.679***
	(0.0653)	(0.234)	(0.236)
Capital to total assets$_b$ * Δ% Funding$_b$		-7.397***	-7.653***
		(2.465)	(2.478)
Interbank assets to total assets$_b$ * Δ% Funding$_b$		-0.445	-0.453
		(0.477)	(0.480)
Sector presence$_{bs}$ * Δ% Funding$_b$			-0.705***
			(0.199)
Sector specialization$_{bs}$ * Δ% Funding$_b$			-0.255***
			(0.0829)
Sector presence$_{bs}$			-0.114**
			(0.0435)
Sector specialization$_{bs}$			0.0419
			(0.0289)
Capital to total assets$_b$	-0.169	-0.233	-0.226
	(0.190)	(0.189)	(0.191)
Return on equity$_b$	-0.0652	-0.0462	-0.0478
	(0.0574)	(0.0478)	(0.0472)
Provision to total loans$_b$	0.394***	0.414***	0.408***
	(0.122)	(0.0955)	(0.0966)
Interbank assets to total assets$_b$	0.0290	0.0545	0.0552
	(0.0699)	(0.0798)	(0.0800)
Deposits to total assets$_b$	-0.126	-0.0754	-0.0695
	(0.0928)	(0.0763)	(0.0742)
Interbank liabilities to total assets$_b$	-0.0633	-0.00321	0.00447
	(0.0932)	(0.0771)	(0.0757)
Bank Size$_b$	-0.00560	-0.0141***	-0.0145***
	(0.00569)	(0.00505)	(0.00505)
Observations	160,224	160,224	160,224
R-squared	0.295	0.296	0.296
Location-sector-size FE	Yes	Yes	Yes

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

Table A2: Within bank heterogeneity in shock transmission: multiple bank relationship firms

This table contains information on the estimated effect of a funding shock on the domestic credit supply, conditional on banks' sector presence and banks' sector specialization. In this table, we report results for both the full sample as well as the sub-sample of firms that borrow from multiple banks. In the full sample, firm demand is controlled for by means of a firm fixed effect if a firm is borrowing from at least two banks and a group fixed effect for single bank borrowers. Single bank borrowers are pooled together in a group based on location, sector and size (LSS fixed effect). In the reduced sample, firm demand is controlled for by means of firm fixed effects. In all specification, we control for all bank-specific covariates, such as for instance bank (re)capitalization or interventions, by including bank fixed effects. Standard errors are clustered at the bank level. ***, ** and * denote p<0.01, p<0.05 and p<0.1 respectively.

	(1) $\Delta\%$ Credit$_{bf}$	(2) $\Delta\%$ Credit$_{bf}$
Sector presence$_{bs}$ * $\Delta\%$ Funding$_b$	-0.520***	-0.918**
	(0.132)	(0.354)
Sector specialization$_{bs}$ * $\Delta\%$ Funding$_b$	-0.252***	-0.332
	(0.0815)	(0.204)
Total assets$_f$ * $\Delta\%$ Funding$_b$	0.00302	-0.00670
	(0.0212)	(0.0257)
Age$_f$ * $\Delta\%$ Funding$_b$	0.000611	0.00163
	(0.00106)	(0.00152)
Leverage$_f$ * $\Delta\%$ Funding$_b$	0.102***	0.194***
	(0.0317)	(0.0698)
Pledged collateral to fixed assets$_f$ * $\Delta\%$ Funding$_b$	0.0197***	0.0134
	(0.00591)	(0.0100)
Financial pressure$_f$ * $\Delta\%$ Funding$_b$	0.0330***	0.0463**
	(0.0109)	(0.0176)
Observations	141,364	44,649
R-squared	0.368	0.459
Controls	Yes	Yes
Bank FE	Yes	Yes
Firm FE	No	Yes
Location-sector-size FE	Yes	No

Table A3: Within bank heterogeneity in shock transmission: alternative shock definition

This table contains information on the estimated effect of an interbank liabilities shock on the domestic credit supply, conditional on banks' sector presence and banks' sector specialization. In this table, we report results for both the full sample as well as the subsample of firms that borrow from multiple banks. In the full sample, firm demand is controlled for by means of a firm fixed effects if a firm is borrowing from at least two banks and a group fixed effect for single bank borrowers. Single bank borrowers are pooled together in a group based on location, sector and size (LSS fixed effect). In the reduced sample, firm demand is controlled for by means of firm fixed effects. In contrast to the body of the paper, we present results using an alternative definition of the funding shock, which is based solely on interbank liabilities (and thus excludes changes in deposit funding). In all specification, we control for all bank-specific covariates, such as for instance bank (re)capitalization or interventions, by including bank fixed effects. Standard errors are clustered at the bank level. ***, ** and * denote p<0.01, p<0.05 and p<0.1 respectively.

