ISSN 1518-3548

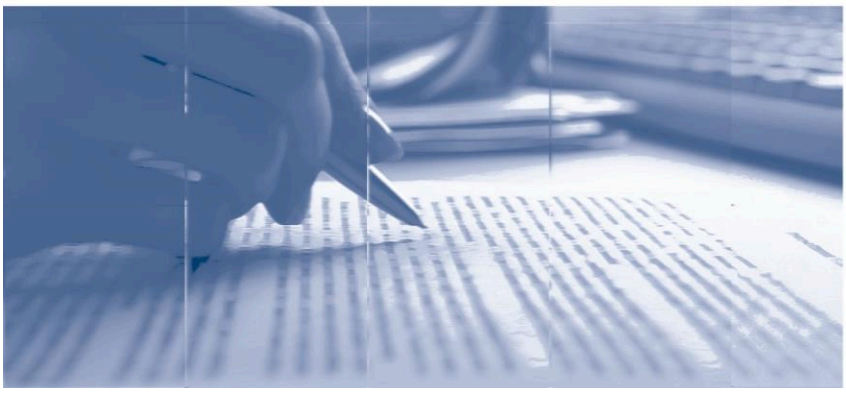
BANCO CENTRAL DO BRASIL

Asymmetric Transmission of a Bank Liquidity Shock

Rafael Felipe Schiozer and
Raquel de Freitas Oliveira

November, 2014

Working Papers



368

ISSN 1518-3548
CGC 00.038.166/0001-05

Working Paper Series	Brasília	n. 368	November	2014	p. 1-44

Working Paper Series

Edited by Research Department (Depep) – E-mail: workingpaper@bcb.gov.br

Editor: Francisco Marcos Rodrigues Figueiredo – E-mail: francisco-marcos.figueiredo@bcb.gov.br
Editorial Assistant: Jane Sofia Moita – E-mail: jane.sofia@bcb.gov.br
Head of Research Department: Eduardo José Araújo Lima – E-mail: eduardo.lima@bcb.gov.br

The Banco Central do Brasil Working Papers are all evaluated in double blind referee process.

Authorized by Carlos Hamilton Vasconcelos Araújo, Deputy Governor for Economic Policy.

General Control of Publications

Banco Central do Brasil

Comun/Dipiv/Coivi

SBS – Quadra 3 – Bloco B – Edifício-Sede – 14º andar

Caixa Postal 8.670

70074-900 Brasília – DF – Brazil

Phones: +55 (61) 3414-3710 and 3414-3565

Fax: +55 (61) 3414-1898

E-mail: editor@bcb.gov.br

Citizen Service Division

Banco Central do Brasil

Deati/Diate

SBS – Quadra 3 – Bloco B – Edifício-Sede – 2º subsolo

70074-900 Brasília – DF – Brazil

Toll Free: 0800 9792345

Fax: +55 (61) 3414-2553

Internet: <http//www.bcb.gov.br/?CONTACTUS>

Asymmetric Transmission of a Bank Liquidity Shock[*]

Rafael Felipe Schiozer[**]

Raquel de Freitas Oliveira[***]

Abstract

The Working Papers should not be reported as representing the views of the Banco Central do Brasil. The views expressed in the papers are those of the author(s) and do not necessarily reflect those of the Banco Central do Brasil.

We investigate whether banks that receive a positive liquidity shock make up for the reduction in the loan supply by banks that suffer a negative liquidity shock. For identification, we use the exogenous shock to the Brazilian banking system caused by the international turmoil of 2008 that sparked a run on small and medium banks towards the systemically important banks. We find that a reduction in liquidity causes banks to strongly decrease their loan supply, whereas a positive liquidity shock has a small (if any) effect on the loan supply. Our findings are consistent with the theories that predict that borrowers face switching costs, and that agents tend to hold on to liquidity during periods of systemic uncertainty. In addition, we find that the shock causes small and medium companies to obtain less bank financing, compared to large firms, possibly because international and domestic capital markets dry out during the crisis. Our evidence suggests that the asymmetric effect of liquidity on loan supply derives mostly from the extensive, rather than the intensive margin. Nonetheless, because we do not identify the exact mechanism driving bank behavior, we cannot predict under which conditions we would find a similar effect should a new shock occur.
Keywords: bank lending channel, credit supply, financial crisis
JEL Classification: G210, G320, G010

