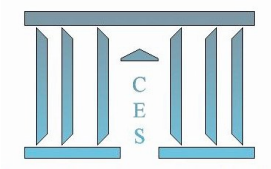
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The supply of long-term credit after a funding shock: evidence from 2007-2009

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Abstract

We study banks' supply of long-term credit after a negative funding shock. Thanks to a unique database at bank-firm level, we take advantage of the exogenous interbank market freeze in 2007-2008 to assess the causal relation between French banks' liquidity risk and their lending. We find that banks with higher funding risk and more maturity transformation provided a lower supply of long-term loans after the shock, even controlling for credit demand. Short-term lending supply is however unaffected. These findings help explain the severity of the recession that followed the liquidity crisis. And they support Basel III liquidity regulation. This regulation should have a stabilising effect on long-term lending in times of funding stress.

Keywords: financial institutions, liquidity risk, loan maturity

JEL: G01, G21, G28.

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1. Introduction

Long-term loans allow firms to switch toward more productive investment. By promoting such assets, banks contribute to economic growth (Bencivenga and Smith, 1991). An important question is how banks grant long-term loans in times of funding crisis. Empirical literature on the transmission of liquidity shocks to the real economy (Iyer et al. 2014, Schnabl 2012, Cornett et al. 2011) has already shown that banks reduce their supply of credit in times of liquidity crisis. Surprisingly, the empirical literature is silent on the reallocation of maturities. They show that banks that were more exposed to the liquidity shock decreased their credit supply, but they do not analyse composition effects on the maturity. If, in addition to the volume effect, banks reallocate their portfolio from long-term loans to short-term loans in times of crisis, it would result in a larger drop in output. Such an amplifying mechanism of the initial shock would further impact long-run productivity.

Banks might have incentives to reduce the supply of long-term loans (i) because such loans constitute one of the most illiquid claims in their balance sheet; (ii) because the value of firms' collateral is decreasing at that time (Bernanke, Gertler 1989, Bernanke, Gertler and Gilchrist 1998), which could be particularly relevant for long-term loans; or (iii) because higher short-term profit opportunities may have motivated strategic liquidity hoarding during the crisis (Radde, 2015). So it is of primary interest to analyse the effects of a funding shock on bank loan maturities.

The paper is also motivated by the post-crisis regulation Basel III. This regulation introduces liquidity constraints on banks, the so-called liquidity coverage ratio (LCR) and net stable funding ratio (NSFR). The LCR obliges banks to store liquid assets to mitigate short-term funding stress, while the NSFR obliges banks to fund long-term loans from long-term

funding. The paper tests empirically the effectiveness of a stable funding ratio in a time period that regulation did not exist.

The paper proceeds in three steps. First, we analyse whether banks with less stable funding reduce their supply of long-term loans after the shock. Second, we test whether higher maturity transformation impacts the supply of long-term loans. Third, we analyse whether funding constraints on long-term loans differ depending on firm size.

We use the Great Recession as a natural experiment of a funding shock impacting the French banking system from 2007Q3. From August 2007, interbank refinancing spreads increased dramatically (De Socio, 2013); the repo markets and unsecured money market funds stopped rolling over banks short-term debts (Gorton and Metrick, 2012; Duffie, 2010). This situation caught banks by surprise as they were used to an environment of abundant liquidity (Brunnermeier, 2009). The funding shock culminated in a paralysis of the interbank market after the failure of Lehman Brothers in September 2008. Our paper considers the funding shock as the main transmission channel constraining the French banking sector because there was no bursting of a real estate bubble in France that could have impacted banks on their asset side, unlike other banking systems such as in the USA, Spain and Ireland. Despite this, the real sector was affected by the financial crisis with a severe output loss in the following years: the cost of the crisis in France is estimated at -1.2% of GDP in 2008 and -4.2% of GDP in 2009 (Bricongne et al., 2010). This framework provides an appropriate set-up to test the effect of banks' funding risk on their long-term credit supply to non-financial firms.

To properly assess the behaviour of banks, a major challenge is to differentiate supply effects from demand effects. After August 2007, the deterioration of the national and international economic outlook decreased investment opportunities for firms, lowering their demand for credit. To control for change in credit demand and properly identify the change in credit supply, Khwaja and Mian (2008) proposed a methodology based on bank-firm credit

relationships. We implement their approach with a highly disaggregated loan database from the Banque de France that reports each bank-firm credit exposure quarterly. We take advantage of the numerous firms that have multi-bank relationships to measure the change in credit for a given firm. When several banks lend to the same counterparty, this allows us to measure how banks with different characteristics change their lending towards the same firm. In this empirical framework, we are thus able to control for firms' characteristics such as firm's credit risk and credit demand. In a nutshell, we analyse the change in banks' credit supply between 2007 and 2009 for several banks lending to the *same* firm.

Our framework compares the change in the supply of long-term credit for a given counterparty before and after the shock. To measure how banks with different liquidity risk reacted to the shock, we merge our loan data with balance sheet data collected from the French prudential authority, the ACPR. Drehmann and Nikolaou (2013) define funding liquidity risk as 'the possibility that over a specific horizon the bank will become unable to settle obligations with immediacy'. To capture this idea, we use banks' ratio of retail deposits to assets. Retail deposits appeared to be a resilient source of funding during the 2007-2008 financial turmoil, especially compared to other sources of short-term funding (Cornett et al., 2011; Gorton and Metrick 2012; BCBS, 2014). In France, there was no bank run by retail depositors during the crisis, indicating that banks that relied heavily on that source of funding should be more immune from the funding shock. We thus expect them to maintain their supply of long-term loans throughout the period.

We complement this measure of funding risk with a maturity mismatch measure, namely the ratio of long-term lending to deposits. This alternative measure captures the proportion of illiquid assets in the bank's stable funding resources. We expect that banks with a higher proportion of illiquid assets will be more constrained in their lending after the funding shock.

As robustness checks, we compare our results with alternative measures of funding risk and maturity mismatch.

Theoretical papers of financial frictions show that liquidity shocks are transmitted to the real economy through frictions at the bank level and firm level (Bernanke and Blinder, 1988; Bernanke, Gertler and Gilchrist, 1999; Holmström and Tirole, 1997). Empirical papers analyse the credit channel using correlation at the aggregate level (Bernanke, 1983), cross-section analysis at the bank level (Kashyap and Stein, 2000) or natural experiments (Khwaja and Mian,2008, Schnabl 2012, Iyer et al. 2014 and Kapan and Minoiu, 2014).

Khwaja and Mian, (2008), Schnabl (2012) and Iyer et al. (2014) use credit register data to determine how liquidity shocks affect lending supply. We follow the same empirical strategy by using the 2007-2009 interbank market freeze as an exogenous liquidity shock and by relying on credit register data to estimate the change in loan supply.

The closest papers to our work are Iyer et al. (2014), Kapan and Minoiu (2014), Cornett et al. (2011) and Ivashina and Scharfstein (2010). These papers analyse bank lending supply during the 2007-2008 financial crisis, but they do not highlight the causality between banks' funding risk and the maturity of the loans they grant after the shock. We contribute to the literature in several ways. First, our approach uses several measures of funding risk and maturity mismatch. Notably, this paper is the first (to the best of our knowledge) to use the residual maturity of banks' balance sheets to test how funding risk and maturity mismatch at bank level affects lending. It thus contributes to the debate on liquidity regulation like the NSFR, which is aimed at building a more resilient banking sector by controlling banks' maturity mismatch and funding risk.[1]

[1] The Basel III Net Stable Funding Ratio (NSFR), which will come into force on 1 January 2018, will require banks to fund long-term and illiquid assets with stable funding such as deposits and liabilities with residual maturity over one year (BCBS 2014).

Secondly, this paper analyses the effect of a funding shock on the maturity of credit. Non-financial firms, especially smaller ones with limited access to capital markets, rely heavily on long-term loans for their investment in fixed assets. Distinguishing the effect of a funding shock on long-term loans and short-term loans can highlight the composition effect that a broad view of loan supply would not. It helps explain the observed consequences of the global financial crisis of 2007-2008 for the real sector.

