Holding strong in a storm: How banks reallocate credit according to their sector presence and specialization after a crisis*

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Abstract

This paper provides evidence on the strategic lending decisions made by banks facing a liquidity shock. We use bank-firm level credit data to investigate the impact of the Lehman collapse on the reallocation of credit within the domestic loan portfolio of Belgian banks. Although banks in general shield domestic firms, we identify two reallocation channels within the domestic market. First, banks reallocate to sectors where they have high sector presence. Second, they also reallocate to sectors in which they are heavily specialized. These channels are present over and above traditional reallocation effects based on firm characteristics. Finally, we provide insight in the timing of these channels.

Keywords: Interbank market, domestic credit, sector specialization, firm risk

JEL classification: G01

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1 Introduction

The collapse of the investment bank Lehman Brothers in September 2008 was an unprecedented shock to Western banks' funding opportunities and many papers by now have analyzed the direct international transmission and local impact of this and similar shocks. Extant research for example confirms that global banks transmitted shocks across borders through their local affiliates, that locally affected banks may have curtailed the granting of credit to corporations and households alike, and that this credit crunch may have had real consequences in terms of corporate financing, performance and trade.[1]

What seems still missing from this most rapidly expanding literature, however, is a comprehensive and detailed analysis of the industry- and firm-specific strategies that banks follow when deciding where to re-allocate credit when their own funding is affected by a negative shock.[2] This is somewhat surprising, given that a number of papers in the banking literature (we will review later) have theoretically modeled and empirically investigated the importance of bank business models, both in terms of bank orientation and (more important for our purposes) bank industry specialization. Additionally, while the current literature documents that there is an impact of financial shocks on bank lending decisions, by the best of our knowledge, no papers investigated whether the magnitude of the impact changes over time and whether the impact persists. Merging the bank business model and bank shock transmission strands in the literature as well as investigating the timing and duration of the shock impact are the gaps this paper aims to fill.

To identify the reallocation in the supply of credit that follows the difficulties for banks to obtain funding on the interbank market, we rely on a unique combination of data sets. We employ credit data from a comprehensive credit register that contains all credit granted in Belgium by financial

[1] On shock transmission see Cetorelli and Goldberg (2011), Cetorelli and Goldberg (2012) , Acharya et al. (2013), Albertazzi and Bottero (2013), Claessens and van Horen (2013), Cull and Martinez Peria (2013), Allen et al. (2014), Bertay (2014), and De Haas and van Lelyveld (2014); on the curtailing of credit see Puri et al. (2011); Iyer et al. (2014); and on the real consequences see Ongena et al. (2013); Chodorow-Reich (2014); Paravisini et al. (2014), among others. See also the seminal work by Peek and Rosengren (1997, 2000).

[2] Puri et al. (2011) do show that firm-bank relationships shield firms somewhat from the curtailing of credit by the affected savings banks, while Ongena et al. (2015) find that German banks re-allocate credit towards less risky industry-region combinations.

institutions, monthly balance sheet data of these financial institutions, and firm data from annual balance sheets of all registered firms. For our analysis we rely on 160,224 fully documented bank-firm combinations and we study various measures of loan growth (at both the intensive and extensive margins of credit granting). Following, e.g., Khwaja and Mian (2008) and Jimenez et al. (2012) the corresponding growth specifications load in sets of fixed effects that saturate the regressions up to the bank-time and firm-time level.

We start by benchmarking our study with related studies. The average firm in our sample borrows from a bank that experiences a contraction in interbank funding equivalent to 10 percent 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 4 percent. This is the unconditional effect of the liquidity shock on credit supply in Belgium, which is in line with previous research[3], although a bit smaller. Further, an investigation of the timing and duration of this effect reveals that the funding shock significantly impacts credit supply already 3 months after the shock started, reaches a maximum impact after 8 to 9 months, and remains significant and high up to 30 months after the shock.

We are, however, particularly interested in how a bank's business model, as reflected in its *sector presence* and *sector specialization*, determines the reallocation of credit when a negative funding shock hits. We define both sector presence and sector specialization later in operational detail, but *en bref* 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 more than 17 percent for the average firm (i.e. a reduction of the average effect from 4 to 3.3 percent). Similarly, a standard deviation increase in sector specialization reduces the negative impact of the funding shock on credit supply by 10 percent for the average firm (i.e. a reduction of the average effect from 4 to 3.6 percent). 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). A look into the timing and duration of these reallocation channels provides interesting and complementary insights. The moderating impact of sector presence has an almost instantaneous significant impact, reaching a maximum after 3 months, and then gradually fades out to become insignificant after 20 months.

[3] See the findings of Khwaja and Mian (2008) for the impact of deposit funding shock in Pakistan or Iyer et al. (2014) for an interbank funding shock in Portugal.

Sector specialization on the other hand only becomes important for the reallocation of credit after about 9 to 10 months, reaches a maximum after 21 months, and is still significant 30 months after the shock.

Importantly, these results also hold when taking into account firm riskiness. Banks reallocate credit after a funding shock towards sectors in which they have high sector presence and in which they are specialized, over and above borrower characteristics such as size, age and risk. This confirms that our main results are not driven by the self-selection of banks into industries that exist of a specific set of firms. When further focusing on firm characteristics, and in contrast to previous literature, we find no evidence that banks hit by the funding shock reallocate credit away from more opaque (i.e. younger and smaller) firms .[4] One potential explanation could be that opacity only matters when there is a lot of asymmetric information as opacity is then believed to proxy for risk. In our sample, nearly all firms file balance sheets and the quality and detail of the balance sheets is very high (as they are checked for inconsistencies by the national authority), hence reducing the asymmetric information. Consistent with this explanation, we do find strong evidence that banks hit by the funding shock reallocate credit away from risky firms.
Finally, we also observe that the real effects of the shocks are rather limited, potentially due to a limited effect on overall credit growth. [5] We find a moderate reduction in investments for firms that are borrowing from banks that where hit by the funding shock, while there is no overall effect on sales and asset growth. Additionally, we also observe a stronger reduction in sales growth for firms borrowing from banks with a larger sector presence. This indicates that the sustained credit by banks with large sector presence may come at higher cost (due to their pricing power), impacting the competitive position of the firm.

In sum, our results suggest that when faced with a funding shock that forces them overall to cut credit, banks will also swiftly reallocate it according to their business model, i.c., their sector presence and specialization. They will also reallocate credit towards safer firms, but not to larger or older firms.

[4]See for instance Stiglitz and Weiss (1981) and Holmstrom and Tirole (1997) for reasons why opacity matters under asymmetric information and see Khwaja and Mian (2008), Hadlock and Pierce (2010) and Iyer et al. (2014) for empirical evidence.

[5]A back of the envelop computation based on our baseline results for example learns that the 'missing credit' due to the funding shock is limited to 4 billion euro, which amount to about four percent of total credit granted prior to the shock.

2 Related literature

To informally structure our discussion of the relevant literature, we observe that a bank granting a unit loan (i.e., of size 1) expects to be repaid the loan amount, E[Loan Repayment], which equals:

$$E[LoanRepayment] = p(1+r) + (1-p)(1+r)(1-LGD) \tag{1}$$

where p is the probability the firm repays the loan and r is the contracted interest rate. In case the firm defaults, which occurs with probability (1-p) the bank expects to be repaid only (1+r) (1-LGD), with LGD denoting the proportional (per unit of loan amount) loss given default.

The presence of a bank in a sector, which is the share of the total loan volume in a sector granted by a particular bank, may in first instance confer on this bank the possibility to charge a higher contracted interest rate (Klein (1971), Monti (1972)), if lending to a sector defines a market for credit and a higher share in a market yields market power (Winton (1997)). The specialization of a bank in a sector, which is the share of the total loan volume of a bank granted to a particular sector, on the other hand, may positively affects the probability of repayment (Boot and Thakor (2000)) and negatively the loss given default, these two elements jointly broadly characterizing firm risk.

But a number of qualifications are in order. A given level of market power for the bank may open opportunities for it to inter-temporally subsidize credit granted, say to small and young firms (Petersen and Rajan (1995)), thereby possibly affecting both their default probability and loss given default in the future. In addition, bank orientation and specialization may be chosen optimally by the banks to soften competition from other banks and capital markets. For example in Stomper (2006) the individual bank‘s exposure to a sector is chosen to optimize rent extraction which itself is based on bank sector specialization and proportional to the bank‘s exposure to industry-specific credit risk. All of this is then in turn determined by the number of banks that plan to lend to the sector. In the model‘s equilibrium, the sector receives funding from a number of banks with sector specialization, as well as from a competitive fringe of banks without such specialization (see also Boot and Thakor (2000), Hauswald and Marquez (2003)).

A vast empirical literature on bank market share, market power and credit (see e.g. Degryse et al. (2009) for a review) finds that market share recurrently leads to higher interest rates and lower credit volumes. Work on bank sector specialization and individual loan outcomes on the other hand is more limited (recent exceptions are Acharya et al. (2006),Degryse and Ongena (2007) and Paravisini et al. (2014)). 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 financial conglomerates (e.g., Laeven and Levine (2007), Kuppuswamy and Villalonga (2010)).

So far none of these papers comprehensively assesses if and how banks when faced with a funding shock will reallocate credit according to sector presence and specialization, and towards which firms they will do so.

In this respect, a 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)) is also relevant. Cremers et al. (2011) for example find that the bank they study reallocates capital within the bank to compensate for deposit shortfalls, but this is done partly according to the influence within the bank of the respective receiving subsidiaries. Cetorelli and Goldberg (2012) provide direct evidence that internal capital markets are active in global banks and contribute to the international propagation of shocks. In particular they find that having global operations insulates banks from changes in domestic monetary policy, in particular global banks manage liquidity on a global scale, actively using cross-border internal funding in response to local shocks. De Haas and Van Horen (2012) find that after the collapse of Lehman Brothers international banks lending in the syndicated loan market readjusted their foreign portfolios based on the closeness of the borrower to the bank. We contribute to this literature by showing that banks when faced with a funding shock will reallocate credit domestically according to sector presence and specialization.

Finally, our paper is also related to theoretical and empirical work dealing with the financing of portfolio of projects by other financiers (e.g., Inderst et al. (2007)).

3 Data

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

3.1 Central Corporate Credit Register (CCCR)

The CCCR compiles information on credits 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 the credit institutions in our sample. These credit institutions should be established in Belgium and licensed by the NBB. This concerns both branches incorporated under foreign law established in Belgium and companies incorporated under Belgian law. A credit institution needs to provide information to the CCCR on a monthly basis on all debtors to which they have an aggregate exposure exceeding 25000 euro. The CCCR contains both identifying information on the debtor and creditor as well as information on the credit authorized and amount drawn, by type of credit. We collapse the data to the firm-bank-month level. Furthermore, we only include corporate credit and exclude firms operating in the financial and insurance sector, the public administration and education sector (sector classifications K, O and P). We also exclude registered household activities and activities of extraterritorial bodies (sector classifications T and U). The final sample includes firms from sixteen sectors of which the five most important ones are wholesale and retail trade, construction, professional activities, real estate, and manufacturing.

Insert TABLE 1 around HERE

3.1.1 Measures of firm-bank level credit growth

From the credit register, we calculate four different credit supply measures capturing different dimensions of the intensive and extensive margin of credit. First of all, we compute a loan growth variable at the bank-firm level. Loan growth is computed as the logarithmic difference between the post-shock averaged and the pre-shock averaged[6] values of the authorized amount (labelled Δ % Committed credit$_{bf}$, henceforth). The shock we exploit corresponds in timing with the collapse of the investment bank Lehman Brothers in September 2008 (called the shock; henceforth). We limit the pre-shock window to thirteen months to use the maximum amount of information available

[6]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 firm-bank level (Bertrand et al., 2004). The empirical approach is also similar in setup to Khwaja and Mian (2008).

without interference with 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 part of the analysis, we also use expanding post shock windows varying in length between one month and thirty months to analyze the timing and time-varying magnitude of the documented effects and channels.