---

[*] Most of this paper was written while Rafael Schiozer visited the Wharton Financial Institutions Center, at the Wharton School of the University of Pennsylvania. Rafael Schiozer acknowledges the financial support received from the State of São Paulo Research Foundation (FAPESP) for this research. We thank Franklin Allen, the participants at the IX Annual Seminar on Risk, Financial Stability and Banking of the Central Bank of Brazil, and at the 2014 Brazilian Finance Meeting, and the seminar participants at the Wharton School – University of Pennsylvania for helpful suggestions and comments. We specially thank André Barbosa Costa for extraordinary research assistance. All remaining errors rest with the authors.
[**] Fundação Getulio Vargas – EAESP
[***]Banco Central do Brasil, Departamento de Estudos e Pesquisas (Depep) and Fundação Escola de Comércio Álvares Penteado (Fecap).

1. Introduction

Financial crises are generally characterized by shocks to the funding of banks. A shock impacts the real sector if it constrains the lending capacity of some banks, and their borrowers cannot perfectly substitute with loans from unconstrained banks or with other sources of financing, such as capital markets or trade credit.

The empirical identification of the transmission of bank liquidity shocks to the real economy is challenging. These shocks typically occur simultaneously to changes in borrower risk and firm investment opportunities that decrease loan demand. This simultaneity makes it difficult for the empiricist to attribute the variation in the observed amount of loans to a change in credit supply by banks. Recent studies have been able to properly address this issue by using multiple loan data at the bank-firm level (i.e., analyzing loans taken by the same firm from more than a single bank), allowing them to control for demand effects by using borrower fixed effects. Most of the evidence from these papers show that loan supply to nonfinancial firms is negatively affected by shocks that decrease bank liquidity, either if these shocks have a domestic (Khwaja and Mian, 2008) or foreign origin (Schnabl, 2012; Ongena et al, 2013; Iyer et al, 2014).

Whether increases and decreases in bank liquidity have symmetric effects on credit supply remains an open question so far, despite its importance in potentially providing valuable inputs to policy makers that need to create crisis management strategies. The purpose of this study is to address this issue. We also control for demand effects in a similar fashion to the previous literature. To do this, we explore an exogenous shock to the Brazilian banking sector that is essentially different in nature from the ones previously analyzed in the literature.

Immediately after the failure of Lehman Brothers in September 2008, many governments and bank regulators throughout the world rushed to implement measures that enabled them to bail out systemically important financial institutions that were under distress[1]. Following these announcements, Brazilian medium and small banks suffered a

[1] In the US, for example, Secretary Henry Paulson's proposal for the Emergency Economic Stabilization Act was publicized in September 20th, and has promptly received formal support from many other governments, such as UK Prime Minister Gordon Brown. The bill was approved by Congress on October 3rd, 2008. At the same time, many other countries supplied systemically important institutions with capital and liquidity. For example, during the first two weeks of October, European governments have committed more than 1 trillion Euros to save systemically important banks in the four weeks following Lehman's demise (Bloomberg, 2008).

deposit run, while systemically important banks (hereafter, big banks) passively received enormous deposit inflows. Oliveira et al (2014) show that this run was driven by the increased perception of an implicit guarantee given to the liabilities of Brazilian big banks, and not by bank fundamentals, such as the pre-crisis quality of the loan portfolio, asset liquidity and capitalization, nor by how each bank could possibly be affected by the crisis (such as their dependence on foreign funding or the characteristics of their loan portfolios). In fact, Brazilian banks had virtually no direct or indirect exposure to subprime assets, and were very little dependent on foreign funding at the onset of the crisis.