This paper is also related to an emerging literature that tries to capture the strengths and weaknesses of bank's balance sheets with regard to liquidity (e.g. Berger and Bouwman, 2009; Brunnermeier, Gorton and Krishnamurthy, 2011, 2012). In this paper, we compare how different characteristics of banks' balance sheets make them more resilient to a liquidity shock.

Our main results show that (i) banks with fewer deposits and more maturity mismatch provided a smaller supply of long-term loans compared to other banks, (ii) on the other hand, no significant difference exists between banks regarding the supply of short-term loans, (iii) smaller firms bear the brunt of the decline in the supply of long-term loans from non-resilient banks.

Some policy implications arise from this paper. The Basel III NSFR liquidity regulation mainly relies on deposits and long-term liabilities (BCBS, 2014). The paper gives support to this regulation and shows how the future liquidity regulation might sustain economic growth during times of funding stress. By insulating banks from funding stresses, these shocks are less likely to be transmitted to banks' supply of long-term loans. This liquidity regulation thus has positive implications for economic growth in periods of downturn.

The rest of the paper is organised as follows. Section 2 presents the data and identification strategy. Section 3 describes the results. Robustness checks are set out in Section 4. Section 5 concludes.

2. Data and methodology

2.1. Data

We employ three different databases in the study. The loan-level data comes from the Banque de France's credit register. The bank-level database is supplied by the French prudential authority (the *Autorité de Contrôle Prudentiel et de Résolution* – ACPR). Finally, we also have access to the Banque de France's database on non-financial firms that provide information on firm size.

2.1.1. Loan-level data

The Banque de France's central credit register database describes loans granted by banks to all firms in France. Each line describes the credit exposure of a bank to a firm where the total credit exposure is greater than EUR 25,000. The database is updated quarterly. Information on maturity is provided and we can distinguish between short-term and long-term loans (i.e. loans with a maturity greater than one year). To measure the change in long-term lending through the funding crisis, we consider two dates: 2007Q2 and 2009Q4. The 2007Q2 exposures describe banks' exposure to non-financial firms just before the shock. The 2009Q4 exposures describe banks' exposure after the shock.[2]

We remove financial institutions from the sample of borrowers. For the remaining firms, we take all bank-firm relationships that appear at both dates and measure the change in lending at

[2] In unreported results, we also tested other periods, namely 2007Q2-2009Q1, 2007Q2-2009Q2, 2007Q2-2010Q2 and 2008Q3-2009Q2. The main results, which are available upon request, remain qualitatively unchanged.

the bank-firm level by the change in their respective credit exposure between 2007Q2 and 2009Q4. Hence we focus here on the intensive margin. Finally, we remove firms that have a single banking relationship as our identification strategy relies on firms borrowing from several banks. The change in lending is then computed as the difference in the logarithm of credit exposures between 2007Q2 (before the funding shock) and 2009Q2 (after the funding shock). The variable is then winsorised at the 1% and 99% levels to avoid the effect of potential outliers – extreme credit growth figures – on the results. We employ the same methodology to compute the change for long-term and short-term lending.

Panel A of Table 2 presents descriptive statistics at the loan level. The average long-term credit exposure in 2007Q2 is EUR 0.769 million, with a huge variation between counterparties (the standard deviation is EUR 5.786 million). This reflects the fact that the database covers borrowers from very small entities to large multinational firms.

The change in long-term lending between 2007Q2 and 2009Q4 is strongly negative, at -11.9% on average. This confirms that long-term credit to firms fell sharply during the crisis in France. However, the change in short-term credit exposures was 'only' -3% on average. This suggests that the decrease in loan supply after the funding shock was not alike for short-term and long-term loans. Next, we match this loan-level dataset with bank level data.

2.1.2. Bank-level data

The bank-level database contains financial statements of French domestic banks at the unconsolidated level. The sample covers all commercial and cooperative banks operating in France during 2007Q2-2009Q4. The data covers detailed information on balance sheets and financial statements. In addition, the data describes residual maturities for assets and liabilities.

Some banks merged between 2007Q2 and 2009Q4. This could lead to an artificial increase in credit exposures to certain borrowers. To correct for this potential bias, we take into account mergers and acquisitions between banks by aggregating the data of entities concerned prior to the merger.

We exclude banks with marginal lending activity, i.e. banks that have less than a thousand bank-firm relationships in the credit register. Our sample ends up with 133 banks.

Panel B in Table 2 gives some descriptive statistics on bank-level data. All balance sheet data is taken in 2007Q2, prior to the funding shock. In our sample, banks have an average asset size of EUR 39 billion and the median is EUR 8.9 billion. A large proportion of their activity is dedicated to lending: the median share of loans to customers in their total assets stands at 67.8%. Deposits constitute a large share of their liabilities, with a median value of 40.6% of their total assets. The median ratio of long-term loans to deposits is 1.282, indicating that banks rely on other sources than deposits to fund their long-term credit. This ratio decreases to 0.822 when we take into account both deposits and liabilities with a residual maturity over one year.

2.1.3. Firm size data

The firm-level database reports annual information on firms operating in France. To distinguish firms by size, we consider firms' turnover in 2006Q4 (see Panel C of Table 2). This reporting date is the latest available before the funding shock. There are 119,041 firms in our sample. These firms borrow before and after the funding shocks and have multi-bank relationships. Firms with a turnover below EUR 10 million or with no information on turnover[3] are deemed to be small. They represent 91.9% of our sample. Firms with a turnover

[3] It is not compulsory for firms with a turnover below EUR 0.75 million to report detailed financial accounts.

between EUR 10 and EUR 100 million are deemed to be medium-sized. They represent 7.1%. Firms with a turnover over EUR 100 million are deemed to be large. They represent the remaining 0.9% of the sample.

2.2. Methodology

In our empirical strategy we want to determine how banks with high funding risk and maturity mismatch adjust their supply of long-term loans after the funding shock.

2.2.1. Measuring banks' funding risk and maturity mismatch

Our goal is to estimate the behaviour of banks' long-term lending during a funding crisis. We thus need to measure the exposure of banks to funding stress. To this end, we compute measures of funding risk and maturity mismatch.

Our funding risk measure is the deposits to assets ratio. Traditionally, deposits have been regarded as a fragile source of funding for banks (Diamond and Dybvig, 1983). Recent evidence however suggests that retail depositors are a stable liability. Cornett et al. (2011) show that deposits were a stable source of funding during the 2007-2009 financial crisis. Explicit deposit guarantee schemes largely explain the stability of non-maturing deposits. Government subsidies on certain deposit contracts also play a role in this stability[4] (Schlueter et al., 2015).

However, measuring the funding risk might not be sufficient to capture the banks' resilience to a liquidity shock. Banks might have a low funding risk but a high maturity mismatch. We

[4] This is, for example, the case in France where certain deposit contracts still benefit from a tax shield and interest rates are set by central regulation.

introduce a maturity mismatch ratio to capture this feature of banks' balance sheets. Our maturity mismatch measure is the long-term loans to deposits ratio. This ratio captures the relation between long-term assets and stable funding. A bank with a higher proportion of (illiquid) long-term loans needs a larger proportion of stable funding in order to be immune to the funding shock. If its maturity mismatch is too large, the bank will face difficulties in rolling over its debt (e.g. due to a lack of assets to be pledged or sold). The bank can thus be forced to reduce lending due to the loss of a funding source. The bank is also incentivised to hoard liquidity in order to build up a larger liquidity buffer after the shock.

In addition to these measures, we also check the robustness of our results against alternative definitions of funding risk and maturity mismatch (see Section 4).