The first measure hence provides information on the intensive margin of bank-firm relationships. Secondly, we create a dummy variable (Increase in committed credit$_{bf}$) which takes on the value of 1 if loan growth was strictly positive and 0 otherwise. Doing so, this variable emphasizes the effect on the propensity to grant extra credit. Thirdly, we create a dummy (Large decrease in committed credit$_{bf}$) which equals 1 if the firm's loan growth is in the lowest quartile of loan growth of all the loans in the credit register, and 0 otherwise. Likewise, this variable proxies for authorized amounts that have been reduced substantially, or maturing loan exposures that have not been rolled over. Note that the second and third variable have both an intensive margin and extensive margin interpretation. Akin to the first measure, they can only be computed for bank-firm relationships that exist in both the pre -and post Lehman default period (intensive margin of bank-firm relationship). However, they serve the purpose to proxy for new loans or loan terminations (extensive margin at the loan level, but intensive at the bank-firm level). We also compute one measure that purely looks at the extensive margin of credit supply. In particular, our fourth measure is a dummy (New relationships$_{bf}$) that equals 1 if a firm has a loan with a bank at the end of the post-shock period and did not have a loan with that bank the month prior to the Lehman default, and 0 otherwise. 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 are reported in Table 2.

TABLE 2: HERE

The average growth in credit authorized is slightly negative. More precisely, it is -2.37%, mainly due to amortizations. However, there is substantial cross-sectional variation, with a standard deviation of 27.8%, indicating that some firms witnesses substantial drops in their credit exposures (due to outright cuts or lower likelihood of renewals or roll-overs), whereas other firm-bank exposures substantially expand. Slightly less than thirty percent of the pre-crisis bank-firm pair credit exposures increase following the Lehman collapse. Large drop is a dummy that takes on the value of one for values of Δ% Committed Credit in the lowest quartile. This corresponds with all bank-firm credit exposures that drop with more than -15%. Regarding the extensive margin of credit, we find that 14.4% of the firm-bank relationships that exist at the end of the post-shock window, did not exist at the time of the shock.

Our full sample consists of 160,224 observations from 134,368 firms. More than 83% of the 160,224 credits are committed by the four biggest banks in Belgium. More than 84% of the 134,368 firms borrow from only 1 bank. Multiple bank firms borrow typically from 2 banks, with a maximum of 8 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.

3.1.2 Bank sector presence and bank sector specialization

The credit register also allows us to compute bank-sector specific measures of competitive and comparative advantages. More specifically, we construct two measures from the bank's perspective: *bank sector presence* and *bank sector specialization*. The sector presence of bank b in sector s is defined as the ratio of all credit granted from bank b to sector s to the total credit granted to sector s. As can be seen in equation (2), we measure the bank sector presence by aggregating all loans in the CCCR that bank b has in sector s, and divide it by the aggregate of all loans in the CCCR in sector s. The higher the bank sector presence, the more dominant a bank is in a given sector and as such the bank can exploit his competitive advantage.

$$Bank\ Sector\ Presence_{bs} = \frac{\sum_{f=1}^{F} L_{fbs}}{\sum_{b=1}^{B}\sum_{f=1}^{F} L_{fbs}} \tag{2}$$

where L_{fbs} is the credit authorized by bank b to firm f in sector s.

The sector specialization of bank b to sector s is defined as the ratio of all credit granted from bank b to sector s to bank b's total credit granted. As can be seen in equation (3), we measure the bank sector specialization by aggregating all loans in the CCR that bank b has in sector s, and divide it by the aggregate of all loans in the CCR of bank b. 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 and as such the bank can exploit his comparative advantage.

$$\textit{Bank Sector Specialization}_{bs} = \frac{\sum_{f=1}^{F} L_{fbs}}{\sum_{s=1}^{S} \sum_{f=1}^{F} L_{fbs}} \tag{3}$$

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 the 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$_{bs}$ (see model (6) below).

The average bank in the sample is active in ten sectors as can be seen from the bank-sector level statistics in Table 2 for bank sector specialization (0.094). The average bank sector specialization in the sample, however, is a bit higher (0.130) 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 average bank sector presence in the sample is 0.185 which is consistent with the observation that the 4 biggest banks in Belgium grant the large majority of credits.

3.2 Bank Balance Sheet and Income Statement

Credit institutions established in Belgium report to the NBB and to the Banking, Finance and Insurance Commission on their financial position via "Schema A". We use the unconsolidated statements to include only the Belgian activities and operations of Belgian or foreign banks. The reporting frequency varies according to the nature of the information. Monthly data are available for the balance sheets and off-balance-sheet items, whereas the profit and loss accounts are filed quarterly. We first time-average the information obtained from "Schema A" to obtain a pre-shock and post-shock average, akin to the treatment of the credit register data. The funding shock is defined as the difference of the time-averaged value of interbank liabilities in the post-shock vs. pre-shock period, scaled by the time-averaged total assets pre-shock. There are 39 banks active in our sample. The average borrower's bank is experiencing an interbank funding outflow (relative to pre-shock total assets) of 10.3% (See Table 2). The worst funding shock corresponds with an outflow of 16.3%. However, many banks also witness an interbank funding inflow. The largest part of the funding shock is absorbed by a reduction in interbank assets, -8.9%. More crucial for our study and the identification of the channels is that there is substantial cross-sectional variation in the funding shock. 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 proxy for 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) and stable deposit funding (demand and savings deposits to total assets).

3.3 Firm Balance Sheet and Income Statement

Belgian corporations file their balance sheets and income statements to the NBB, which not only collects all the information but also performs a number of consistency and control checks on the reported balance sheets and income statements. For the majority of firms, the reporting frequency is annually and the accounting year coincides with the calender year and closes the 31st of December. Almost all Belgian firms 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 pre-shock with the firms' credit and bank data. After matching, we lose 16,175 observations from 14,974 firms that are present in the credit register for which we have no balance sheet and income statement data. Table 2 shows that credit in our sample is committed to firms with a median age of 12 years old, with 573,779 euro assets and 4 employees. The median leverage ratio (measured as total debt to total assets) in the sample is 0.746. When only debt at financial institutions is considered, we find a median financial leverage of 0.244 in the sample. Further, the median Altman Z-score in the sample is 0.665; the median coverage ratio shows that total interest payments take up 82.2% of EBIT; and the median cash stock in the sample is 5.6% of total assets. Finally, Table 2 shows that the median pledged collateral is zero, but the average pledged collateral amounts up to 39.5% of the value of the fixed assets.

4 Bank funding shocks and domestic credit supply

The main economic and academic contribution of the paper is the analysis of the within bank heterogeneity, due to bank sector presence and bank sector specialization, in the transmission of a funding shock to domestic firms. However, for comparison with other papers, we first document how the funding shock affects domestic credit supply. We introduce the methodology in subsection 4.1 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 4.2, 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. Another contribution to the literature is the dynamic analysis of the impact of the funding shock using varying lengths of the post-shock period (from 1 month to 30 months). We present the setup and results in subsection 4.3.

4.1 Methodology

To analyze the impact of the bank funding shock on domestic credit supply, we first run a baseline regression of changes in credit supply on the interbank funding shock as well as pre-shock bank characteristics. In particular, we estimate the following equation:

$$CREDIT_{fb} \quad = \quad \beta_1 \ \Delta\% IBL_b + \gamma \ BANK \ CONTROLS_b + \alpha_f + \epsilon_{fb} \tag{4}$$

Equation (4) shows our baseline model. β_1 shows the effect of a shock to the interbank liabilities (Δ% IBL$_b$) on the credit growth at the firm-bank level, while controlling for important time-averaged predetermined bank level covariates, which are defined in subsection 3.2. Next to including the funding shock and bank-specific controls, we control for all observed and unobserved firm heterogeneity (among which firm-specific credit demand shocks) by means of a set of firm fixed effects, α_f. 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 2 bank relationships. As mentioned before, 84% of the firms in Belgium borrow from only one bank. Hence, including firm fixed effects would substantially reduce the sample size (see Section 3.1) and bias the sample towards larger firms.

Therefore, we take a two-pronged approach. In one approach, we work with the sample of firms that borrow from at least 2 banks and include the firm fixed effects to control for firm-specific credit demand, and we thus estimate model (4). In the other approach, 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 size, sector affiliation and firm location (defined SSL, size-sector-location, henceforth. More specifically, these firms are grouped according to the decile of loan size in the CCR, 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) in a US setup. In this second approach we thus estimate model (5).

$$CREDIT_{fb} \quad = \quad \beta_1 \ \Delta\% IBL_b + \gamma \ BANK \ CONTROLS_b + \alpha_{SSL} + \epsilon_{fb} \tag{5}$$

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

4.2 Results: full sample vs multiple borrowers

The results showing the impact of the bank funding shock on domestic credit supply are presented in Table 3. We present the results using four different credit supply indicators as dependent variable. They are Δ% Committed credit$_{bf}$, Increase in committed credit$_{bf}$, Large decrease in committed credit$_{bf}$ and New relationships$_{bf}$, respectively. The odd columns correspond with the full sample results, whereas the even columns report results for the subsample of multiple bank borrowers.

TABLE 3: HERE

We first discuss the results for the full sample, hence including the single bank-relationship firms and using the SSL group fixed effects. We find that the shock to the interbank funding market has a statistically significant effect in each of the four specifications. Firms borrowing from banks facing a larger interbank funding outflow will face a lower credit growth (column 1), have a lower likelihood of seeing an increase in their exposure (column 3) and are more likely to experience a large drop in the authorized loan amount (column 5). Overall, actual interbank 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 interbank liabilities are more (less) likely to originate loans to new clients (column 7).

The results are not only statistically significant, but also economically meaningful. For example, what does a point estimate of 0.403 in column 1 of Table 3 imply in economic terms? The total amount of committed credit prior to the shock by all firms in the sample is 100 billion euro. The average firm's bank experiences a funding shock of -10%. A point estimate of 0.403 thus implies that the average firm's supply-induced drop in credit availability is -4%. Our results thus indicate that the supply-shock induced 'missing credit' in the Belgian credit market is 4 billion euro. The other coefficients can be interpreted as changes in probabilities. A firm borrowing from a bank hit by a funding shock of -10% has a 5.71 percentage points lower probability of seeing an increase in committed credit (sample mean is 0.289), a 8.63 percentage points higher probability of seeing a large decrease in committed credit (sample mean is 0.25, by construction), and a 4.63 percentage points reduced probability of starting a relationship with another bank (sample mean is 0.144).

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 size-sector-location triples. In the even columns 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 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 could either indicate that including size-sector-location triples is sufficient to control for firm demand, or that firms' credit demand is not a driving factor in observed variation in credit during the post-crisis period. Given the similarity in results, we will focus on the larger sample in the subsequent analyzes of the paper. However, for the sake of transparency, we also report the smaller sample results in the appendix.

4.3 Results: expanding post-shock windows

In subsection 4.2, we report the results of an analysis using a pre- and post-event window of equal length (13 months). The shock we exploit corresponds in timing with the collapse of the investment bank Lehman Brothers in September 2008. The 13 month horizon is chosen to avoid interference with 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)), which did, however, not lead to an interbank funding outflow at banks operating in Belgium. In this subsection, we present results using expanding post-shock windows, but still using the same 13 month pre-shock window, 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. Secondly, it also serves the purpose of simply showing robustness for alternative post-event horizons.