Therefore, the shock we use in this study differs from the other liquidity events previously used in the literature in two main aspects. First, all the previously used experiments involve a shock to the liquidity of banks, but their variation is mostly one-sided[2] (i.e, they explore different degrees of either reduction or increase in bank liquidity), which partially impairs the identification of the ability of firms to switch from constrained to unconstrained banks. Our study uses a shock that triggered a massive redistribution of deposits across banks, resulting in some banks suffering from a liquidity shortage whereas others were benefited with excess liquidity. In other words, the shock we explore in this study is purely distributional and provides almost as many observations of improvement as of reduction in bank liquidity. We argue that this particular natural experiment is even better than the ones previously used in the literature because it is richer in terms of cross-sectional variation, and thus allows us to evaluate whether there are financial frictions that prevent borrowers from substituting between constrained and unconstrained banks. More importantly, this redistribution of deposits was unrelated to each bank's pre-crisis loan portfolio, as Oliveira et al (2014) show.

The second fundamental feature that makes the Brazilian liquidity shock unique is its transmission channel. While most of the other studies rely on very clear mechanisms through which bank funding is affected, such as the dry up of foreign funding (Schnabl, 2012; Ongena et al, 2013; Iyer et al, 2014) or of a specific domestic source of financing (Khwaja and Mian, 2008), the transmission mechanism of the recent crisis to emerging economies is more subtle: as Allen and Carletti (2010) point out, nervousness and distrust

[2] For example, in Khwaja and Mian (2008), Schnabl (2012) and Iyer et al (2014) all the banks are negatively (or at least, not positively) affected by the shocks, and in Paravisini (2008) banks are benefited by a governmental program.

have spread through many emerging markets during the international financial turmoil. Particularly in Brazil, the degree to which banks were affected by the international financial crisis is related to how domestic investors perceived the implicit guarantees enjoyed by each bank. This feature adds another layer to the discussion about the regulation and supervision of systemically important banks and shows another facet of the negative externalities of systemically important banks: their access to liquidity during crises (extensively discussed by Oliveira et al, 2014), and its implications on credit supply to the real economy.

One potential concern about interpreting an association between changes in liquidity and changes in lending as causal is that banks that lose deposits could, ex-ante, have been lending to firms that are fundamentally exposed to the shock, i.e., firms whose investment opportunities or risk have been negatively affected by the crisis. To deal with this identification issue, we analyze change in loans within very similar firms (i.e., in the same industry and of similar size). We also conduct several robustness tests to ensure that our results are being driven by a liquidity supply effect rather than changes in loan demand or borrower risk. Namely, we control for pre-crisis loan characteristics (working capital; revolving lines; export loans, etc.) and bank features, such as size, asset liquidity, profitability and bank ownership (private, governmental and foreign). Our results are also robust to different measures of change in bank liquidity, and varying the time window of the pre and post-crisis periods.

We use a within-industry-size estimator and find that the supply of liquidity has an asymmetric effect on lending. Our results show that a 1% reduction in deposits reduces loan supply by at least 0.4%, whereas an increase in deposits of the same magnitude increases loan supply by no more than 0.1%. The effect of the liquidity shock is also heterogeneous across borrower size. Consistent with evidence found in other markets, a shock to bank liquidity causes lending to decrease more for small than for large firms. These results are directly related to the theories about financing frictions and bank lending (Kashyap et al, 1993; Holmstrom and Tirole, 1997; Stein, 1998; Peek and Rosengreen, 2000), and the empirical papers that specifically investigate the effects of changes in bank funding on loan supply, such as Khwaja and Mian (2008), Paravisini (2008), Imai and Takarabe (2011) Schnabl (2012), Ongena et al. (2013) and Iyer et al. (2014).

We also find asymmetric effects of bank liquidity on lending at the extensive margin. A 1% decrease in deposits implies an approximate 0.5% reduction in the number of borrowing firms, and decreases by approximately 0.2% the probability of increasing the number of borrowers within the same industry-size, whereas the effect of a 1% increase in bank liquidity on the number of borrowers is nearly zero. These results are consistent with the literature that views banks as relationship lenders, such as Petersen and Rajan (1994), Berger and Udell (1995) and Bharath et al (2008), and suggest that firms that relate to banks that become constrained are not able to readily switch their borrowing to banks with excess liquidity.

Our paper also speaks indirectly to the literature that relates loan supply to the business cycle, such as Bernanke and Gertler (1989) and Diamond and Rajan (2005), and the vast literature on the bank lending channel (for example Bernanke and Blinder, 1992; Kashyap and Stein, 2000; Campello, 2002; Ashcraft, 2006).