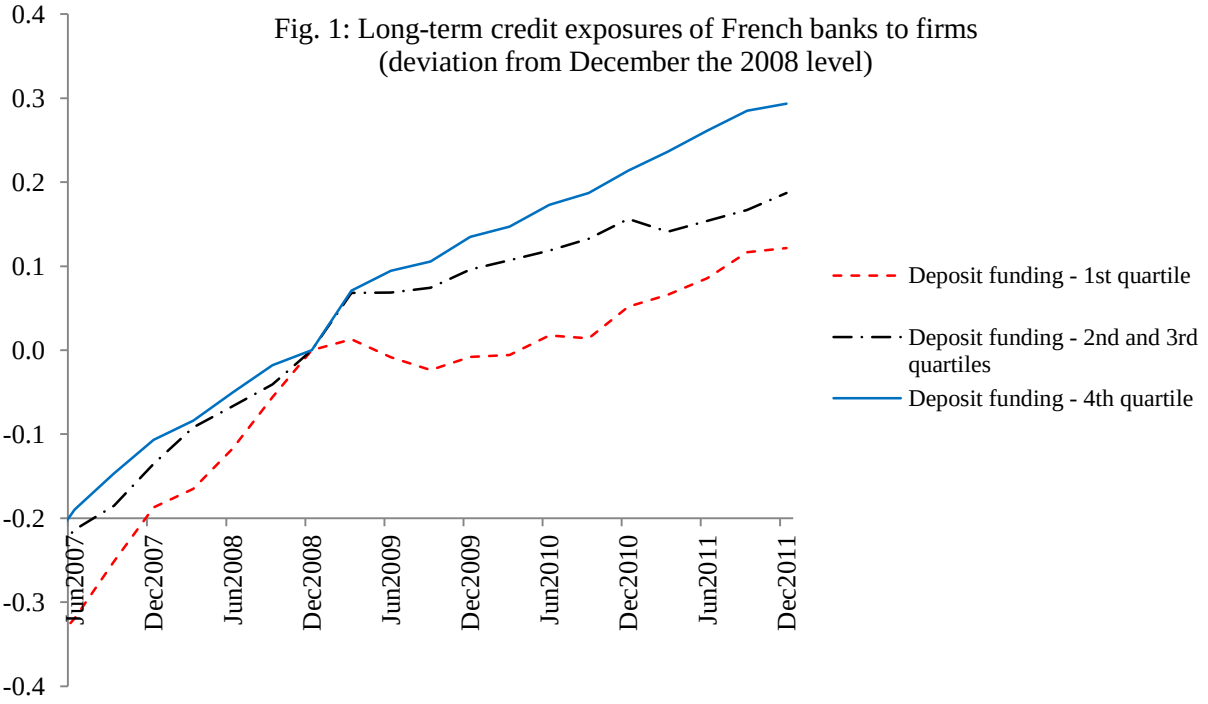
2.2.2. Identification strategy

We study how banks adjust their long-term lending during a funding crisis. The funding shock is expected to be transmitted to the real sector by a decrease in long-term lending from banks which were not insulated from the funding shock. We hypothesise that the funding risk and maturity mismatch of banks before the shock (2007Q2) explain their lending behaviour after it (captured through the exposures of 2009Q4). Hence, banks with a larger deposit and a lower maturity mismatch should have a greater supply of long-term credit throughout the period.

Figure 1 summarises our approach for the deposit ratio. The chart shows the average evolution of banks' long-term credit exposures for three sub-samples of banks defined by their deposit ratio before the shock in 2007Q2: in red is the average long-term credit exposure of banks in the first quartile of the distribution of deposit ratio (lowest deposit ratio in 2007Q2), in blue is the average long-term credit exposure of banks with the fourth quartile of the distribution (highest deposit ratio in 2007Q2), while the black line is the average long-term

credit exposure of banks in the second and third quartiles of the deposit ratio distribution in 2007Q2. As expected, the chart shows steady growth in long-term loans for the banks with the highest deposit ratio in 2007Q2. Long-term lending from these banks appears, graphically, unaffected by the events of 2007-2008. The dotted red line shows the evolution of the long-term exposures of banks with the lowest share of deposits in 2007Q2. Their credit exposures slowdown from 2008Q4 and then even decrease. They only reach their pre-crisis level at the end of 2010. The black (irregularly-dotted) line shows an intermediate evolution for banks in the second and third quartile of the 2007Q2 distribution. The abrupt change in the pace of lending growth for the second and third group of banks gives a strong support to the claim that the funding shock was an unanticipated event for French banks. The 'kick' in March 2009 is indeed a piece of evidence that banks had to restraint lending in a very short time span. This framework shock provides a setting close to a natural experiment in which we can test the effect of an exogenous funding shock on banks' long-term lending.

Fig. 1: Long-term credit exposures of French banks to firms
(deviation from December the 2008 level)



This chart shows the logarithm of banks' aggregated figures of long-term credit exposures to firms in France. The blue line shows the evolution of the long-term credit exposure of banks that have a deposits to assets ratio in

the fourth quartile. The black (irregularly-dotted) line shows the evolution of the long-term credit exposure of banks that have a deposits to assets ratio in the second or third quartile. The red (dotted) line shows the evolution of the long-term credit exposure of banks that have a deposits to assets ratio in the first quartile. The logarithms of long-term credit exposures are rescaled to zero in 2008Q4.

Source: Banque de France central credit register, banks' financial statements collected by the ACPR and authors' own calculations.

Obviously, this graphical evidence is polluted with other factors affecting long-term credit exposures during this period. A major challenge is to disentangle firms' demand effects from the banks' supply effect we want to estimate. It might be that demand was much lower for banks having a lower deposit ratio. In that case, the decline in loan supply would result from firms' choices and not bank supply. The next step in our identification strategy is thus to disentangle supply from demand effects in bank lending.

To cope with this issue, we follow the methodology proposed by Khwaja and Mian (2008) and Gan (2007). The identification strategy relies on the fact that a large proportion of borrowers have several banking relationships over the period considered. Thus, it is possible to study how several banks adjust their lending to the *same* counterparty. By doing so, we control for possible demand bias (if demand was low for a particular group of banks) and other borrower characteristics such as risk and investment opportunities. In practice, it consists in including firm fixed effects in the specification. Fixed effects capture firms' heterogeneity and remove the suspicion of an omitted variable bias that could be correlated with bank characteristics.

As many banks in our sample belong to larger banking groups, one last concern is that banking groups were not necessarily exposed to the same extent to the funding shock. As banks within a banking group might follow more similar funding strategies or have different intra-group liquidity management practices, we need to test if banking group effects are

biasing our results. To this end, we add banking group fixed effects into our specification.[5] Thus, in our most constrained specification, we analyse the difference in long-term lending for banks belonging to the *same* banking group and lending to the *same* counterparty but with *different* liquidity risk. We are thus confident that a significant coefficient in such a specification properly identifies a funding risk (or maturity mismatch) effect and is not due to correlations with banking group effects or firms' heterogeneity.

Given the unexpected nature of the shock, this strategy makes it possible to identify a causal relation between the level of funding risk or maturity mismatch and the change in long-term credit supply.