	(1) $\Delta\%$ Credit$_{bf}$	(2) $\Delta\%$ Credit$_{bf}$
Sector presence$_{bs}$ * $\Delta\%$ Interbank liabilities$_b$	-0.856***	-1.449**
	(0.258)	(0.662)
Sector specialization$_{bs}$ * $\Delta\%$ Interbank liabilities$_b$	-0.316**	-0.351
	(0.147)	(0.277)
Total assets$_f$ * $\Delta\%$ Interbank liabilities$_b$	0.0133	-0.00808
	(0.0303)	(0.0414)
Age$_f$ * $\Delta\%$ Interbank liabilities$_b$	0.000888	0.00340
	(0.00185)	(0.00249)
Leverage$_f$ * $\Delta\%$ Interbank liabilities$_b$	0.181***	0.350***
	(0.0465)	(0.0943)
Pledged collateral to fixed assets$_f$ * $\Delta\%$ Interbank liabilities$_b$	0.0331***	0.0202
	(0.0106)	(0.0208)
Financial pressure$_f$ * $\Delta\%$ Interbank liabilities$_b$	0.0565***	0.0784***
	(0.0157)	(0.0285)
Observations	141,364	44,649
R-squared	0.368	0.459
Controls	Yes	Yes
Bank FE	Yes	Yes
Firm FE	No	Yes
Location-sector-size FE	Yes	No

Table A4: Heterogenous shock transmission robustness check: four largest banks dropped

This table shows the impact of a funding shock on domestic credit supply, conditional on banks' sector presence, banks' sector specialization and firm characteristics. To test for the sensitivity of our results to a single large bank, we reproduce the regression results shown in Table 6, but exclude the four biggest banks one by one from the estimation. The four biggest bank (in alphabetical order, unrelated to the columns of the Table) are Dexia, BNP Fortis, ING and KBC. The dependent variable is the percentage growth in the granted loan amount. We control for all observed and unobserved bank-specific covariates by including bank fixed effects. Firm demand is controlled for by means of a firm fixed effect if a firm is borrowing from at least two banks and a group fixed effect for single bank borrowers. Single bank borrowers are pooled together in a group based on location, sector and size (LSS fixed effect). Standard errors are clustered at the bank level. ***, ** and * denote p<0.01, p<0.05 and p<0.1 respectively.

	(1) $\Delta\%$ Credit$_{bf}$	(2) $\Delta\%$ Credit$_{bf}$	(3) $\Delta\%$ Credit$_{bf}$	(4) $\Delta\%$ Credit$_{bf}$
Sector presence$_{bs}$ * $\Delta\%$ Funding$_b$	-0.570**	-0.571**	-0.616***	-0.343***
	(0.236)	(0.273)	(0.118)	(0.0919)
Sector specialization$_{bs}$ * $\Delta\%$ Funding$_b$	-0.265***	-0.291*	-0.218**	-0.158*
	(0.0799)	(0.163)	(0.0862)	(0.0813)
Total assets$_f$ * $\Delta\%$ Funding$_b$	0.0248***	-0.0277	0.00588	0.0109
	(0.00845)	(0.0231)	(0.0203)	(0.0201)
Age$_f$ * $\Delta\%$ Funding$_b$	0.00107	-0.000961	0.000689	-4.53e-05
	(0.000874)	(0.00138)	(0.00104)	(0.00126)
Leverage$_f$ * $\Delta\%$ Funding$_b$	0.0992***	0.0311	0.0829***	0.112***
	(0.0321)	(0.0427)	(0.0211)	(0.0376)
Pledged collateral to fixed assets$_f$ * $\Delta\%$ Funding$_b$	0.0141***	0.0103	0.0123**	0.0169***
	(0.00515)	(0.00677)	(0.00536)	(0.00496)
Financial pressure$_f$ * $\Delta\%$ Funding$_b$	0.0449***	0.0257	0.0327**	0.0365***
	(0.00722)	(0.0212)	(0.0125)	(0.0106)
Observations	128,674	100,973	113,104	106,876
R-squared	0.307	0.293	0.295	0.291
Controls	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes
Location-sector-size FE	Yes	Yes	Yes	Yes
Omitted Bank	large bank 1	large bank 2	large bank 3	large bank 4