Our findings are consistent with both the theories that predict that borrowers face switching costs, and that agents tend to hold on to liquidity during periods of systemic uncertainty. Because we do not identify the exact mechanism driving bank behavior, more studies are needed to allow a thorough understanding of the phenomenon, and provide a roadmap to policy makers.

The remainder of the article proceeds as follows. Section 2 describes the effects of the crisis on the Brazilian banking system. Section 3 introduces the empirical strategy, provides the institutional details and describes the data and the sample selection. Section 4 presents the results and provides some robustness checks. Section 5 concludes the article.

2. Effects of the global financial crisis on the Brazilian banking system

The start of the subprime crisis can be dated to early 2007. The first symptoms of the crisis were a reduction in interbank and repo markets, especially in the US and the Eurozone. Financial authorities have responded with actions to improve liquidity conditions, such as a strong monetary easing and micro-level measures to recuperate interbank and repo markets (Allen and Carletti, 2010). At the same time, emerging economies were benefited by the continuing increase in commodity prices and improved domestic macroeconomic conditions. In particular, the Brazilian market has seen its largest wave of initial public offerings, with more than 60 companies going public in 2007, a record inflow of foreign direct investment, inflation under control for more than a decade, and the upgrade of its sovereign debt to the status of investment grade given by major rating agencies. All these features resulted in consistent GDP growth and very good forecasts for the forthcoming years. It was not until the second quarter of 2008 that emerging economies (Brazil included) started to experiment the consequences of the crisis in developed markets. As Moreno (2010) notes, the worst consequences of the global financial crisis to emerging economies came in the aftermath of Lehman Brothers bankruptcy.

Mesquita and Torós (2010) provide a detailed description of the macroeconomic effects of the crisis on Brazil and the measures taken by the Brazilian Central Bank and other financial authorities to mitigate its effects, and Oliveira et al (2014) study in detail the bank run from medium and small banks to systemically important banks that started as soon as large bank bailouts abroad were announced.

In a nutshell, these studies show that, due to an increased perception of implicit guarantees given to systemically important banks, the small and medium banks lose almost 15% of their regular deposits (checking, savings and time deposits) on average, while systemically important banks passively increase their regular deposits by more than 20%. One clear piece of evidence that big banks were not actively searching for deposits is that, on average, they have reduced interest rate premiums on certificates of deposits, while other banks have raised the premium they paid.[3] Although there was a substantial devaluation of the Brazilian Real, mostly because of the fear of international investors pulling their money out of risky assets such as equities, the shift in bank deposits is unrelated to changes in the exchange rate because Brazilian banks are only allowed to take deposits in Brazilian Reais.[4] Deposit insurance, which is mandatory and provided by the Brazilian Deposit Insurance Fund (Fundo Garantidor de Credito – FGC, in Portuguese), was very limited (60 thousand BRL per depositor, equivalent to approximately 30 thousand US dollars) at the onset of the crisis.

To mitigate the effects of the liquidity crunch in small and medium banks, the Central Bank took several measures attempting to spread liquidity throughout the system

[3] In fact, Oliveira et al (2014) show that this deposit flight from small and medium to big banks was even more pronounced among institutional depositors. While the certificates of deposits (CDs) held by institutional investors have decreased by 26% from June to December 2008 in small and medium banks, in big banks they have increased by more than 40%.

[4] There are a few exceptional cases in which banks are allowed to take dollar deposits, but these account for less than 0.1% of the total deposits in the Brazilian banking system. Oliveira et al. (2014) also show that the shift in deposits was not driven by the banks' exposure to the exchange rate on the asset side or on off-balance-sheet instruments.

(i.e., from big to other banks), starting in October 2008.[5] The most effective of these measures was a reduction in reserve requirements for big banks conditional on them being used to provide interbank loans to small and medium banks. The distribution of changes in regular deposits and total (i.e., regular + interbank) deposits from June to December/2008 is shown in Figure 1. From this figure, we can infer that, although the interbank market partially redistributed liquidity across the system (the extreme negative variation for total deposits is smaller than for regular deposits), the cross sectional variation in total deposits is still large. Despite all the Central Bank measures to redistribute liquidity, 50 out of the 102 banks in our sample face negative changes in total deposits between June and December 2008.