Finally, we take into account the possibility that funding risk and maturity mismatch may be correlated with other balance sheet characteristics which also affect lending. We consider five bank characteristics that could influence loan supply: size (logarithm of total assets), profitability (ROA), the non-performing loans ratio (non-performing loans to total assets), the business model (credit to total assets) and the capital ratio (equity to total assets). Larger banks might be able more easily to substitute funding sources, which could make them more insulated to the funding shock. On the other hand, these banks tend to rely more on market funding. Profitability might also be related to bank liquidity risk as banks that rely on short-term markets to fund illiquid assets might have a higher ROA before a funding shock. Credit to total assets captures the business model orientation of banks, where a higher share indicates that banks perform traditional banking activities. Non-performing loans and the capital ratio

[5] Including banking group fixed effects forces us to remove from our sample foreign subsidiaries when they do not constitute a banking group in France, and a few stand-alone domestic entities. Thus, for most specifications, we report results with and without banking group fixed effects. Note that foreign subsidiaries and stand-alone entities do not account for a large share of the credit market in France. Moreover, empirical evidence suggests that excluding foreign subsidiaries should result in more conservative estimates as these subsidiaries tend to behave pro-cyclically (see e.g. Albertazzi, 2014).

indicate the quality of the loan portfolio and banks' solvency respectively. There are potential interactions between credit risk and liquidity risk (Distinguin et al., 2013; Imbierowicz and Rauch, 2014; Zheng, 2006). A higher capital ratio might also insulate banks from a run as investors might continue to roll over the debt of more solvent institutions. We thus control for the bank's solvency and the quality of its loan portfolio to be confident that we indeed capture a liquidity risk effect. Equation (1) describes the main model of interest in the paper:

$$\text{LT Lending}_{b,f} = \propto_f + \delta_g + \beta \ . \text{Bank's liquidity risk}_b + \text{Control variables}_b . \gamma + \varepsilon_{b,f} \qquad (1)$$

Where *LT Lending*$_{b,f}$ is the difference in the log of long-term lending by bank *b* to firm *f* between 2007Q2 and 2009Q4. The *Bank's liquidity risk*$_b$ variable is alternatively the deposits to total assets ratio or the long-term loans to deposits ratio. β is our main parameter of interest. *Control variables*$_b$ are bank characteristics, namely size (logarithm of total assets), profitability (ROA), the non-performing loans ratio (non-performing loans to total assets), the business model (credit to total assets) and solvency (equity to total assets). γ is a vector of parameters to be estimated. All independent variables are measured prior to the shock in 2007Q2. α_f are firms' fixed effects capturing firm heterogeneity. δ_g are banking groups' fixed effects capturing banking group heterogeneity. Standard errors are clustered at the bank level.

3. Results

3.1. Main results: funding risk, maturity mismatch and long-term lending

We analyse in turn the effect of funding risk and maturity mismatch on long-term lending. Both are measured at bank level in 2007Q2, prior to the funding shock.

3.1.1. Funding risk and long-term loan supply after the funding shock

We start our analysis by considering how the funding risk of banks affects their supply of long-term credit after 2007Q2. The deposits ratio measures banks' funding risk, with a higher ratio indicating that banks should be more immune to the funding shock. Table 2 reports the results of our model. We start our estimations by regressing the change in long-term lending without including borrowers' fixed effects (columns 1 and 2). We report these columns to allow comparison with the regressions where borrowers' heterogeneity is controlled for. When we only include the deposits to assets ratio, the coefficient is statistically significant (almost at 5%). The magnitude and statistical significance of the coefficient increases when we control for other bank characteristics. So in the pooled regression, a higher deposits ratio has a positive effect on the long-term lending of banks.

Next, we include firms' fixed effects to control for firms' heterogeneity (i.e. change in loan demand, risk or business opportunities). Remember that in the first two columns, demand effects potentially drive the results if firms with lower demand tend to borrow more heavily from one particular group of banks. Columns 3 and 4 confirm that banks with lower funding risk extend more long-term loans after a funding shock, even when controlling for firms' heterogeneity: the coefficients are both positive and highly significant. In other words,

demand effects do not seem to drive our results. Interestingly, the coefficients for the deposits to assets variable are very similar to those obtained in the regressions without firms' fixed effects. This result brings additional support to the assumption that the shock was unanticipated: if firms had anticipated the shock, we could have observed a shift towards more resilient banks prior to the shock.

Other bank characteristics are also significant, with overall expected signs. Larger banks with more capital, a higher ROA and a business model oriented towards traditional credit activities are more likely to increase long-term lending after the funding shock.

Finally, we also include banking group fixed effects in our specification. Banking group heterogeneity could drive our results to some extent as some banking groups were more affected by the subprime crisis via foreign subsidiaries. Moreover, internal liquidity management could vary between banking groups. Column 5 reports the results with the inclusion of banking group fixed effects. As a result, most bank characteristics – apart from ROA – become non-significant. This can be explained by the fact that size, capital ratio and loans to assets do not vary much within a banking group. Thus, banking group effects soak up the significance of these variables. A very interesting result however is that our deposits to assets variable remains highly significant with a similar coefficient as those obtained in the previous specifications. Thus, we find that long-term lending differs after a funding shock depending on the level of deposit funding even for banks lending to the same counterparty and belonging to the same banking group. Given the number of constraints we impose in the last specification, this result makes us confident that we are identifying a proper funding risk effect that is not related to other bank or firm characteristics.

The economic importance of the estimated coefficients also appears significant. If we take the coefficient obtained in column 5, a one-standard deviation in the deposits to assets ratio causes long-term lending to decrease on average by $0.128 \times 0.213 = 2.7\%$.

3.1.2. Maturity mismatch and the supply of long-term loans after the funding shock

We next consider how maturity mismatch predicts banks' behaviour after the shock. So far, we have only considered how the liability side of the bank's liquidity risk affects long-term lending. However, considering funding risk alone does not take into account the liquidity risk from the asset side. A bank with a higher proportion of illiquid assets will need more stable funding in order to be immune from the funding shock.

We test whether considering maturity mismatch brings additional information about banks' resilience to a funding shock. Maturity mismatch is defined as the ratio of long-term loans to deposits. A higher ratio indicates that the bank has a relatively more illiquid balance sheet on the asset side. Table 3 reports regression results for our maturity mismatch ratio. As for our funding risk measure, columns 1 and 2 report results without controlling for firms' fixed effects. We find, as expected, a negative correlation between banks' maturity mismatch and their long-term lending, i.e. banks that rely on alternative sources than deposits to fund their portfolio of long-term loans reduce their supply of long-term loans after the shock more. Not too surprisingly given our previous results, we find in columns 3, 4 and 5 that these results are robust to the inclusion of firms' fixed effects and banking group fixed effects. The relation between maturity mismatch and long-term lending thus appears to be causal, with a highly significant coefficient in all specifications.

We do not find that other characteristics affect long-term lending in these specifications. Only the NPL ratio is significant in the OLS model (column 2). In this specification, a higher NPL ratio prior to the shock causes long-term lending to decrease over the period.

Our results are consistent with the fact that the asset side also matters for banks' resilience to funding shocks. Banks with a higher relative proportion of illiquid assets are less immune to the shock.

In terms of economic significance, our regressions provide estimates of an average decrease in long-term lending of the same magnitude as above for the deposits to assets ratio. A one standard deviation in the long-term lending to deposits ratio leads to a decrease in lending of $0.002 \times 16.208 = 3.2\%$.

3.2. Additional analyses

So far, we have shown that funding risk and maturity mismatch cause banks to reduce long-term lending after a funding shock. These results fit well with the macroeconomic effects observed after the financial crisis. A credit rationing of long-term loans might be more severe for the real sector than a temporary reduction in short-term lending. However, we have not shown that banks decrease long-term loans exclusively. Banks might have decided to ration credit for all credit maturities without distinguishing between short-term and long-term loans. In this sub-section, we test whether the funding shock also affected the supply of short-term loans.

3.2.1. Change in short-term lending after the funding shock

Table 4 reports the same sets of results for the change in short-term lending. The dependent variable is defined as the change in logarithm of short-term credit exposures between 2007Q2 and 2009Q4. Short-term credit exposures are exposures with a maturity of one year or less. For the sake of brevity, Table 4 only reports regressions with firms' fixed effects included.

However, the results are qualitatively unchanged for the other set of OLS regressions without firms' fixed effects.

Columns 1 and 2 report the results for the deposits to assets ratio (funding risk), while columns 3 and 4 report the results for the long-term loans to deposits ratio (maturity mismatch). The coefficients for the deposits to assets ratio are of the same magnitude as those obtained for long-term lending, but not significant. It is thus not possible to conclude that banks with different deposits ratio behave differently after the funding shock. Coefficients for the long-term loans to deposits ratio are very close to zero and also not statistically significant. In a nutshell, the table shows that funding risk and maturity mismatch do not seem to affect banks' supply of short-term loans, as we do not find evidence that banks with higher liquidity risk behave differently to the other group of banks.