The regression specifications remain similar to Equation (5), but 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 1 to 30 months, and estimate model (5) each time to test which factor is important at each horizon. The pre-shock period is always the same time average over the 13 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 funding) as the difference in the four-month post-shock average and the 13 month pre-shock average. In Figure 2, we graphically present information on time variation in the point estimate of interest, i.e. β_1 of model (5), for four different dependent variables: $\Delta\%$ Committed credit$_{bf}$, Increase in committed credit$_{bf}$, Large decrease in committed credit$_{bf}$ and New relationships$_{bf}$. In each subplot, we depict the point estimate on the funding shock variable, β_1 of model (5) as well as a 90% confidence bound (dotted lines).

FIGURE 2: HERE

This expanding window analysis yields a number of interesting and complementary insights. First of all, 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 slightly more than three months before the funding shock starts to have a significant impact on growth in committed credit, the likelihood of a large drop in committed credit or the start of a new bank-firm relationship. As soon as the post-event window exceeds five or six months, the point estimates related to the effect of the funding shock on various dimensions of credit availability remain fairly constant. Statistically, the point estimates reported in Table 3 for the full sample using a 13 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 due to 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 interbank funding outflow hits banks gradually with the largest reductions in October 2008 and December 2008 (see the upper left panel of Figure 1).

5 Reallocating domestic credit

The results in the previous section document that the interbank 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. What seems still missing from this most rapidly expanding literature, however, is a comprehensive and detailed analysis of the industry- and firm-specific strategies that banks follow when deciding where to reallocate credit when their own funding is affected by a negative shock. 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 industry specialization.[7] In this section, we analyze the importance of bank sector presence and bank sector specialization for the pass-through of bank funding shocks to firms' credit in a static framework (Subsection 5.3.2) and using expanding post-shock event windows (Subsection 5.2).

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

5.1 Bank sector presence and bank sector specialization: Static analysis

To analyze the within-bank heterogeneity in shock transmission, due to banks' sector presence and banks' sector specialization, we expand our baseline model (see Eq. (5)) with measures of bank sector presence (Eq. (2)) and bank sector specialization (Eq. (3)) and their interaction terms with the bank funding shock:

$$\begin{aligned} CREDIT_{fb} = {} & \beta_1 \; Bank\ Sector\ Presence_{bs} + \beta_2 \; Bank\ Sector\ Specialization_{bs} + \\ & \beta_3 \; Bank\ Sector\ Presence_{bs} * \Delta\%IBL_b + \beta_4 \; Bank\ Sector\ Specialization_{bs} * \Delta\%IBL_b + \\ & \alpha_{SSL} + \upsilon_b + \epsilon_{fb} \end{aligned} \tag{6}$$

An attractive feature of the specialization measures 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 4.2)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. As before, firm demand is again controlled for by using the SSL group fixed effects, while standard errors are clustered at the bank level. The results are reported in Table 4. All results in table 4 also survive when using the firm fixed effects to control for firm demand (see Appendix, table A1), when dropping the set of bank-time fixed effects and instead control for bank balance sheet characteristics or when further expanding equation 6) 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 A2).

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. Whether we focus on the actual growth of committed credit (column 1) or on the probability of increasing committed credit (column 2), the coefficient of the interaction term between the funding shock and sector specialization is always 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 standard deviation increase in sector presence (0.082, see table 2) reduces the negative impact of a ten percent reduction in interbank funding from 4 to 3.3 percent (i.e. a reduction of more than 17 percent).[8] Similarly, the third column illustrates that the impact of a negative funding shock on the probability of a large drop in committed credit is less severe for firms operating in sectors where the bank has more market power. The only exception on this moderating impact of sectoral market power is the granting of new loans (column 4), where the impact goes in the opposite direction

Apart from sector presence, sector specialization also plays an important role for the pass through of bank funding shocks, although to a somewhat smaller extent. Our results indicate that, after a negative funding shock, credit growth is less affected for sectors that make up a relatively larger share of a banks' portfolio. More precisely, the results in the first column of table 4 imply that a standard deviation increase in sector specialization (0.15) reduces the negative impact of a ten percent reduction in interbank funding from 4 to 3.6 percent (i.e. reduction in impact of 10 percent). The impact of sector specialization on the probability of increasing authorized credit goes in the same direction but is insignificant, while we do find a significant reduction of the probability of a large drop in committed credit for firms operating in sectors in which the bank is specialized. The impact on new credit is again insignificant.

Overall, the results in table 4 indicate that bank sector presence and sector specialization matter for the pass-through of bank funding shocks to firms. Banks prefer to shield firms in sectors in which they have market power 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. Boot, Thakor and Greenbaum (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. The 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 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.

[8] The impact of a ten percent reduction is based on the results in Table 3 : -10% * 0.403 = -4%. Based on the results in Table 4, a standard deviation increase in sector presence of 0.082 leads to an impact of -10% * (0.403 - 0.835 * 0.082) = -3.3%.

5.2 Bank sector presence and bank sector specialization: Expanding window analysis

The result in table 4 showed the average impact of sector presence and sector specialization 13 months after the start of the financial crisis in September 2008, relative to a 13 month pre-shock window. As explained above, the 13 month post-shock horizon is chosen to avoid potential interference of other shocks used in the literature. In this part, we focus on the time variation in the impact of sector presence and sector specialization on the pass-through of the funding shock. This not only allows us to analyze whether the initial choice of the time frame has an impact on our results, but also makes it possible to investigate whether the one of the two off-setting channels is more quickly activated than the other. In order to do so, figure 3 illustrates the impact of the interaction term of the shock in bank funding with either bank sector presence (upper panel) or bank sector specialization (lower panel) for every month starting from one month after the shock until 30 months after the shock. For example, the impact after 13 months in the upper panel corresponds with the coefficient on the interaction term between sector specialization and the funding shock in column 1 of table 4.

The moderating impact of sector presence has an almost instantaneous significant impact and grows steeply during the first months. It reaches a maximum after three months, when the coefficient of the interaction term is just below minus two. This implies that, for this three month period, the impact of a ten percent funding shock is almost non-existing for firms operating in sectors in which a bank has a high sector presence, compared to an average impact (based on Figure 2) of -2.4 percent. After three months, the effect then gradually fades out and becomes indistinguishable from 0 (at the 10 % level) after 20 months. The bank sector specialization effect exhibits different dynamics. The effect is ignorable in the first months after the initial shock, but gradually becomes more important. As soon as the post-event window exceeds nine months, it is both economically and statistically significant for all but two event windows. Tying the results of both figures together, we find that the magnitude of the pass-through of the funding shock on the average borrower is similar across different event windows. However, the source of heterogeneity in the pass-through across firms varies. 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 payoff. 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 Reallocating domestic credit: The role of firm risk

Both theoretical[9] and empirical[10] work has indicated that firms with fewer collateral or net worth (size), with no track record (age) or with weaker balance sheets (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' relative market power or the banks' relative monitoring advantage, 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 present the results for the static setup in subsection 5.3.1 and for the expanding window analysis in subsection 5.3.2.

5.3.1 Static analysis

We augment equation (6) with a firm characteristic and an interaction between the funding shock and that firm characteristic, leading to the following specification:

$$\begin{aligned}\Delta\%Committedcredit_{bf} = {} & \beta_1\ Firm\ Variable_f + \beta_2\ Bank\ Sector\ Presence_{bs} + \beta_3\ Bank\ Sector\ Specialization_{bs} + \\ & \beta_4\ Firm\ Variable_f * \Delta\%IBL_b + \beta_5\ Bank\ Sector\ Presence_{bs} * \Delta\%IBL_b + \\ & \beta_6\ Bank\ Sector\ Specialization_{bs} * \Delta\%IBL_b + \alpha_{SSL} + \upsilon_b + \epsilon_{fb}\end{aligned} \tag{7}$$

[9] See Stiglitz and Weiss (1981) and Holmstrom and Tirole (1997) for instance.

[10] See Khwaja and Mian (2008), Hadlock and Pierce (2010) and Iyer et al. (2014) amongst others.

We define $Firm\ Variable_f$ as a dummy equal to 1 if the value of the investigated firm characteristic is below the sample median, and 0 otherwise. We consider ten different risk characteristics, which we include one-by-one. More specifically, we proxy for firm size (based on total assets, total committed credit and number of employees, firm age and firm risk (leverage, financial leverage, Altman Z-score, the coverage ratio, pledged collateral to fixed assets, cash stock). Hence, using Equation (7), we test if banks that faced an interbank 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_1 captures the direct effect of the firm characteristic on growth in committed credit. The parameter of interest, β_4, captures the additional impact of the interbank funding shock on growth in committed credit for all observations below the median of the investigated firm characteristic. The average impact of the interbank funding shock on growth in committed credit is again subsumed in the bank fixed effect υ_b, together with all other observed and unobserved bank characteristics. The results are shown in Table 5.

TABLE 5: HERE

Columns 1 to 4 of Table 5 show interactions based on different definitions of size and age as commonly used in the literature to proxy for opacity. In contrast to Khwaja and Mian (2008) and Iyer et al. (2014), who take a similar approach using credit data for respectively Pakistan and Portugal, we do not find evidence that banks transmit liquidity shocks more to smaller firms. We actually find that the impact of the interbank funding shock on growth in committed credit is lower, though not statistically so, for firms whose total assets are below the sample median (see column 1 of Table 5). Columns 2 and 3 of Table 5 confirm this lack of statistical effects for size measures based on the number of employees or total committed credit. The results in column 4 indicate that banks do not transmit the interbank funding shock differentially to young firms neither. These results are robust to taking alternative (and even multiple) cutoffs for both age and size to explore additional non-linearities in the transmission of the funding shock[11] and robust to the exclusion of

[11] We experiment with models differentiating between firms with less than 250,000 total assets (total credit) and with more than 1,000,000 total assets (total credit). For age we interact with dummies separating firms less than 5 years old and firms more than 25 years old. We also interact the funding shock with dummies for firms with less than 10 employees and firms with more than 50 or 250 employees.

bank sector presence and bank sector specialization interactions[12]. More importantly, the results in columns 1 to 4 confirm that banks transmit funding shocks less to sectors in which they are more present and in which they are more specialized, when controlling for firm opacity.

Columns 5 and 6 of Table 5 show that banks transmit the funding shock significantly less to firms with low debt levels. Low leverage ratios or low financial leverage ratios imply high solvency and low financial risk. Thus banks appear to transmit a funding shock more (less) to riskier (healthier) firms. Columns 7 to 10 of Table 5 further confirm this bank behavior. The funding shock is transmitted more to firms with low values for the Altman Z-score (Column 7) and firms with low levels of cash (Column 10). The Altman Z-score is a composite indicator of firm health where lower values correspond to higher firm risk. Firms with high cash balances could use such a buffer to repay maturing debt if the firm would run into working capital liquidity problems, while firms without cash buffer would need to default on their loan repayment in such case. Finally, the funding shock is transmitted less to firms with low coverage ratios (Column 8) and firms with few pledged collateral relative to fixed assets (Column 9). A low coverage ratio implies a high spare debt capacity from the perspective of the lender, implying a lower risk. The lower the amount of already pledged collateral relative to firms' fixed assets, the lower the loss given default for the bank (and thus a lower risk for the bank). Furthermore, Columns 5 to 10 of Table 5 show that the reallocation channels documented in section 5.1 are still standing 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 less risky firms.