[Insert Figure 1 about here]

Figure 2 – Panel A shows that the average deposit growth for Brazilian banks during the crisis was nearly zero, but the cross-sectional standard deviation of deposit growth has increased dramatically compared to previous periods (from 11–13% to more than 20%), indicating large differences in deposit growth across banks following Lehman's demise. Despite the average deposit growth being nearly zero, total bank deposits have increased by around 11% in the last quarter of 2008, as figure 2, Panel B shows. This is because systemically important banks – which are larger than the other banks on average – had positive growth, while negative growth was observed mostly in medium and small financial institutions. Oliveira et al (2014) show that small and medium banks start to timidly increase regular deposits in January/2009, but do not fully recover their pre-crisis level of deposits until June/2009. The spike in average deposit growth, and the increase in standard deviation observed for the second quarter of 2009 is due to a measure taken by the National Monetary Council authorizing small banks to issue a special type of deposit, insured up to the limit of 20 million BRL (approximately 10 million USD) in March 28, 2009.

[Insert Figure 2 about here]

Other sources of funding used by nonfinancial firms have dried up during the crisis. Public offerings and private placements in international bond markets have slowed down throughout 2008, and came to a complete shutdown after Lehman's failure, and only started to recover in late 2009. Issuances in the domestic capital markets (both bonds

[5] See Mesquita and Torós (2010) for a detailed description of the measures.

and equity) have also suffered a drastic reduction after Lehman's episode as shown in Figure 3, Panel A, and the aggregate rollover rate[6] of foreign debt by Brazilian nonfinancial firm has decreased dramatically in the last quarter of 2008 and first half of 2009. This severe crunch in domestic capital markets and foreign funding potentially increased the demand for bank loans, mostly by larger firms that typically used these markets for funding prior to the crisis. Schiozer and Brando (2010) report a decrease in trade credit supplied and uptaken by Brazilian publicly traded firms in 2008, as compared to the previous years, which also indicates a decrease in alternative sources of financing in the economy. Finally, the amount of credit provided by unregulated financial intermediaries to nonfinancial firms in Brazil is irrelevant.

[Insert Figure 3 about here]

3. Data and identification strategy

We work with two main sources of data, both provided by the Central Bank of Brazil (BCB). The first dataset is public and comprises detailed balance sheet and income and earnings reports of banks in the Brazilian financial system. Our second source of data is private[7]: the credit information system (SCR, for its acronym in Portuguese) contains loan-level information on loans made by banks to nonfinancial firms. Our data is quarterly and spans from December/2007 to December/2009.

All banks and finance companies in Brazil are regulated at the federal level, by the BCB. We use data from commercial banks, universal banks, investment banks and bank holding companies. For banks belonging to a holding company, we use information from the holding-company-level balance sheets, following Gatev and Strahan (2006), Schnabl (2012) and Oliveira et al. (2014). For simplicity, we refer to all these financial institutions as "banks". We exclude microfinance companies and finance companies not associated to bank holding companies because they do not provide significant lending to nonfinancial firms.

We also exclude: banks without deposits during our whole sample period, banks that do not lend to nonfinancial firms, development banks, and banks that initiate

[6] The rollover rate is defined as the ratio between the aggregate issuance of foreign debt and the amortization of foreign debt by Brazilian nonfinancial firms.

[7] The collection and manipulation of the data from the SCR were conducted exclusively by the staff of the Central Bank of Brazil.

operations during the sample period. Merged banks are considered as a single unit from the start of the sample period.[8] We end up with 102 banks that are categorized into 3 different classes according to ownership structure: domestic privately owned banks, subsidiaries of foreign banks, and state-owned banks (controlled by either the federal or a state government). The banks in our sample take more than 98% of all deposits and make more than 98.5% of the non-earmarked loans to nonfinancial firms in the Brazilian financial system. Unlike in most emerging markets, the funding structure of almost all banks (including subsidiaries of foreign banks) is mostly domestic. Deposits are the single most important source of funding for Brazilian banks on average.