This set of results suggests that banks with high liquidity risk shortened the maturity of their loan portfolio after the shock: compared to other banks, they reduced their supply of long-term loans but continued to lend short-term loans at a similar pace. The results might thus be driven by a strategy of banks highly exposed to liquidity risk of reducing their maturity mismatch after the shock. This also holds true after controlling for firms' demand effects.

To sum up, the change in lending seems to be driven by the change in long-term lending, whereas we do not find that banks with high liquidity risk particularly reduced short-term lending compared to other banks. This result has potentially important macroeconomic implications. Whereas firms might be able to cope with short-term credit rationing by turning to trade credit or factoring, they cannot use these substitutes for long-term credit. Only capital markets are a possible alternative for the external financing of firms. This option is however only credible for the largest firms in our sample. To properly understand how the funding shock affects the ability of firms to fund their long-term assets, we next analyse whether the credit rationing depends on the size of the borrowing firm.

3.2.2. Do smaller firms bear the brunt of the rationing of long-term loans?

Table 5 shows the proportion of LT loans in total credit exposures in the Banque de France central credit register database. The mean share of long-term loans is the highest for small firms: it represents 79.7% of their bank funding. This share decreases to 40.2% for medium-sized firms. Finally, this share is only 24.3% for large firms. This is unsurprising given that large firms rely more on capital markets for their long-term borrowing and mainly use bank debt to refinance their working capital. Large firms also have access to bank lending abroad via the international syndicated loan market (which is not captured in our data when the lending bank is not a domestic credit institution). An important point to note with these figures is that the smaller a firm is, the more it will be affected by a rationing of long-term loans.

Given this feature, we go deeper in our analysis to identify if borrower size is an important factor in explaining the decrease in the supply of long-term loans after the shock. The premise of this analysis is that banks tend to ration opaque customers first of all to avoid problems of adverse selection and moral hazard (Stiglitz and Weiss, 1981).

To capture this theoretical prediction, we consider the size of borrowers. We create three dummy variables capturing size. The 'small firm' dummy is equal to one when a firm's turnover in 2006Q4 is below EUR 10 million, and zero otherwise. The 'medium-sized firm' dummy is equal to one when a firm's turnover in 2006Q4 is between EUR 10 and 100 million, and zero otherwise. Finally, the 'large firm' dummy is equal to one when a firm's turnover in 2006Q4 is above EUR 100 million, and zero otherwise.

To capture a size effect, we interact each dummy with our main variables of interest: the deposits to assets ratio and the long-term lending to deposits ratio. For the sake of brevity, we

only report results including firms' fixed effects. However, the results are robust when these firm fixed effects are not included.

Table 6 reports the regressions of the change in long-term lending on the interaction between firm size and banks' liquidity risk. For small firms, we find that banks' funding risk (deposits ratio) and maturity mismatch (long-term loans to deposits ratio) prior to the shock have a significant effect on long-term lending. We find mixed evidence for firms belonging to the medium-sized category: the long-term loans to deposits ratio is always significant but not the deposits to assets ratio.

Finally, for large firms, the coefficients are not statistically significant in all regressions. In the case of these large firms, these results indicate that on average banks with high liquidity risk do not behave differently after a funding shock compared to other banks: they continue to lend at the same pace.

The results show a clear gradation in the rationing of firms. Small firms clearly bear the largest burden in terms of rationing: they receive fewer long-term loans after the shock from non-resilient banks as measured by funding risk or maturity transformation. Medium-sized firms are also rationed but especially by banks which have a higher proportion of illiquid assets relative to their deposits. Finally, large firms do not appear to be rationed on average by non-resilient banks.

Small firms in our sample rely heavily on long-term bank loans as an external funding source. They are also less likely to substitute capital market funding for these bank loans due to information asymmetry problems and the fixed costs of public issuance. These results confirm that a funding shock can have major macroeconomic consequences.

4. Robustness checks

4.1. Placebo test: 2006Q1-2007Q1

Our identification strategy is based on the assumption that the funding shock was exogenous to a group of banks that showed a similar trend in lending before the shock. Figure 1 is supportive of this assumption as banks were all increasing their long-term lending before the funding shock, while the trend abruptly changed for the less resilient banks after the shock.

In this sub-section, we formally test this assumption by performing a placebo test, i.e. running the analysis on a period prior to the shock. In this period, banks' lending should not be affected by their funding risk or maturity mismatch as no shock occurs. We thus expect that the main coefficients of interest to be non-significant in these regressions.

We apply the same methodology as before by computing the change in the logarithm of long-term credit exposures. We choose to compute the change in long-term lending between 2006Q1 and 2007Q1. This choice is driven by two considerations. First, our period needs to end before the funding shock. Second, the Banque de France central credit register changed the minimum threshold for inclusion in the database from EUR 76,000 to 25,000 in the first quarter of 2006. Choosing a date prior to 2006Q1 would result in selection bias towards the largest firms. We thus prefer to take 2006Q1 in order to keep the same threshold of inclusion in the central credit register database as in our main sample.

Table 7 reports the results of our placebo test. Again, we only report results with the firms' fixed effects. OLS regressions give similar results. In all regressions, neither the deposits to assets ratio nor the long-term loans to deposits ratio are statistically significant. These results notably hold with or without controlling for banks' other characteristics or banking group fixed effects.

In conclusion, we do not find that banks with different funding risk or maturity mismatch behave differently before the funding shock. This test gives us confidence in our previous results, indicating that they were indeed driven by an exogenous shock during the period 2007Q2 to 2009Q4.

4.2. Alternative definitions of funding risk and maturity transformation

In this sub-section, we compare our main results with alternative definitions of funding risk and maturity mismatch. Namely, we expand our definition of stable funding by also taking into account banks' long-term debt (defined as bank balance sheet liabilities with a residual maturity over one year).

We define the sum of deposits and long-term debt as 'stable funding'. Our funding risk measure then becomes the ratio of stable funding to total assets. Our maturity mismatch metric similarly becomes the long-term loans to stable funding ratio. The rationale for these measures is that long-term debt might also immunise banks from the funding shock and act as a substitute for deposits. Table 1 gives descriptive statistics for these two liquidity risk measures. The average stable funding ratio is much higher for banks than the deposit ratio, at 63.4%. The long-term loans to stable funding ratio averages 79.5%. This indicates that banks' stable funding covers the portfolio of long-term loans.

Table 8 shows the results for our alternative definitions of funding risk and maturity mismatch. The coefficient for the stable funding ratio is always significant and positive, indicating that banks with a lower ratio reduce their supply of long-term loans. Magnitudes of the coefficients are of the same order as those obtained for the deposits to assets ratio.

The long-term loans to stable funding ratio is also highly significant, except in the first specification where we do not include other control variables and banking group fixed effects.

Given the overall results of the paper, this indicates that this ratio is correlated with other bank characteristics. When we do not control for bank characteristics, the ratio fails to reveal the effect of the funding shock. Thus, this ratio appears slightly inferior to the deposits to assets ratio in terms of predicting banks' resilience to the funding shock.

Overall, the alternative funding metrics confirm the credit rationing of long-term loans for firms, although stability of funding only defined in terms of deposits appears to be a slightly better predictor of banks' supply of long-term loans after the funding shock.

5. Conclusion

This study belongs to the literature that analyses the transmission of financial shocks to the real sector. It is the first to assess how banks adjust the maturity of their lending after a funding shock. The question is of great importance as a decline in long-term lending is detrimental for firms' long-term investment.