5.3.2 Expanding post-shock windows

Subsequently, we present information on the time-variation of the impact of firm characteristics on the funding shock transmission. Figure 4 shows 30 point estimates of β_4 of model (7), each corresponding to an estimation of model (7) where the post shock period is gradually expanded from 1 month to 30 months post shock. First of all, it can be seen that the (insignificant) findings in Columns 1 to 4 of Table 5 are not related to the choice of the post-shock time window. We cannot find a direct nor a long term effect of any of the firm size or age measures on the pass-through of the funding shock. Second, Figure 4 shows that the amplifying effect of firm risk becomes significant

[12] See Table A3 in the Appendix.

after five to six months post-shock. The effect of the risk channel through firm leverage, financial leverage, the Altman Z-score and coverage ratio continues to increase in potency, especially after about fifteen months post-shock, while the effect of the cash stock and of pledged collateral to fixed assets tends to decrease slightly over time, but not statistically so.

FIGURE 4: HERE

6 Affecting firms' decisions: Firm investment, profitability and growth

We have shown that banks operating in Belgium transmitted the funding shock to their borrowers and have done this heterogeneously according to their presence and specialization in a sector as well as differentiating between firms with different risk profiles. In this section, we are investigating the extent to which this reduction in bank lending affects firm outcomes along three dimensions: long-term investment, profitability and firm growth. We analyze this in the following setup:

$$\begin{aligned} Real\ Effect_f = \beta_1 \Delta\% IBL_b + \beta_2\ Firm\ Variable_f * \Delta\% IBL_b + \beta_3\ Firm\ Variable_f + \\ \beta_4\ Firm\ Controls_f + \alpha_{Sector} + \epsilon_f \end{aligned} \tag{8}$$

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 three dependent variables we are interested in are growth in fixed assets (investment), growth in gross margin (profitability), and asset growth. 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 captures whether the funding shock impact on firm outcome variables varies with bank or firm characteristics. The set of bank and firm characteristics, we consider is identical to those analyzed in Sections 5.1 and 5.3.1. As in the previous section, we define $Firm\ Variable_f$ as a dummy equal to 1 if the value of the investigated firm characteristic is below the sample median, and 0 otherwise. The exceptions are sector presence and sector specialization which are continuous and expressed as deviations from the bank-specific mean. We also include $Firm\ Variable_f$, three firm control variables, $Firm\ Controls_f$ (firm size, firm age and firm leverage) as well as a set of industry dummies α_{Sector}. Standard errors are clustered at the bank level (the largest lender if a firm borrows from multiple banks). The results of this analysis are presented in Table 6. The table consists of three panels (one for each dependent variable) and thirteen columns (one for each interaction term).

TABLE 6: HERE

The first column serves the purpose of showing whether or not there is a real effect of the credit supply shock for the average firm. The coefficient has the expected positive sign in each of the three panels, but is only significant for investment growth. All else equal, firms borrowing from banks that face a larger interbank funding outflow will have lower investment growth in the years following the shock. However, the credit crunch does not have a significant effect on sales or asset growth. The insignificant effect could be due to multiple reasons. First of all, firms might be able to offset the reduction in bank lending with other funding sources. Unfortunately, the available data do not allow us to completely rule out access to alternative finance. However, recall that most firms borrow from only one bank, so the usual option to turn to another less-affected relationship bank is unavailable. Accessing a new bank for financing investments is also difficult during the financial crisis. In addition, only the very large firms in the Belgian market are able to issue debt. So, most firms in our sample could not turn to the commercial paper market. The second reason why we may not find a significant effect on asset or sales growth is the limited effect on credit growth. A back of the envelop computation based on the results in the first column of Table 3 learns us that the 'missing credit' due to the funding shock is limited to 4 billion euro.

Next, we investigate whether or not the insignificant average real effect hides heterogeneous responses by different firms. First of all, we find that sector presence or sector specialization only leads to differential effect on sales growth. Firms borrowing from banks with a larger sector presence will see a larger reduction in sales growth compared to other firms. Recall that we also find that these banks are more inclined to support credit in the wake of a funding shock. Tying these two results together, it seems that the sustained credit by high sector-presence banks may come at a higher cost (because of their pricing power), which is passed on in firms' output prices leading

to a drop in sales. While sector specialization also has a positive effect, it is not significant, further indicating that sector presence may capture a pricing channel, whereas sector specialization is linked to an information channel for the bank. Of the four size and age indicators we considered in Section 5.3.1, we only find a significant effect of firm size in panel A and panel C. For large firms, the effect of the funding shock does not lead to changes in investments or firm size. However, we do find a large and significant effect for firms with below median size. In Table A3, we show that the funding shock did not have a differential effect for large or small firms. Again, tying these two results together, we can conclude that banks do not differentiate the transmission of the funding shock based on firm size, but that larger firms may have better access to alternative sources of financing that mitigate the real effects. Small firms are equally credit-constrained by banks and have no outside option to turn to for funding, leading to real effects on investment and size.
The (financial) leverage of the firm does not lead to different real outcomes following funding shocks. If anything, we find that the real effects of credit constraints are smaller for riskier firms. More specifically, we find that the impact of the funding shock on investment, sales or asset growth is smaller and not significantly different from zero for firms with a below median Altman Z-score (high risk), larger and significant for firms with a coverage ratio below the median (firms with low financial commitments relative to their EBIT) and smaller for firms with a low cash stock (nearly significant). The latter three findings are more consistent with a gambling for resurrection behavior by riskier firms rather than tailoring investment and firm growth to credit supply.

7 Conclusion

We conduct a comprehensive and detailed analysis of the industry- and firm-specific strategies that banks follow when deciding where to re-allocate credit when their own funding is affected by a negative shock. Additionally, while the current literature documents that there is an impact of financial shocks on bank lending decisions, by the best of our knowledge, no papers investigated whether the magnitude of the impact changes over time and whether the impact persists. Merging the bank business model and bank shock transmission strands in the literature as well as investigating the timing and duration of the shock impact are the gaps this paper aims to fill.

To identify the reallocation in the supply of credit that follows the difficulties for banks to obtain funding on the interbank market, we rely on a unique combination of data sets. We employ 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 firm data from 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 interbank funding equivalent to 10 percent 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 4 percent. Further, an investigation of the timing and duration of this effect reveals that the funding shock significantly impacts credit supply already 3 months after the shock started, reaches a maximum impact after 8 to 9 months, and remains significant and high up to 30 months after the shock.

Our results indicate that a bank's business model, as reflected in its *sector presence* and *sector specialization*, determines the reallocation of credit when a negative funding shock hits. *en bref* 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 more than 17 percent for the average firm (i.e. a reduction of the average effect from 4 to 3.3 percent). Similarly, a standard deviation increase in sector specialization reduces the negative impact of the funding shock on credit supply by 10 percent for the average firm (i.e. a reduction of the average effect from 4 to 3.6 percent). 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). Importantly, these results also hold when taking into account firm riskiness. Banks reallocate credit after a funding shock towards sectors in which they have high sector presence and in which they are specialized, over and above borrower characteristics such as size, age and risk. This confirms that our main results are not driven by the self-selection of banks into industries that exist of a specific set of firms.

In sum, our results suggest that when faced with a funding shock that forces them overall to cut credit, banks will also swiftly reallocate it according to their business model, i.c., their sector presence and specialization. They will also reallocate credit towards safer firms, but not to larger or older firms.

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Figure 1: The Funding Shock and its impact: Aggregate statistics

This figure consists of four bar charts with information on interbank liabilities, domestic corporate loans, interbank assets, and foreign corporate loans, respectively. Each subplot depicts the evolution of the aggregate volume in billion euro of a given item over the period 2007:8 - 2009:9. Each bar corresponds with the aggregate amount of that balance sheet item for all banks in the sample in a given month. The vertical line corresponds with August 2008, the month prior to the collapse of Lehman brothers, and splits the sample period in the pre-crisis window and the crisis-window.

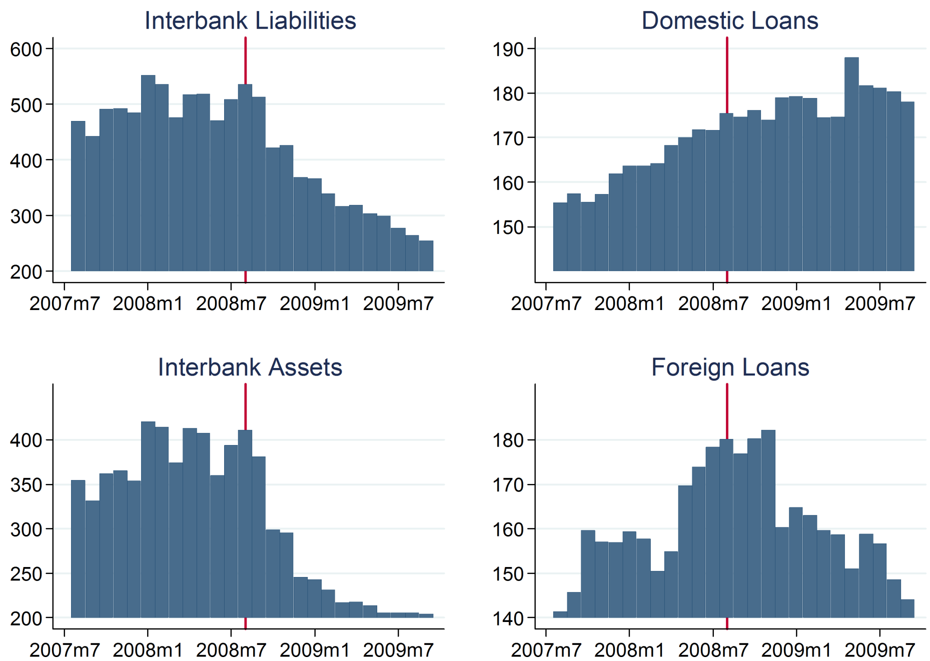


Figure 2: Timing of the interbank shock pass-through

This graph provides an indication on the timing and magnitude of the impact of the funding shock on the four credit supply indicators: growth in committed credit, increase in committed credit, large drop in committed credit, and starting a new bank-firm relationship. We plot the coefficients and 90% confidence bounds (dashed lines) for the effect of a shock to the interbank liabilities ($\Delta\%$ IBL_b), which corresponds with β_1 in our baseline model (Equation (4)), obtained from 30 separate estimations. The estimations differ from each other in terms of the length of the post-shock horizon, which expands from 1 month after the Lehman failure to 30 months post Lehman, whereas the pre-shock horizon remains fixed at one year. The x-axis indicates the sample length after the Lehman failure. For example, a value of 5 implies that we compute loan growth, the funding shocks and the offsetting factors as the difference between the time averaged value during the five months following Lehman and the time averaged value over the year prior to Lehman. Hence, the coefficients at month 13 coincide with the results reported in Table 3.