The SCR system contains firm-level information on all loans above 5 thousand[9] BRL (approximately 2,500 USD) in the Brazilian banking system, comprising virtually all loans made to nonfinancial firms. For each bank, non-earmarked loans are aggregated at the industry level and size of the borrower. We use the industry classification of the Brazilian Institute for Geography and Statistics (IBGE, for its acronym in Portuguese). The industry classification used by the IBGE (national classification of economic activities, or CNAE codes) has nearly 1,300 different industries. It is more specific, for example, than the 4-digit SIC. In addition, borrowers are classified by size, using the aggregate amount that an individual firm borrows from the banking system. Following the criteria of BCB (2013, p. 24), a firm that borrows more than 100 million BRL (approximately 50 million USD), summing up all the loans it uptakes from all the banks in Brazil, is classified as a "large" borrower. Firms that do not match this criterion (i.e., firms that borrow less than 100 million BRL in the banking system) are classified as "small and medium" borrowers (SMEs). As a result, our loan information is at the bank/industry/borrower-size level. We also have information on the number of borrowing firms within each bank-industry/size relationship. To exemplify, one data piece of our loan information is of the type: "bank A lent X million BRL to N large firms in industry Z in period t". This data structure is particularly relevant for our identification strategy, since we compare lending to firms of similar size in the same industry (we refer to it as industry-size fixed effects) across banks. Finally, we have the information on loans within

[8] Because our period of analysis is quite short, the number of mergers is small. In addition, Oliveira et al (2014) show that sample attrition is not correlated to the changes in deposits during the sample period, which means that, for our identification purposes, bank mergers are as good as random.

[9] In 2012, after the sample period, the Central Bank introduced a new version of the system, with firm-level information on all loans above 1 thousand BRL (Circular 3.567, of December 12, 2011).

each bank-industry/size relationship by type of loan (the types are: export, revolving credit, working capital and others) as of June/2008. We end up with more than 33,000 observations of bank-industry-size lending to almost one million firms from 1,383 different industry-sizes, which amount to approximately 340 billion BRL as of June/2008 (approximately 180 billion USD at the time).

3.1 Identification strategy

We use a difference estimation to compare lending before and after the crisis, across banks that were differently affected by the exogenous liquidity shock. To consider unobserved heterogeneity in borrower demand and risk, we use industry-size fixed effects. For this identification to be possible, we only use data from industry-sizes that have loan relationships with at least two banks either before or after the crisis. In other words, we examine whether changes in lending within the same industry-size are related to changes in deposits. In the cases where we are particularly interested in assessing heterogeneous effects of the shock across borrower size, we use industry (instead of industry-size) fixed effects.

We define the shock (crisis) to happen in the third quarter of 2008. Specifically, we estimate the following baseline regression:

$$\Delta Loans_{ij} = \Sigma\alpha_j + \beta\,\Delta Deposits_i + \gamma' Controls_{i,j} + \varepsilon_{ij} \qquad (1),$$

where subscripts i and j refer to bank and industry-size, respectively.

$(\Delta Loan)_{ij}$ is the log change in loans of bank i to industry-size j between the pre and post crisis periods. We collapse loans from a bank to an industry-size within the 3 quarters that precede the crisis (i.e., quarters ending in Dec/2007, Mar/2008 and Jun/2008) and 3 quarters that follow it (i.e., Dec/2008, Mar/2009 and Jun/2009),[10] as shown in Equations (2) and (3). We refer to these as pre-crisis and post-crisis periods, respectively. Collapsing data reduces concerns about time-series correlation and seasonality in the data.[11] To make this computation possible, we exclude all observations for which bank-industry-size loans are equal to zero either before or after the crisis and

[10] We do not use data from December/2009 in our regressions to avoid seasonality problems.
[11] We follow Khwaja and Mian (2008) and Schnabl (2012) in this procedure, although our concern on time-series correlation would be smaller than theirs because we have a larger number of banks that serve as clustering units in our regressions (see Bertrand et al, 2004, for details). In our particular case, collapsing is especially useful to mitigate concerns on the potential seasonality of loans.

compute the mean balance of each period. With this procedure, we lose approximately 20% of the observations and 4% of the total amount of loans.

$$\text{Loans}_{\text{Postcrisis};i,j} = [\frac{\sum_{\text{Dec 2008}}^{\text{Jun 2009}} (\text{Loans to industry (industry} - \text{size)}\ \mathbf{j}\ \text{from bank}}{3} \quad \textbf{(2)}$$

$$\text{Loans}_{\text{Precrisis};i,j} = [\frac{\sum_{\text{Dec 2007}}^{\text{Jun 2008}} (\text{Loans to industry (industry} - \text{size)}\ \mathbf{j}\ \text{from bank}\ \mathbf{i}}{3} \quad \textbf{(3)}$$

We also use an alternative measure for the change in loans, described in Appendix A, that considers all the observations, and the results are very similar to our baseline results using the log change in loans.