We take advantage of the international interbank market freeze which started in August 2007 – and was exogenous to the domestic French banking sector – to analyse how banks hit by a funding shock change their supply of long-term loans depending on their level of liquidity risk. To measure the change in long-term lending, we have access to a rich bank-firm credit register dataset on a quarterly basis, with information on credit maturity. This data allows us to disentangle loan demand from loan supply effects by estimating the change in lending between two banks with different liquidity profiles with respect to the same counterparty. We match this data with residual bank balance sheet maturity to measure funding risk and maturity mismatch at the bank level. Finally, we also collect information on firm size to assess the interaction between borrower size and the transmission of the funding shock.

We find that banks with less deposit funding reduce their supply of long-term loans after the shock. Maturity mismatch also explains banks' supply of long-term credit after the shock. However, all banks continued to grant short-term loans at the same pace.

The decline in long-term lending is borne by the smallest firms, which rely more on long-term bank loans as a source of external financing and are less likely to find alternative sources to fund their long-term assets.

Moreover, these results are robust to the inclusion of controls capturing other bank characteristics and banking group fixed effects. They are also robust to alternative definitions of funding risk and maturity mismatch.

These findings help us to understand some of the mechanisms behind the global recession that followed the massive liquidity shock in 2007-2008. The rationing of long-term loans to the smallest firms has important macroeconomic implications. In essence, they also give support to the future liquidity regulations. The Basel III NSFR will require banks to finance their illiquid assets with a minimum share of stable funding. Our empirical results support the rationale of this regulation by showing that lower funding risk and a lower maturity mismatch immunise banks from funding shocks. This in turn allows banks to continue extending long-term loans to firms in times of funding stress. Such a regulation might thus support economic growth during periods of downturn by ensuring that banks continue their role of long-term funding providers for firms that cannot access alternative financing sources.

References

Albertazzi, U. and Bottero M., 2014. Foreign bank lending: Evidence from the global financial crisis, *Journal of International Economics*, 92, 22-35.

BCBS, 2014. Basel III: the net stable funding ratio, Basel Committee on Banking Supervision, October 2014. Available at http://www.bis.org/bcbs/publ/d295.pdf

Bencivenga V.R., and Smith B.D., 1991. Financial intermediation and endogenous growth, *Review of Economic Studies*, 58, 195-209.

Berger, A. and Bouwman C.H., 2009. Bank liquidity creation, *Review of Financial Studies*, 22, 9, 3779-3837.

Bernanke, B., 1983. Nonmonetary effects of the financial crisis in propagation of the great depression, *American Economic Review*, 73, 257-276.

Bernanke, B. and Gertler M., 1989. Agency Costs, Net Worth, and Business Fluctuations, *American Economic Review*, 79, 14–31.

Bernanke, B.S., Gertler, M. and Gilchrist, S., 1998. The financial accelerator in a quantitative business cycle framework. In: Taylor, J., Woodford, M. (Eds.), Handbook of Macroeconomics.

Bricongne J-C., Fournier J-M, Lapègue V., and Monso O., 2010. De la crise financière à la crise économique, l'impact des perturbations financières de 2007-2008 sur la croissance de sept pays industrialisés, *Économie et Statistique*, 438, 1, 47-77.

Brunnermeier, M. K., 2009. Deciphering the liquidity and credit crunch 2007-2008, *Journal of Economic Perspectives*, 23, 1, 77-100.

Brunnermeier, M. K., Gorton G., and Arvind Krishnamurthy A., 2011. Risk topography, *NBER Macroeconomics Annual.*

Brunnermeier, M. K., Gorton G., and Krishnamurthy A., 2012. Liquidity mismatch measurement, *NBER Systemic Risk and Macro Modeling.*

Cornett, M.M., McNutt J.J., Strahan P.E. and Tehranian H., 2011. Liquidity risk management and credit supply in the financial crisis, *Journal of Financial Economics*, 101, 297-312.

De Socio, A., 2013. The interbank market after the financial turmoil: squeezing liquidity in a "lemons market" or asking liquidity "on tap", *Journal of Banking and Finance*, 37, 1340-1358.

Diamond D.W., and Dybvig, P.H., 1983. Bank runs, deposit insurance, and liquidity, *Journal of Political Economy*, 91, 3, 401-419.

Distinguin, I., Roulet C. and Tarazi A., 2013. Bank regulatory capital and liquidity: evidence from US and European publicly traded banks, *Journal of Banking and Finance*, 37, 3295-3317.

Drehmann, M. and Nikolaou K., 2013. Funding liquidity risk: definition and measurement, *Journal of Banking and Finance*, 37, 2173-2182.

Duffie, D., 2010. The failure mechanics of dealer banks, *Journal of Economic Perspectives*, 24, 1, 51-72.

Gan, J., 2007. The real effects of asset market bubbles: loan and firm level evidence of a lending channel, *Review of Financial Studies*, 20, 1941-1973.

Gorton, G. and Metrick A., 2012. Securitized banking and the run on repo, *Journal of Financial Economics*, 104, 425-451.

Kapan, T. and Minoiu C., 2014. Liquidity shocks and the supply of credit after the 2007-2008 crisis, *International Journal of Finance and Economics*, 19, 12-23.

Kashyap, A.K. and Stein J.C., 2000. What do a million observations on banks say about the transmission of monetary policy?, *American Economic Review*, 90, 3, 407-428.

Khwaja, A.I. and Mian A., 2008. Tracing the impact of bank liquidity shocks, *American Economic Review*, 98, 4, 1413-1442.

Holmström, B. and Tirole J., 1997. Financial intermediation, loanable funds, and the real sector, *Quarterly Journal of Economics*, 112, 3, 663-691.

Imbierowicz, B. and Rauch C., 2014. The relationship between liquidity and credit risk in banks, *Journal of Banking and Finance*, 40, 242-256.

Ivashina, V. and Scharfstein D., 2010. Bank lending during the financial crisis of 2008, *Journal of Financial Economics*, 97, 319-338.

Iyer, R., Peydró J-L, da-Rocha-Lopes S and Schoar A., 2014. Interbank liquidity crunch and the firm credit crunch: Evidence from the 2007-2009 crisis, *Review of Financial Studies*, 27(1), 347-372.

Radde, S., 2015. Flight to liquidity and the great recession, *Journal of Banking and Finance*, 54, 192-207.

Schlueter, T., Sievers S. and Hartmann-Wendels T., 2015. Bank funding stability, pricing strategies and the guidance of depositors, *Journal of Banking and Finance*, 51, 43-61

Schnabl, P., 2012. Financial globalization and the transmission of credit supply shocks: Evidence from an emerging market. *Journal of Finance*, 67, 897-932.

Stiglitz, J.E., and Weiss, J., 1981. Credit rationing in markets with imperfect information, *American Economic Review*, 71, 3, 393-410.

Zheng, H., 2006. Interaction of credit and liquidity risks: modelling and valuation, *Journal of Banking and Finance*, 30, 391-407.

Table 1
Sample descriptive statistics

Variables	Description	N. obs.	Median	Mean	Std. Dev.
Panel A: Loan level					
Change in long-term lending	Change in log of long-term credit exposures (over 1 year) between 2007Q2 and 2009Q4	233,212	-0.201	-0.119	0.900
Change in short-term lending	Change in log of short-term credit exposures (less than 1 year) between 2007Q2 and 2009Q4	74,291	0	-0.030	1.398
Long-term credit exposure 2007Q2	Long-term credit exposure in 2007Q2 in thousands of euro	233,212	153	769	5786
Short-term credit exposure 2007Q2	Short-term credit exposure in 2007Q2 in thousands of euro	74,291	78	553	13437
Panel B: Bank level					
Deposits to assets	Deposits to total assets in 2007Q2	133	0.406	0.373	0.213
Long-term loans to deposits	Loans with residual maturity greater than 1 year to deposits in 2007Q2	133	1.282	4.654	16.208
Stable funding to assets	Deposits and liabilities with residual maturity greater than 1 year to total assets in 2007Q2	133	0.647	0.634	0.172
Long-term loans to stable funding	Loans with residual maturity greater than 1 year to stable funding in 2007Q2	133	0.822	0.795	0.326
Bank size	Ln of total assets in 2007Q2	133	15.996	15.993	1.375
Total assets	Total assets in 2007Q2 in thousands of euro	133	8,852,190	38,785,240	146,396,931
Capital ratio	Equity to total assets in 2007Q2	133	0.093	0.092	0.035
NPL ratio	Non-performing loans to total assets in 2007Q2	133	0.007	0.009	0.007
ROA	Net profit to total assets in 2007Q2	133	0.004	0.005	0.003
Loans to assets	Loans to total assets in 2007Q2	133	0.678	0.593	0.212
Panel C: Firm level					
Large firms	Dummy equal to 1 if a firm has a turnover over EUR 100 million in 2006Q4; 0 otherwise	119,041		0.009	
Medium-sized firms	Dummy equal to 1 if a firm has a turnover between EUR 10 and 100 million in 2006Q4; 0 otherwise	119,041		0.071	
Small firms	Dummy equal to 1 if a firm has a turnover under EUR 10 million in 2006Q4; 0 otherwise	119,041		0.919	