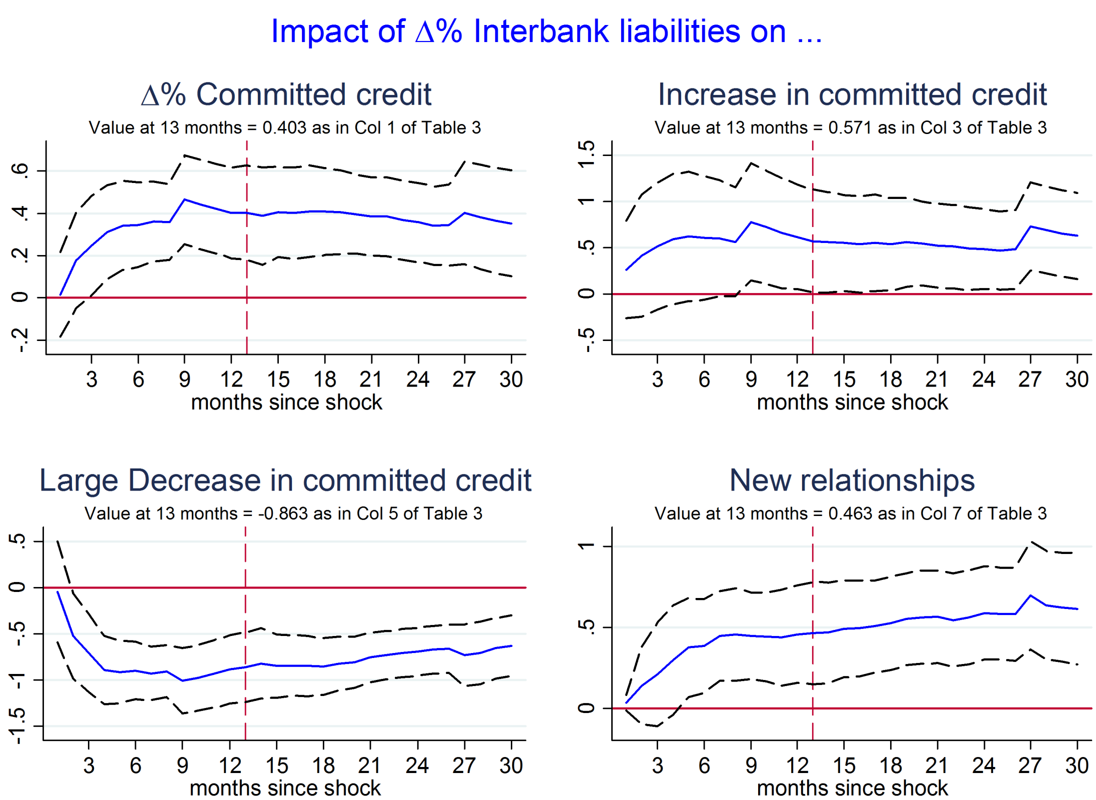
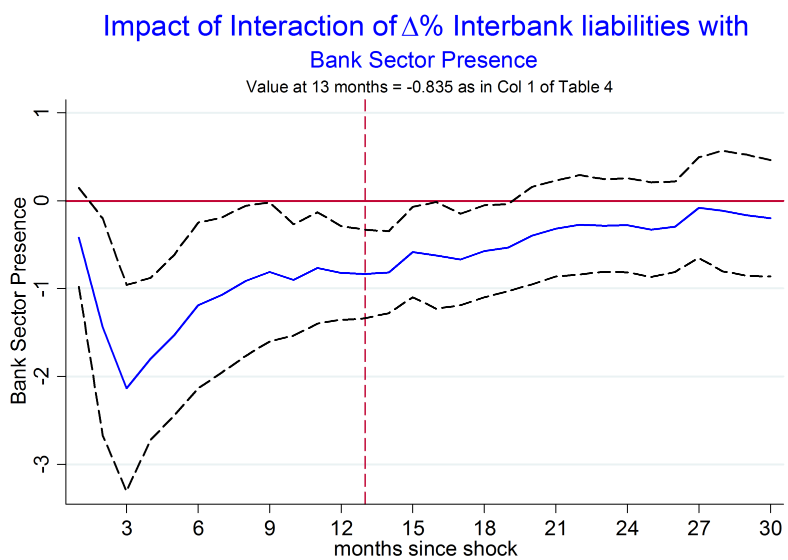


Figure 3: Timing of the channels: bank sector presence and specialization

This graph provides an indication on the timing and magnitude of the channels. The panels contains information on the interaction effect of the interbank funding shock and either the bank's sector presence or the bank's sector specialization. We plot the coefficients and 90% confidence bounds (dashed lines) for the interaction coefficient obtained from 30 separate estimations. The estimations differ from each other in terms of the length of the post-shock horizon, which expands from 1 month after the Lehman failure to 30 months post Lehman, whereas the pre-shock horizon remains fixed at one year. The x-axis indicates the sample length after the Lehman failure. For example, a value of 5 implies that we compute loan growth, the funding shocks and the offsetting factors as the difference between the time averaged value during the five months following Lehman and the time averaged value over the year prior to Lehman. Hence, the coefficients at month 13 coincide with the results reported in column 1 of Table 4.



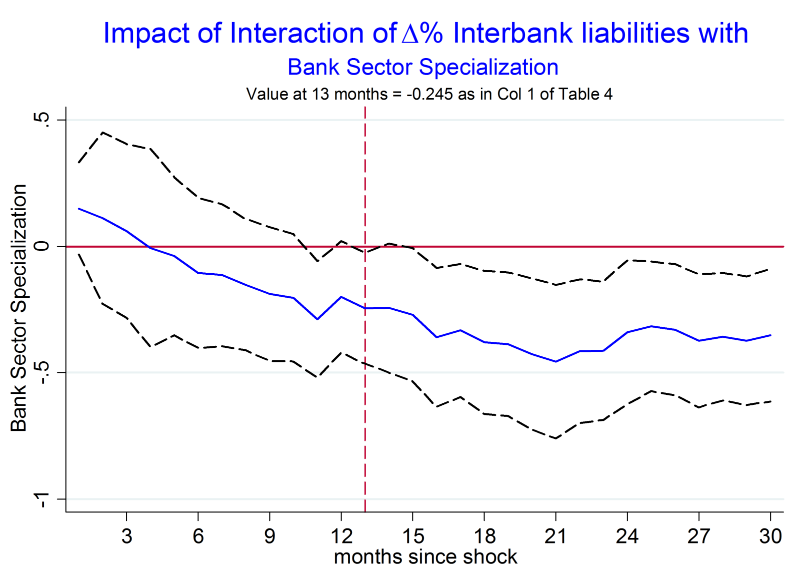


Figure 4: Timing of the channels: firm size, age and risk

This graph provides an indication on the timing and magnitude of the channels. The panels contains 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 coefficient obtained from 30 separate estimations. The estimations differ from each other in terms of the length of the post-shock horizon, which expands from 1 month after the Lehman failure to 30 months post Lehman, whereas the pre-shock horizon remains fixed at one year. The x-axis indicates the sample length after the Lehman failure. For example, a value of 5 implies that we compute loan growth, the funding shocks and the offsetting factors as the difference between the time averaged value during the five months following Lehman and the time averaged value over the year prior to Lehman. Hence, the coefficients at month 13 coincide with the results reported in Table A3.

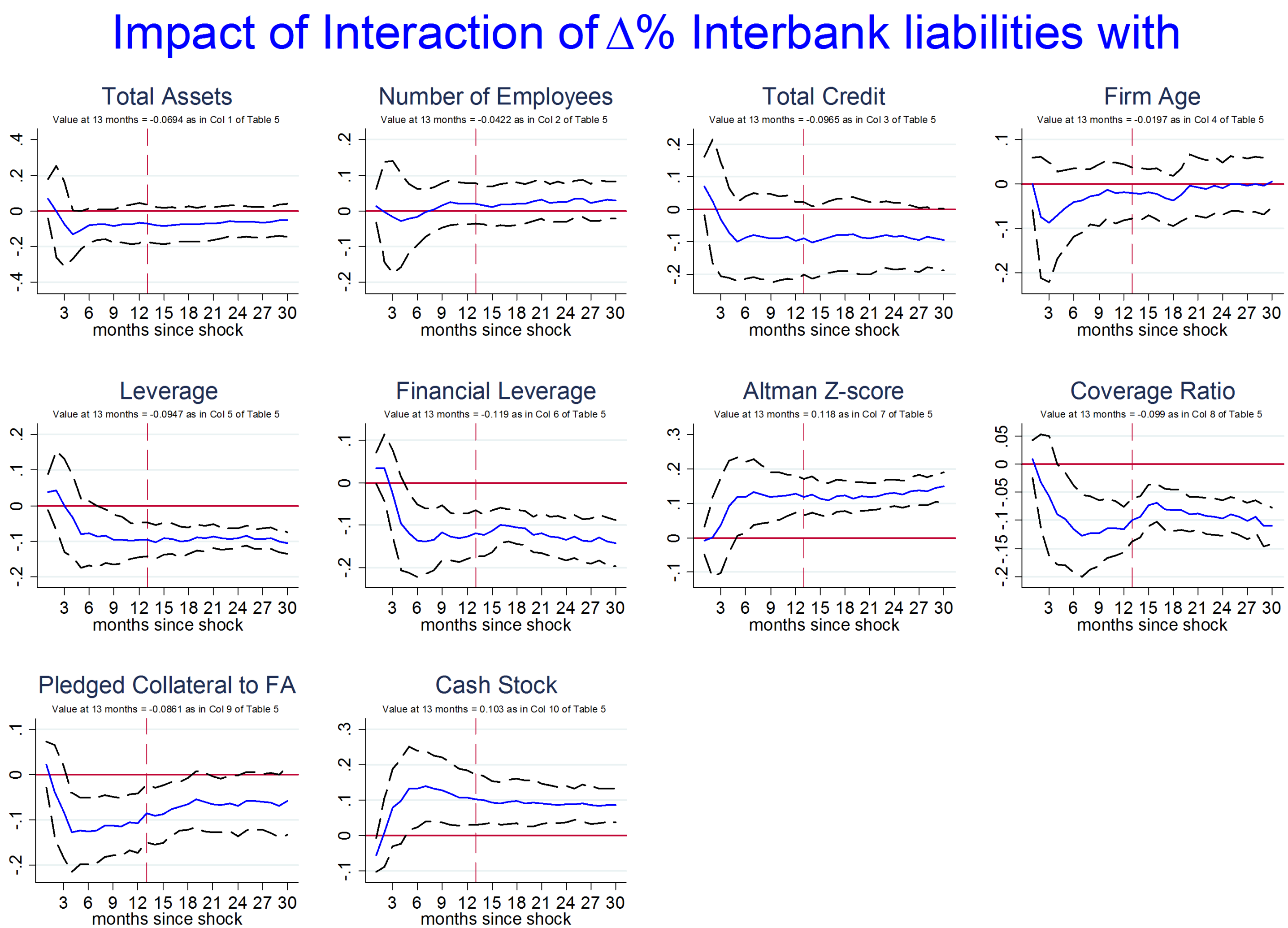


Table 1: Variable definition

Credit variables	
Δ % Committed credit$_{fb}$	natural logarithm of time averaged credit authorized post shock - natural logarithm of time averaged credit authorized pre shock
Increase in committed credit$_{fb}$	A dummy = 1 if Δ% Committed credit$_{bf}$ $>$ 0, and 0 otherwise
Large decrease in committed credit$_{fb}$	A dummy = 1 if Δ% Committed credit$_{bf}$ is in the lowest quartile of the distribution, and 0 otherwise
New relationships$_{fb}$	A dummy = 1 if a bank-firm pair exists in 2009m9 but not yet in 2008m8, and 0 otherwise
Bank variables	
Δ% Interbank liabilities$_b$ (Δ% IBL$_b$)	(time averaged interbank liabilities post shock - time averaged interbank liabilities 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
deposits to total assets$_b$	time averaged demand and savings 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
Bank-sector variables	
Sector presence$_{bs}$	time averaged total credit authorized pre shock by bank b in sector s / time averaged total credit authorized pre shock in sector s
Sector specialization$_{bs}$	time averaged total credit authorized pre shock by bank b in sector s / time averaged total credit authorized pre shock by bank b
Firm variables	
Total assets$_f$	pre shock natural log of total assets
Employees$_f$	pre shock number of total employees (full time equivalent)
Total credit$_f$	pre shock natural log of toal committed credit
Age$_f$	pre shock number of years since incorporation
Leverage$_f$	pre shock total debt / pre shock total assets
Financial leverage$_f$	pre shock total bank debt / pre shock total assets
Altman Z-score$_f$	pre shock: 0.717 * working capital / total assets + 0.847 * retained earnings / total assets + 3.107 * EBIT / total assets + 0.42 * equity / total debt + 0.988 * operating revenue / total assets
Coverage ratio$_f$	pre shock total interest payments / pre shock EBIT
Pledged collateral to fixed assets$_f$	pre shock pledged collateral / pre shock fixed assets
Cash stock$_f$	pre shock cash / pre shock total assets