Table 2
Funding risk and long-term credit supply after the funding shock

This table reports the results of regressions where the dependent variable is the difference in the log of long-term credit exposures between 2009Q4 and 2007Q2 for each bank-firm in the sample. The explanatory variable of interest is the deposits to assets ratio, measured before the funding shock in 2007Q2. Other control variables are bank size computed as the logarithm of banks' total assets in 2007Q2, the capital ratio computed as equity divided by total assets in 2007Q2, the NPL ratio computed as non-performing loans divided by total assets in 2007Q2, the ROA computed as net income divided by total assets in 2007Q2, and the loans to assets ratio computed as loans to non-financial customers divided by total assets in 2007Q2. Standard errors are clustered at the bank level and robust to heteroscedasticity. '***', '**' and '*' indicate statistically significant coefficients at the 1%, 5% and 10% levels respectively.

	Change in long-term lending				
	(1)	(2)	(3)	(4)	(5)
Deposits to assets	0.115*	0.151***	0.137**	0.163***	0.128***
	(0.059)	(0.045)	(0.053)	(0.053)	(0.045)
Bank size		0.004		0.015***	0.012
		(0.008)		(0.005)	(0.007)
Capital ratio		0.677**		0.417*	0.300
		(0.281)		(0.227)	(0.449)
NPL ratio		-7.901***		-1.767	-1.230
		(1.656)		(1.130)	(1.334)
ROA		4.238		6.308*	5.623*
		(3.551)		(3.375)	(3.321)
Loans to assets		0.129**		0.142***	0.035
		(0.051)		(0.047)	(0.074)
Constant	-0.155***	-0.322*	-0.162***	-0.544***	-0.412**
	(0.024)	(0.180)	(0.021)	(0.132)	(0.176)
Firm FE	No	No	Yes	Yes	Yes
Banking group FE	No	No	No	No	Yes
Observations	233,212	233,212	233,212	233,212	218,232
R^2	0.001	0.004	0.484	0.485	0.507

Table 3
Maturity mismatch and long-term credit supply after the funding shock

This table reports the results of regressions where the dependent variable is the difference in the log of long-term credit exposures between 2009Q4 and 2007Q2 for each bank-firm in the sample. The explanatory variable of interest is the long-term loans to deposits ratio computed as loans with maturity over 1 year divided by deposits, measured before the funding shock in 2007Q2. Other control variables are bank size computed as the logarithm of banks' total assets in 2007Q2, the capital ratio computed as equity divided by total assets in 2007Q2, the NPL ratio computed as non-performing loans divided by total assets in 2007Q2, the ROA computed as net income divided by total assets in 2007Q2, and the loans to assets ratio computed as loans to non-financial customers divided by total assets in 2007Q2. Standard errors are clustered at the bank level and robust to heteroscedasticity. '***' indicates statistically significant coefficients at the 1% level.

	Change in long-term lending				
	(1)	(2)	(3)	(4)	(5)
Long-term loans to deposits	-0.002***	-0.002***	-0.002***	-0.002***	-0.002***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Bank size		-0.011		-0.001	-0.006
		(0.009)		(0.006)	(0.008)
Capital ratio		0.481		0.209	0.246
		(0.291)		(0.205)	(0.429)
NPL ratio		-6.666***		-0.328	0.131
		(1.631)		(0.961)	(1.259)
ROA		3.497		4.626	3.563
		(4.095)		(2.966)	(2.800)
Loans to assets		0.074		0.081	-0.054
		(0.064)		(0.052)	(0.078)
Constant	-0.109***	0.024	-0.110***	-0.162	-0.016
	(0.011)	(0.186)	(0.006)	(0.135)	(0.183)
Firm FE	No	No	Yes	Yes	Yes
Banking group FE	No	No	No	No	Yes
Observations	233,212	233,212	233,212	233,212	218,232
R^2	0.001	0.003	0.484	0.485	0.507

Table 4
Short-term credit supply after the funding shock

This table reports the results of regressions where the dependent variable is the difference in the log of short-term credit exposures between 2009Q4 and 2007Q2 for each bank-firm in the sample. Short-term credit exposures are exposures with a maturity of less than one year. The explanatory variables of interest are the deposits to assets and long-term loans to deposits ratios computed as loans to non-financial customers with maturity over 1 year divided by deposits. Both variables are measured before the funding shock in 2007Q2. Other control variables are bank size computed as the logarithm of banks' total assets in 2007Q2, the capital ratio computed as equity divided by total assets in 2007Q2, the NPL ratio computed as non-performing loans divided by total assets in 2007Q2, the ROA computed as net income divided by total assets in 2007Q2, and the loans to assets ratio computed as loans to non-financial customers divided by total assets in 2007Q2. Standard errors are clustered at the bank level and robust to heteroscedasticity. '**' and '*' indicate statistically significant coefficients at the 5% and 10% levels respectively.

	Change in short-term lending			
	(1)	(2)	(3)	(4)
Deposits to assets	0.106	0.124		
	(0.073)	(0.098)		
Long-term loans to deposits			0.001	-0.000
			(0.001)	(0.001)
Bank size	-0.007	-0.004	-0.013	-0.008
	(0.012)	(0.015)	(0.012)	(0.015)
Capital ratio	0.733*	0.744	0.666*	0.774
	(0.388)	(0.856)	(0.377)	(0.869)
NPL ratio	-2.105	-1.663	-0.902	-0.317
	(2.196)	(2.926)	(2.136)	(2.963)
ROA	-7.730	-8.625	-10.138**	-11.420
	(4.668)	(6.963)	(5.057)	(7.214)
Loans to assets	-0.073	-0.069	-0.077	-0.056
	(0.089)	(0.129)	(0.090)	(0.129)
Constant	0.083	0.018	0.216	0.132
	(0.273)	(0.322)	(0.258)	(0.317)
Firm FE	Yes	Yes	Yes	Yes
Banking group FE	No	Yes	No	Yes
Observations	74,291	70,535	74,291	70,535
R^2	0.709	0.722	0.709	0.722

Table 5
Bank loan maturity of French non-financial firms in 2007Q2

This table reports mean exposures in thousands of euro for long-term loans, i.e. loans with a maturity over 1 year, and short-term loans, i.e. loans with a maturity below 1 year for non-financial firms in France. Small firms are non-financial firms with a turnover below EUR 10 million in 2006Q4. Medium-sized firms are non-financial firms with a turnover between EUR 10 and 100 million in 2006Q4. Large firms are non-financial firms with a turnover above EUR 100 million in 2006Q4.

Source: Banque de France credit register and authors' own calculations.