Table 2: Summary statistics

	Obs	Mean	StDev	Min	p25	p50	p75	Max
CREDIT VARIABLES								
firm-bank level								
Δ % Committed credit$_{fb}$	160224	-0.024	0.278	-0.644	-0.155	-0.051	0.026	0.941
Increase in committed credit$_{fb}$	160224	0.289	0.453	0.000	0.000	0.000	1.000	1.000
Large decrease in committed credit$_{fb}$	160224	0.252	0.434	0.000	0.000	0.000	1.000	1.000
New relationships$_{fb}$	188827	0.144	0.352	0.000	0.000	0.000	0.000	1.000
BANK VARIABLES								
firm-bank level								
Δ% IBL$_b$	160224	-0.103	0.063	-0.163	-0.163	-0.110	-0.091	0.301
interbank liabilities to total assets$_b$	160224	0.320	0.112	0.000	0.293	0.342	0.374	0.936
capital to total assets$_b$	160224	0.045	0.021	0.001	0.041	0.041	0.056	0.356
return on equity$_b$	160224	0.080	0.116	-0.131	-0.072	0.106	0.172	1.009
provision to total loans$_b$	160224	0.026	0.025	-0.203	0.007	0.027	0.055	0.213
interbank assets to total assets$_b$	160224	0.241	0.086	0.016	0.231	0.263	0.279	0.741
deposits to total assets$_b$	160224	0.404	0.146	0.000	0.248	0.406	0.445	0.881
bank level								
Δ% IBL$_b$	39	0.020	0.117	-0.163	-0.045	0.000	0.051	0.301
interbank liabilities to total assets$_b$	39	0.322	0.291	0.000	0.090	0.238	0.442	0.936
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
provision 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
BANK-SECTOR VARIABLES								
firm-bank level								
Sector presence$_{bs}$	160224	0.185	0.091	0.000	0.158	0.207	0.241	0.425
Sector specialization$_{bs}$	160224	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

FIRM VARIABLES

firm-bank level

Table 2: continued

	Obs	Mean	StDev	Min	p25	p50	p75	Max
Total assets$_f$	144049	13.40	1.302	10.78	12.48	13.26	14.19	16.50
Employees$_f$	88274	21.474	277.3	0.015	1.500	4.200	12.00	36936
Total credit$_f$	160224	12.35	1.400	6.908	11.35	12.23	13.14	21.12
Age$_f$	144049	14.173	10.23	1.000	6.000	12.15	20.00	40.00
Leverage$_f$	144049	0.724	0.270	0.116	0.555	0.746	0.892	1.568
Financial leverage$_f$	144049	0.288	0.242	0.000	0.077	0.244	0.451	0.885
Altman Z-score$_f$	143995	0.831	1.093	-1.915	0.212	0.665	1.299	4.848
Coverage ratio$_f$	143834	2.482	3.228	0.009	0.210	0.822	5.376	15.549
Pledged collateral to fixed assets$_f$	142932	0.395	0.762	0.000	0.000	0.000	0.425	3.038
Cash stock$_f$	144049	0.117	0.150	0.000	0.013	0.056	0.161	0.679
firm level								
Total assets$_f$	119394	13.20	1.224	10.78	12.36	13.08	13.92	16.50
Employees$_f$	68264	14.17	190.8	0.015	1.200	3.400	8.892	36936
Total credit$_f$	134368	12.13	1.277	6.908	11.19	12.03	12.88	21.12
Age$_f$	119394	13.23	9.811	1.000	5.000	11.00	19.00	40.00
Leverage$_f$	119394	0.726	0.279	0.116	0.546	0.748	0.899	1.568
Financial leverage$_f$	119394	0.289	0.247	0.000	0.071	0.242	0.458	0.885
Altman Z-score$_f$	119341	0.838	1.139	-1.915	0.187	0.665	1.333	4.848
Coverage ratio$_f$	119206	2.485	3.192	0.009	0.201	0.820	5.376	15.549
Pledged collateral to fixed assets$_f$	118333	0.365	0.737	0.000	0.000	0.000	0.202	3.038
Cash stock$_f$	119394	0.122	0.155	0.000	0.013	0.059	0.171	0.679

Table 3: Baseline: Full Sample

This table contains information on the estimated effect of an interbank liability shock on the domestic credit supply. We investigate both the intensive and extensive margin of credit. Information on the effects on the intensive margin is reported in columns 1-6. The dependent variable is growth in the authorized loan amount (columns 1 and 2), an indicator variable that is one if the authorized amount increases and zero otherwise (columns 3 and 4) and an indicator variable that is one if the growth in the authorized loan amount belongs to the lowest quartile and zero otherwise (columns 5 and 6), respectively. For each of these three measures, 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. Results on the extensive margin are in columns 7 and 8 where we report results on new bank-firm relationships. 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. The independent variable of interest is the change in interbank liabilities scaled by total assets. More specifically, it is the average value of interbank liabilities in the year post Lehman minus the average value in the year prior to the Lehman default, scaled by the average value of total assets over the year preceding 2008:09. We include six bank-specific control variables. Each bank-specific control variable is constructed as the ratio of the average pre-Lehman value of the numerator divided by the average pre-Lehman value of the denominator. The control variables proxy for pre-crisis differences in funding structure, bank capitalization, profitability, credit risk and interbank loans. In the odd columns, 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 size, location and industry. In the even columns, firm demand is controlled for by means of a firm fixed effect, as such only firms that are borrowing from at least two banks are taken into account. Standard errors are clustered at the bank level.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Δ% Committed credit_{fb}	Δ% Committed credit_{fb}	Increase in committed credit_{fb}	Increase in committed credit_{fb}	Large decrease in committed credit_{fb}	Large decrease in committed credit_{fb}	New $\text{relationships}_{fb}$	New $\text{relationships}_{fb}$
Δ% Interbank liabilities_b	0.403***	0.424***	0.571*	0.583**	-0.863***	-0.605**	0.463**	0.443**
	(0.136)	(0.147)	(0.338)	(0.277)	(0.229)	(0.238)	(0.191)	(0.171)
interbank liabilities to total assets_b	-0.0565	0.0735	-0.220	0.0873	0.00949	0.0448	0.0729	0.201
	(0.0923)	(0.0950)	(0.191)	(0.169)	(0.154)	(0.181)	(0.134)	(0.143)
capital to total assets_b	-0.0917	0.0208	-0.251	0.0943	0.240	0.0160	-0.354	-0.241
	(0.184)	(0.144)	(0.440)	(0.322)	(0.223)	(0.211)	(0.235)	(0.190)
return on equity_b	-0.0724	-0.00999	-0.0703	0.00136	0.148	0.108	0.000353	-0.00949
	(0.0626)	(0.0761)	(0.117)	(0.106)	(0.117)	(0.118)	(0.0719)	(0.0843)
provision to total loans_b	0.501***	0.427***	0.630**	0.465	-0.851***	-0.274	0.440**	0.683**
	(0.106)	(0.148)	(0.272)	(0.296)	(0.192)	(0.209)	(0.196)	(0.285)
interbank assets to total assets_b	0.0653	0.0253	-0.0635	-0.102	-0.229*	-0.142	-0.0874	0.00637
	(0.0718)	(0.0798)	(0.158)	(0.128)	(0.130)	(0.128)	(0.0920)	(0.0905)
deposits to total assets_b	-0.0801	-0.0535	-0.314	-0.230	0.0545	0.128	0.00490	0.173
	(0.0948)	(0.111)	(0.220)	(0.188)	(0.163)	(0.182)	(0.132)	(0.143)
Observations	160,224	47,205	160,224	47,205	160,224	47,205	188,838	59,973
R-squared	0.295	0.455	0.276	0.463	0.289	0.480	0.244	0.488
Firm FE	SSL	YES	SSL	YES	SSL	YES	SSL	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 4: Within bank heterogeneity in shock transmission: Sector presence and sector specialization

This table contains information on the estimated effect of an interbank liability shock on the domestic credit supply, conditional on banks competitive and comparative advantage in lending to specific sectors. We investigate both the intensive and extensive margin of credit. The dependent variable is percentage growth in the authorized loan amount (column 1), an indicator variable that is one if the authorized amount increases and zero otherwise (column 2), an indicator variable that is one if the growth in the authorized loan amount belongs to the lowest quartile and zero otherwise (column 3), and a dummy variable that is one for new bank-firm relationships (column 4). The independent variables of interest are the interaction between bank specialization (Sector Presence and Sector Specialization) and the interbank liability shock (Δ% IBL_b). We control for all bank-specific covariates, such as for instance bank (re)capitalization or interventions, 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 group fixed effects for single bank borrowers. Firms are pooled together in a group based on size, location and industry. Standard errors are clustered at the bank level.

	(1)	(2)	(3)	(4)
VARIABLES	Δ% Committed credit$_{fb}$	Increase in committed credit$_{fb}$	Large decrease in committed credit$_{fb}$	New relationships$_{fb}$
Sector presence$_{bs}$	-0.116**	-0.330***	0.240***	0.0326
	(0.0530)	(0.106)	(0.0559)	(0.0522)
Sector specialization$_{bs}$	0.0198	0.136*	-0.0426	-0.120***
	(0.0378)	(0.0791)	(0.0548)	(0.0367)
Sector presence$_{bs}$ * Δ% IBL_b	-0.835***	-1.936***	1.433***	0.511*
	(0.306)	(0.577)	(0.329)	(0.253)
Sector specialization$_{bs}$ * Δ% IBL_b	-0.245*	-0.475	0.966***	0.113
	(0.133)	(0.374)	(0.185)	(0.265)
Observations	160,224	160,224	160,224	188,827
R-squared	0.298	0.282	0.292	0.248
Bank FE	YES	YES	YES	YES
Firm FE	SSL	SSL	SSL	SSL

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 5: Heterogenous shock transmission: Sector presence, sector specialization and the role of firm characteristics

This table contains information on the estimated effect of an interbank liability shock on the domestic credit supply, conditional on banks' sector presence, banks' sector specialization and firm characteristics. The independent variables of interest are the interaction between bank specialization (Sector Presence and Sector Specialization) and the interbank liability shock ($\Delta\%$ IBL_b). In addition, we analyze whether the relationship between the funding shock and growth in committed credit varies with firm characteristics by means of an interaction effect between the funding shock and a firm characteristic. The column title corresponds with the interaction variable used in that specification. We define the firm characteristic as a dummy which takes the value of one if value of firmvar $\leq$ sample median. The dependent variable is percentage growth in the authorized loan amount. The independent variables of interest are the interaction between a firm characteristic and the interbank liability shock ($\Delta\%$ IBL_b). 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 group fixed effects for single bank borrowers. Firms are pooled together in a group based on size, location and industry. Standard errors are clustered at the bank level.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Firm variable$_f$ is $\longmapsto$	total assets$_f$	employees$_f$	total credit$_f$	age$_f$	leverage$_f$	financial leverage$_f$	Altman Z-score$_f$	coverage ratio$_f$	pledged collateral to fixed assets$_f$	cash stock$_f$
Dep var is $\Delta\%$ Committed credit$_{fb}$										
Firm variable$_f$	0.119***	0.0353***	0.409***	0.0174***	0.0168***	0.0652***	-0.0398***	0.0326***	0.0421***	-0.0208***
	(0.00434)	(0.00654)	(0.00768)	(0.00349)	(0.00368)	(0.00486)	(0.00431)	(0.00425)	(0.00337)	(0.00479)
Sector presence$_{bs}$	-0.106**	-0.206***	-0.0727*	-0.113**	-0.117**	-0.122**	-0.120**	-0.126**	-0.106*	-0.117**
	(0.0490)	(0.0654)	(0.0426)	(0.0532)	(0.0536)	(0.0553)	(0.0548)	(0.0531)	(0.0564)	(0.0535)
Sector specialization$_{bs}$	0.0301	-0.00128	0.0205	0.0267	0.0240	0.0266	0.0203	0.0267	0.0255	0.0238
	(0.0350)	(0.0334)	(0.0313)	(0.0372)	(0.0385)	(0.0375)	(0.0392)	(0.0383)	(0.0366)	(0.0376)
Firm variable$_f$ * $\Delta\%$ IBL_b	-0.0694	-0.0422	-0.0965	-0.0197	-0.0947***	-0.119***	0.118***	-0.0990***	-0.0861**	0.103**
	(0.0638)	(0.0832)	(0.0642)	(0.0351)	(0.0288)	(0.0328)	(0.0323)	(0.0228)	(0.0388)	(0.0431)
Sector presence$_{bs}$ * $\Delta\%$ IBL_b	-0.676**	-1.668***	-0.517**	-0.731**	-0.758**	-0.860***	-0.768**	-0.811**	-0.698**	-0.765**
	(0.285)	(0.365)	(0.232)	(0.309)	(0.307)	(0.316)	(0.315)	(0.303)	(0.322)	(0.308)
Sector specialization$_{bs}$ * $\Delta\%$ IBL_b	-0.361**	-0.167	-0.235**	-0.352**	-0.331**	-0.279	-0.373**	-0.369**	-0.368**	-0.369**
	(0.137)	(0.157)	(0.107)	(0.138)	(0.158)	(0.168)	(0.164)	(0.158)	(0.148)	(0.154)
Observations	144,049	88,274	160,224	144,049	144,049	144,049	143,995	143,834	142,932	144,049
R-squared	0.333	0.374	0.393	0.314	0.315	0.324	0.318	0.317	0.319	0.315
Bank FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Firm FE	SSL	SSL	SSL	SSL	SSL	SSL	SSL	SSL	SSL	SSL

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 6: Real effects: Investment, Sales and Asset Growth

This table contains information on the estimated effect of an interbank liability shock on investment growth (upper panel), sales growth (middle panel) and firm growth (lower panel), while controlling for firm characterstics and industry fixed effects. In columns 2 to 13, we analyze whether this relationship varies with firm characteristics by means of an interaction effect between the funding shock and a firm characteristic. The column title corresponds with the interaction variable used in that specification. in columns 2 and 3, we interact the funding shock with sector presence and sector specialization, which are measured as deviations from the bank-specific mean (i.e. exploiting and relying on within bank variation). In columns 4 tot 13, we define the firm characteristic as a dummy which takes the value of one if value of firmvar $\leq$ sample median. Standard errors are clustered at the bank level. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Interaction dummy		sector presence$_{bs}$	sector specialization$_{bs}$	total assets$_f$	age$_f$	total credit$_f$	employees$_f$
Panel A: dep var is growth in fixed assets							
Δ% IBL$_b$	0.0725**	0.0730**	0.0721**	-0.0361	0.0654**	0.0152	0.0485
	(0.0289)	(0.0289)	(0.0286)	(0.0298)	(0.0301)	(0.0598)	(0.0374)
Δ% IBL$_b$ * interaction dummy		0.228	-0.254	0.193***	0.0129	0.0353	-0.0335
		(0.568)	(0.284)	(0.0424)	(0.0489)	(0.0851)	(0.0390)
Interaction dummy		0.0276	0.00981	0.0980***	0.0591***	-0.103***	-0.00129
		(0.0826)	(0.0479)	(0.00534)	(0.00454)	(0.00800)	(0.00351)
R-squared	0.020	0.020	0.020	0.020	0.020	0.028	0.014
Panel B: dep var is growth in gross margin							
Δ% IBL$_b$	0.0179	0.0186	0.0183	0.0232***	0.0428**	0.0154	0.0513*
	(0.0178)	(0.0177)	(0.0176)	(0.00817)	(0.0184)	(0.0139)	(0.0298)
Δ% IBL$_b$ * interaction dummy		0.317**	0.157	-0.00930	-0.0455	0.00106	-0.0820**
		(0.122)	(0.118)	(0.0255)	(0.0498)	(0.0200)	(0.0343)
Interaction dummy		0.0262*	-0.0256*	0.0345***	0.0291***	-0.00541**	0.000448
		(0.0151)	(0.0140)	(0.00309)	(0.00316)	(0.00260)	(0.00491)
R-squared	0.022	0.022	0.022	0.022	0.022	0.022	0.025
Panel C: dep var is growth in total assets							
Δ% IBL$_b$	0.0331	0.0346	0.0331	-0.0720	0.0699	-0.0194	0.00884
	(0.0346)	(0.0347)	(0.0346)	(0.0456)	(0.0677)	(0.0673)	(0.0477)
Δ% IBL$_b$ * interaction dummy		0.717	0.176	0.187***	-0.0676	0.0129	-0.0103
		(0.745)	(0.392)	(0.0669)	(0.120)	(0.132)	(0.0555)
Interaction dummy		0.0659	0.0169	0.153***	0.116***	-0.123***	-0.00743
		(0.104)	(0.0613)	(0.00837)	(0.00729)	(0.0105)	(0.00622)
R-squared	0.030	0.030	0.030	0.030	0.030	0.036	0.028
Observations	115,913	115,913	115,913	115,913	115,913	115,913	66,091
Firm controls and industry FE	YES	YES	YES	YES	YES	YES	YES

Panel A: dep var is growth in fixed assets

Table 6: continued

	(8)	(9)	(10)	(11)	(12)	(13)
Interaction dummy	leverage_f	financial leverage_f	Altman Z-score_f	coverage ratio_f	pledged collateral to fixed assets_f	cash stock_f
$\Delta\%$ IBL_b	0.0526	0.0311	0.154***	0.0155	0.0319	0.125**
	(0.0346)	(0.0504)	(0.0389)	(0.0313)	(0.0347)	(0.0469)
$\Delta\%$ IBL_b * interaction dummy	0.0422	0.138	-0.139**	0.131***	0.0511	-0.101
	(0.0532)	(0.108)	(0.0531)	(0.0356)	(0.0538)	(0.0671)
Interaction dummy	0.0858***	0.101***	-0.0790***	0.0817***	0.0331***	-0.0544***
	(0.00594)	(0.0126)	(0.00549)	(0.00624)	(0.00656)	(0.00834)
R-squared	0.020	0.027	0.023	0.024	0.020	0.022
Panel B: dep var is growth in gross margin						
$\Delta\%$ IBL_b	-0.00334	0.0120	0.0463**	-0.0146	0.0149	0.0192
	(0.0224)	(0.0135)	(0.0194)	(0.0219)	(0.0210)	(0.0254)
$\Delta\%$ IBL_b * interaction dummy	0.0453**	0.0194	-0.0614**	0.0610***	-0.000847	-0.00154
	(0.0177)	(0.0319)	(0.0251)	(0.0200)	(0.0380)	(0.0231)
Interaction dummy	-0.00867***	0.0134***	0.0230***	-0.0220***	0.0113**	-0.0129***
	(0.00192)	(0.00379)	(0.00348)	(0.00309)	(0.00441)	(0.00286)
R-squared	0.022	0.023	0.025	0.026	0.023	0.023
Panel C: dep var is growth in total assets						
$\Delta\%$ IBL_b	0.00851	-0.00654	0.154***	-0.0271	-0.0244	0.0774*
	(0.0530)	(0.0612)	(0.0444)	(0.0378)	(0.0620)	(0.0403)
$\Delta\%$ IBL_b * interaction dummy	0.0523	0.158	-0.211***	0.144***	0.0760	-0.0853*
	(0.0782)	(0.113)	(0.0648)	(0.0311)	(0.0734)	(0.0487)
Interaction dummy	0.131***	0.143***	-0.125***	0.121***	0.0582***	-0.0593***
	(0.00960)	(0.0127)	(0.00744)	(0.00675)	(0.00938)	(0.00692)
R-squared	0.030	0.038	0.034	0.035	0.030	0.031
Observations	115,913	115,913	115,864	115,734	114,898	115,913
Firm controls and industry FE	YES	YES	YES	YES	YES	YES

Appendix

Table A1: Within bank heterogeneity in shock transmission: Sector presence and sector specialization (multiple bank relationship firms)

This table contains information on the estimated effect of an interbank liability shock on the domestic credit supply, conditional on banks competitive and comparative advantage in lending to specific sectors. In this table, we report results for the subsample of firms that borrow from multiple banks. We investigate both the intensive and extensive margin of credit. The dependent variable is percentage growth in the authorized loan amount (column 1), an indicator variable that is one if the authorized amount increases and zero otherwise (column 2), an indicator variable that is one if the growth in the authorized loan amount belongs to the lowest quartile and zero otherwise (column 3), and a dummy variable that is one for new bank-firm relationships (column 4). The independent variables of interest are the interaction between bank specialization (Sector Presence and Sector Specialization) and the interbank liability shock (Δ% IBL_b). We control for all bank-specific covariates, such as for instance bank (re)capitalization or interventions, by including bank fixed effects. Firm demand is controlled for by means of a firm fixed effect. Standard errors are clustered at the bank level.

	(1)	(2)	(3)	(4)
VARIABLES	Δ% Committed credit_{fb}	Increase in committed credit_{fb}	Large decrease in committed credit_{fb}	New $\text{relationships}_{fb}$
Sector presence_{bs}	-0.190**	-0.180	0.187	0.0578
	(0.0817)	(0.111)	(0.147)	(0.0674)
Sector $\text{specialization}_{bs}$	0.0367	0.0875	-0.126	-0.107**
	(0.0613)	(0.103)	(0.111)	(0.0468)
Sector presence_{bs} * Δ% IBL_b	-1.306***	-1.124*	1.012	0.648
	(0.444)	(0.577)	(0.804)	(0.394)
Sector $\text{specialization}_{bs}$ * Δ% IBL_b	-0.241	-0.786*	1.303***	0.412
	(0.266)	(0.401)	(0.461)	(0.253)
Observations	47,205	47,205	47,205	59,964
R-squared	0.460	0.469	0.486	0.493
Bank FE	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES

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

Table A2: Between and within bank heterogeneity in shock transmission: Bank Capital and Liquidity vs. Sector presence and sector specialization

This table contains information on the estimated effect of an interbank liability shock on the domestic credit supply, conditional on banks competitive and comparative advantage in lending to specific sectors. In this table, we report results for the subsample of firms that borrow from multiple banks. We investigate both the intensive and extensive margin of credit. The dependent variable is percentage growth in the authorized loan amount (column 1), an indicator variable that is one if the authorized amount increases and zero otherwise (column 2), an indicator variable that is one if the growth in the authorized loan amount belongs to the lowest quartile and zero otherwise (column 3), and a dummy variable that is one for new bank-firm relationships (column 4). The independent variables of interest are the interaction between bank specialization (Sector Presence and Sector Specialization) and the interbank liability shock (Δ% IBL_b). We control for all bank-specific covariates, such as for instance bank (re)capitalization or interventions, by including bank fixed effects. Firm demand is controlled for by means of a firm fixed effect. Standard errors are clustered at the bank level.