	Small firms (N = 1,874,632)	Medium-sized firms (N=20,111)	Large firms (N=2,487)
Mean LT loan exposure in 2007Q2 (thousands of euro)	349	4,212	28,904
Mean ST loan exposure in 2007Q2 (thousands of euro)	129	1,241	11,626
Mean share of LT loan over total exposures in 2007Q2	79.7%	40.2%	24.3%

Table 6
Borrower size and change in long-term lending

This table reports the results of regressions where the dependent variable is the difference in the log of long-term credit exposure between 2009Q4 and 2007Q2 for each bank-firm in the sample. Long-term credit exposures are exposures with a maturity of 1 year or greater. The explanatory variables of interest are the deposits to assets and long-term loans to deposits ratios computed as loans to non-financial customers with maturity over 1 year divided by deposits. Both variables are measured before the funding shock in 2007Q2. Other control variables are bank size computed as the logarithm of banks' total assets in 2007Q2, the capital ratio computed as equity divided by total assets in 2007Q2, the NPL ratio computed as non-performing loans divided by total assets in 2007Q2, the ROA computed as net income divided by total assets in 2007Q2, and the loans to assets ratio computed as loans to non-financial customers divided by total assets in 2007Q2. Small firms is a dummy variable equal to one if a firm has a turnover below EUR 10 million, and zero otherwise. Medium-sized firms is a dummy variable equal to one if a firm has a turnover between EUR 10 and 100 million and zero otherwise. Large firms is a dummy equal to one if a firm has a turnover above EUR 100 million and zero otherwise. Firms' turnover is measured in 2006Q4. Standard errors are clustered at the bank level and robust to heteroscedasticity. '***', '**' and '*' indicate statistically significant coefficients at the 1%, 5% and 10% levels respectively.

	Change in long-term lending					
	(1)	(2)	(3)	(4)	(5)	(6)
Deposits to assets × Small firms	0.134**		0.165***		0.130***	
	(0.055)		(0.056)		(0.048)	
Deposits to assets × Medium-sized firms	0.167		0.154*		0.120	
	(0.104)		(0.093)		(0.117)	
Deposits to assets × Large firms	0.087		0.083		0.090	
	(0.181)		(0.178)		(0.215)	
Long-term loans to deposits × Small firms		-0.002***		-0.001**		-0.002**
		(0.001)		(0.001)		(0.001)
Long-term loans to deposits × Medium-sized firms		-0.004***		-0.004***		-0.005***
		(0.001)		(0.001)		(0.001)
Long-term loans to deposits × Large firms		-0.006		-0.006		-0.008
		(0.006)		(0.005)		(0.006)
Bank size			0.015***	-0.002	0.012	-0.005
			(0.005)	(0.006)	(0.007)	(0.008)
Capital ratio			0.416*	0.217	0.298	0.265
			(0.228)	(0.205)	(0.450)	(0.430)
NPL ratio			-1.759	-0.352	-1.223	0.096
			(1.124)	(0.955)	(1.339)	(1.260)
ROA			6.296*	4.493	5.619*	3.533
			(3.374)	(2.949)	(3.318)	(2.804)
Loans to assets			0.143***	0.080	0.035	-0.051
			(0.048)	(0.052)	(0.074)	(0.079)
Constant	-0.161***	-0.110***	-0.546***	-0.159	-0.412**	-0.025
	(0.021)	(0.006)	(0.133)	(0.136)	(0.175)	(0.185)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Banking group FE	No	No	No	No	Yes	Yes
Observations	233,212	233,212	233,212	233,212	218,232	218,232
R^2	0.484	0.484	0.485	0.485	0.507	0.507

Table 7
Placebo test 2006Q1-2007Q1

This table reports the results of regressions where the dependent variable is the difference in the log of long-term credit exposures between 2007Q1 and 2006Q1 for each bank-firm in the sample. The explanatory variables of interest are the deposits to assets and long-term loans to deposits ratios computed as loans to non-financial customers with maturity over 1 year divided by deposits. Both variables are measured at the beginning of the placebo test in 2006Q1. Other control variables are bank size computed as the logarithm of banks' total assets in 2006Q1, the capital ratio computed as equity divided by total assets in 2006Q1, the NPL ratio computed as non-performing loans divided by total assets in 2006Q1, the ROA computed as net income divided by total assets in 2006Q1, and the loans to assets ratio computed as loans to non-financial customers divided by total assets in 2006Q1. Standard errors are clustered at the bank level and robust to heteroscedasticity. '**' and '*' indicate statistically significant coefficients at the 5% and 10% levels respectively.

	Change in long-term lending					
	(1)	(2)	(3)	(4)	(5)	(6)
Deposits to assets	0.042	0.019	-0.053			
	(0.027)	(0.030)	(0.033)			
Long-term loans to deposits				-0.000	0.000	0.000
				(0.000)	(0.000)	(0.001)
Bank size		0.001	0.013**		0.001	0.012*
		(0.006)	(0.007)		(0.005)	(0.007)
Capital ratio		0.040	0.157		-0.050	0.186
		(0.188)	(0.291)		(0.178)	(0.333)
NPL ratio		-0.540	-0.195		-0.672	-0.977
		(0.976)	(1.048)		(0.992)	(1.207)
ROA		1.138	10.420**		-0.247	8.573
		(3.176)	(4.094)		(2.547)	(5.922)
Loans to assets		0.083***	0.096**		0.100***	0.085**
		(0.028)	(0.042)		(0.032)	(0.041)
Constant	-0.097***	-0.154	-0.329**	-0.084***	-0.139	-0.320**
	(0.011)	(0.132)	(0.126)	(0.005)	(0.101)	(0.132)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Banking group FE	No	No	Yes	No	No	Yes
Observations	250,993	250,993	231,953	250,993	250,993	231,953
R^2	0.465	0.465	0.495	0.440	3.368	7.247

Table 8
Alternative definition of funding risk and maturity mismatch

This table reports the results of regressions where the dependent variable is the difference in the log of long-term credit exposures between 2009Q4 and 2007Q2 for each bank-firm in the sample. Long-term credit exposures are exposures with a maturity of 1 year or greater. The explanatory variables of interest are the stable funding ratio defined as the sum of deposits and liabilities with maturity greater than 1 year and the long-term loans to stable funding ratio computed as loans to non-financial customers with maturity over 1 year divided by the sum of deposits and liabilities with maturity greater than 1 year. Both variables are measured before the funding shock in 2007Q2. Other control variables are bank size computed as the logarithm of banks' total assets in 2007Q2, the capital ratio computed as equity divided by total assets in 2007Q2, the NPL ratio computed as non-performing loans divided by total assets in 2007Q2, the ROA computed as net income divided by total assets in 2007Q2, and the loans to assets ratio computed as loans to non-financial customers divided by total assets in 2007Q2. Standard errors are clustered at the bank level and robust to heteroscedasticity. '***', '**' and '*' indicate statistically significant coefficients at the 1%, 5% and 10% levels respectively.

	Change in long-term lending					
	(1)	(2)	(3)	(4)	(5)	(6)
Stable funding ratio	0.159***		0.180***		0.098**	
	(0.057)		(0.062)		(0.042)	
Long-term loans to stable funding ratio		0.048		-0.102**		-0.138***
		(0.029)		(0.047)		(0.034)
Bank size			0.020***	0.007	0.013	0.004
			(0.007)	(0.006)	(0.008)	(0.006)
Capital ratio			0.234	0.192	0.265	0.209
			(0.208)	(0.203)	(0.459)	(0.452)
NPL ratio			-0.721	-0.768	-0.873	-0.883
			(0.976)	(1.025)	(1.286)	(1.272)
ROA			7.151*	6.374**	4.397	6.068*
			(3.988)	(3.124)	(3.339)	(3.115)
Loans to assets			0.141**	0.234***	0.056	0.156**
			(0.055)	(0.071)	(0.079)	(0.068)
Constant	-0.215***	-0.156***	-0.687***	-0.316**	-0.448**	-0.199
	(0.038)	(0.025)	(0.184)	(0.123)	(0.187)	(0.152)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Banking group FE	No	No	No	No	Yes	Yes
Observations	233,212	233,212	233,212	233,212	218,232	218,232
R^2	0.484	0.484	0.485	0.485	0.507	0.507