	(1)	(2)	(3)
VARIABLES	Δ% Committed credit$_{fb}$	Δ% Committed credit$_{fb}$	Δ% Committed credit$_{fb}$
Δ% Interbank liabilities$_b$	0.403***	0.952***	0.955***
	(0.136)	(0.343)	(0.346)
capital to total assets$_b$ * Δ% IBL_b		-8.372***	-8.542***
		(2.794)	(2.767)
interbank assets to total assets$_b$ * Δ% IBL_b		-0.685	-0.678
		(0.611)	(0.619)
Sector presence$_{bs}$ * Δ% IBL_b			-0.912***
			(0.329)
Sector specialization$_{bs}$ * Δ% IBL_b			-0.287*
			(0.150)
Sector presence$_{bs}$			-0.127**
			(0.0527)
Sector specialization$_{bs}$			0.0159
			(0.0318)
interbank liabilities to total assets$_b$	-0.0565	-0.0151	-0.00996
	(0.0923)	(0.0820)	(0.0812)
capital to total assets$_b$	-0.0917	-0.344**	-0.344**
	(0.184)	(0.140)	(0.143)
return on equity$_b$	-0.0724	-0.0700	-0.0716
	(0.0626)	(0.0633)	(0.0629)
provision to total loans$_b$	0.501***	0.480***	0.476***
	(0.106)	(0.103)	(0.104)
interbank assets to total assets$_b$	0.0653	0.0882	0.0890
	(0.0718)	(0.0739)	(0.0734)
deposits to total assets$_b$	-0.0801	-0.0525	-0.0489
	(0.0948)	(0.0830)	(0.0822)
Observations	160,224	160,224	160,224
R-squared	0.295	0.295	0.295
Firm FE	SSL	SSL	SSL

Robust standard errors in parentheses

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table A3: Heterogenous shock transmission: The role of firm characteristics

This table contains information on the estimated effect of an interbank liability shock on the domestic credit supply, conditional on firm characteristics. In particular, we analyze whether the relationship between the funding shock and growth in committed credit varies with firm characteristics by means of an interaction effect between the funding shock and a firm characteristic. The column title corresponds with the interaction variable used in that specification. We define the firm characteristic as a dummy which takes the value of one if value of firmvar $\leq$ sample median. The dependent variable is percentage growth in the authorized loan amount. The independent variables of interest are the interaction between a firm characteristic and the interbank liability shock ($\Delta\%$ IBL_b). 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 group fixed effects for single bank borrowers. Firms are pooled together in a group based on size, location and industry. Standard errors are clustered at the bank level.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Firm variable$_f$ is $\longmapsto$	total assets$_f$	employees$_f$	total credit$_f$	age$_f$	leverage$_f$	financial leverage$_f$	Altman Z-score$_f$	coverage ratio$_f$	pledged collateral to fixed assets$_f$	cash stock$_f$
Dep var is $\Delta\%$ Committed credit$_{fb}$										
Firm variable$_f$	0.120***	0.0353***	0.409***	0.0180***	0.0168***	0.0652***	-0.0402***	0.0329***	0.0422***	-0.0210***
	(0.00413)	(0.00637)	(0.00765)	(0.00337)	(0.00373)	(0.00489)	(0.00429)	(0.00425)	(0.00333)	(0.00479)
Firm variable$_f$ * $\Delta\%$ IBL_b	-0.0636	-0.0424	-0.0934	-0.0140	-0.0952***	-0.120***	0.114***	-0.0965***	-0.0850**	0.100**
	(0.0612)	(0.0808)	(0.0635)	(0.0335)	(0.0294)	(0.0334)	(0.0320)	(0.0225)	(0.0381)	(0.0430)
Observations	144,049	88,274	160,224	144,049	144,049	144,049	143,995	143,834	142,932	144,049
R-squared	0.333	0.373	0.393	0.314	0.315	0.324	0.318	0.317	0.319	0.315
Bank FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Firm FE	SSL	SSL	SSL	SSL	SSL	SSL	SSL	SSL	SSL	SSL

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table A4: Heterogenous shock transmission: Sector presence, sector specialization and the role of firm characteristics (multiple bank relationship firms)

This table contains information on the estimated effect of an interbank liability shock on the domestic credit supply, conditional on banks' sector presence, banks' sector specialization and firm characteristics. The independent variables of interest are the interaction between bank specialization (Sector Presence and Sector Specialization) and the interbank liability shock (Δ% IBL_b). In addition, we analyze whether the relationship between the funding shock and growth in committed credit varies with firm characteristics by means of an interaction effect between the funding shock and a firm characteristic. The column title corresponds with the interaction variable used in that specification. We define the firm characteristic as a dummy which takes the value of one if value of firmvar $\leq$ sample median. The dependent variable is percentage growth in the authorized loan amount. The independent variables of interest are the interaction between a firm characteristic and the interbank liability shock (Δ% IBL_b). 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 group fixed effects for single bank borrowers. Firms are pooled together in a group based on size, location and industry. Standard errors are clustered at the bank level.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Firm variable$_f$ is $\longmapsto$	total assets$_f$	employees$_f$	total credit$_f$	age$_f$	leverage$_f$	financial leverage$_f$	Altman Z-score$_f$	coverage ratio$_f$	pledged collateral to fixed assets$_f$	cash stock$_f$
Dep var is Δ% Committed credit$_{fb}$										
Sector presence$_{bs}$	-0.147	-0.231**	-0.190**	-0.146	-0.140	-0.148	-0.149	-0.159*	-0.141	-0.151
	(0.0932)	(0.0985)	(0.0824)	(0.0908)	(0.0906)	(0.0901)	(0.0920)	(0.0892)	(0.0879)	(0.0898)
Sector specialization$_{bs}$	0.0340	0.0325	0.0371	0.0335	0.0309	0.0318	0.0291	0.0345	0.0350	0.0311
	(0.0618)	(0.0595)	(0.0622)	(0.0610)	(0.0611)	(0.0610)	(0.0617)	(0.0612)	(0.0602)	(0.0612)
Firm variable$_f$ * Δ% IBL_b	0.0303	-0.0269	0.0247	0.0251	-0.119***	-0.111***	0.181***	-0.197***	-0.0619	0.218***
	(0.107)	(0.109)	(0.0725)	(0.0635)	(0.0409)	(0.0401)	(0.0373)	(0.0386)	(0.0439)	(0.0606)
Sector presence$_{bs}$ * Δ% IBL_b	-1.182**	-1.983***	-1.309***	-1.177**	-1.131**	-1.192**	-1.177**	-1.233**	-1.153**	-1.206**
	(0.519)	(0.589)	(0.446)	(0.505)	(0.515)	(0.507)	(0.518)	(0.496)	(0.508)	(0.522)
Sector specialization$_{bs}$ * Δ% IBL_b	-0.283	-0.101	-0.231	-0.285	-0.298	-0.290	-0.353	-0.362	-0.265	-0.331
	(0.248)	(0.290)	(0.252)	(0.257)	(0.279)	(0.283)	(0.279)	(0.286)	(0.279)	(0.281)
Observations	45,008	36,096	47,205	45,008	45,008	45,008	45,006	44,956	44,904	45,008
R-squared	0.459	0.453	0.460	0.459	0.459	0.459	0.459	0.459	0.459	0.460
Bank FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table A5: Heterogenous shock transmission: Sector presence, sector specialization and the role of firm characteristics (continuous firm characteristics)

This table contains information on the estimated effect of an interbank liability shock on the domestic credit supply, conditional on banks' sector presence, banks' sector specialization and firm characteristics. The independent variables of interest are the interaction between bank specialization (Sector Presence and Sector Specialization) and the interbank liability shock ($\Delta\%\ IBL_b$). In addition, we analyze whether the relationship between the funding shock and growth in committed credit varies with firm characteristics by means of an interaction effect between the funding shock and a firm characteristic. The column title corresponds with the interaction variable used in that specification. We define the firm characteristic as a dummy which takes the value of one if value of firmvar $\leq$ sample median. The dependent variable is percentage growth in the authorized loan amount. The independent variables of interest are the interaction between a firm characteristic and the interbank liability shock ($\Delta\%\ IBL_b$). 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 group fixed effects for single bank borrowers. Firms are pooled together in a group based on size, location and industry. Standard errors are clustered at the bank level.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Firm variable$_f$ is $\longmapsto$	total assets$_f$	employees$_f$	total credit$_f$	age$_f$	leverage$_f$	financial leverage$_f$	Altman Z-score$_f$	coverage ratio$_f$	pledged collateral to fixed assets$_f$	cash stock$_f$
Dep var is $\Delta\%$ Committed credit$_{fb}$										
Firm variable$_f$	-0.104***	-0.0301***	-0.511***	-0.0140***	-0.0102***	-0.0328***	0.0194***	-0.0128***	-0.0199***	0.0126***
	(0.00470)	(0.00417)	(0.0146)	(0.00214)	(0.00216)	(0.00244)	(0.00199)	(0.00224)	(0.00125)	(0.00213)
Sector presence$_{bs}$	-0.118**	-0.204***	-0.0702**	-0.113**	-0.117**	-0.118**	-0.124**	-0.128**	-0.106*	-0.118**
	(0.0468)	(0.0625)	(0.0343)	(0.0526)	(0.0526)	(0.0538)	(0.0534)	(0.0528)	(0.0567)	(0.0530)
Sector specialization$_{bs}$	0.0384	0.00176	0.0249	0.0291	0.0231	0.0274	0.0207	0.0271	0.0257	0.0244
	(0.0358)	(0.0322)	(0.0309)	(0.0373)	(0.0388)	(0.0385)	(0.0387)	(0.0379)	(0.0368)	(0.0373)
Firm variable$_f$ * $\Delta\%\ IBL_b$	0.0182	0.0349	-0.0275	0.0115	0.0479***	0.0668***	-0.0719***	0.0540***	0.0386**	-0.0406**
	(0.0391)	(0.0627)	(0.0441)	(0.0288)	(0.0147)	(0.0232)	(0.0128)	(0.0126)	(0.0157)	(0.0192)
Sector presence$_{bs}$ * $\Delta\%\ IBL_b$	-0.752***	-1.655***	-0.543***	-0.737**	-0.769**	-0.821***	-0.800**	-0.828***	-0.688**	-0.744**
	(0.269)	(0.354)	(0.174)	(0.307)	(0.299)	(0.302)	(0.309)	(0.304)	(0.325)	(0.304)
Sector specialization$_{bs}$ * $\Delta\%\ IBL_b$	-0.335**	-0.162	-0.0853	-0.355***	-0.328**	-0.259	-0.398**	-0.370**	-0.381**	-0.376**
	(0.133)	(0.145)	(0.0958)	(0.129)	(0.161)	(0.180)	(0.164)	(0.156)	(0.144)	(0.152)
Observations	144,049	88,274	160,224	144,049	144,049	144,049	143,995	143,834	142,932	144,049
R-squared	0.349	0.375	0.565	0.315	0.315	0.325	0.320	0.316	0.319	0.316
Bank FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Firm FE	SSL	SSL	SSL	SSL	SSL	SSL	SSL	SSL	SSL	SSL

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