α_j are industry-size fixed effects (alternatively, we use only industry fixed effects in some specifications);

$\Delta Deposits_i$ is the log change in total deposits of bank *i* between June/2008 and December/2008 (alternatively, we also use the change in regular deposits, excluding interbank deposits from the computation);

The control variables are all pre-crisis (Jun/2008) measures, defined as follows:

- *Export loans*$_{ij}$ is the fraction of export finance loans to total loans made by bank *i* to industry-size *j*;
- *Working capital loans*$_{ij}$ is the fraction of working capital loans to total loans made by bank *i* to industry-size *j*;
- *Revolving credit loans*$_{ij}$ is the fraction of revolving credit lines and guaranteed overdraft account loans to total loans made by bank *i* to industry-size *j*;
- *Foreign currency loans*$_{ij}$ is the fraction of loans with exposure to foreign currency (dollar) to total loans made by bank *i* to industry-size *j*;
- *Total assets*$_i$ is the log of total assets of bank *i*;
- *ROA*$_i$ is the Return on Assets of bank *i*;
- *Loans / Assets*$_i$ is the ratio between total loans and total assets of bank *i*;
- *Asset liquidity*$_i$ is the ratio between liquid assets and total assets of bank *i*;
- *Deposits / Assets*$_i$ is the ratio between total (regular + interbank) deposits and total assets of bank *i*;
- *Capital*$_i$ is the ratio between bank equity and total assets of bank *i*;
- *Loan Loss Provision / Loans*$_i$ is the ratio between loan loss provision and total loans of bank *i*;
- *Government*$_i$ is a *dummy* that assumes 1 for state-owned banks and 0 otherwise;

- *Foreign$_i$* is a *dummy* that assumes 1 for subsidiaries of foreign banks and 0 otherwise.

We use loan-specific controls because the credit demand for some industries may be loan-specific. For example, typically exporting sectors may depend on a specific type of loan, collateralized by revenues of an export contract, which may be more likely to be supplied by certain banks (for example, because of expertise). If the demand for loans is type-specific by some reason correlated to the deposit shock, industry-size fixed effects would not be sufficient to guarantee the unbiasedness of β. As such, we use pre-crisis measures of the types of loans to account for this feature. Bank specific controls (at pre-crisis levels) are added to account for possible differential effects that these variables might have on credit supply. Specifically, we expect that state owned banks can be more prone to increase loans in the post-crisis period, in an attempt to mitigate the credit crunch, and that larger banks may be better able to access alternative sources of funding.

Implicit to our empirical identification strategy is the assumption that firms of the same size and in the same industry are similarly affected by the financial crisis, in terms of investment opportunities and risk, and industry-size (or industry) fixed effects would capture the variation in loan demand in this group of firms. One could possibly be concerned with these assumptions if the change in deposits is potentially correlated with borrower quality within industry-size. One potential concern is that the banks that lose deposits during the crisis lend to the worst firms (or the firms that are most affected by the crisis) within the same industry-size. In this story, the massive redistribution of deposits could have happened because the depositors screened the banks and identified those that lent to the worst borrowers.

The study by Oliveira et al (2014) shows that bank features such as the quality of the banks' loan portfolio, the types of loans, and other bank fundamentals were not important in explaining the deposit run. We add two simple pieces of evidence that support their conclusions and strengthen our assumption: first, the average pre-crisis ratio of loan loss provisions to total loans of banks that lose deposits in the crisis is smaller than that of the banks that increase deposits (see the appendix for more detail on this); second, the average change in loan loss provisions from Jun/2008 to December/2008 (pre to post-crisis) is not statistically different between the group of banks that lose deposits and the group that gains deposits.[12]

Financial theory has several reasons as to why positive and negative shocks to liquidity may have different effects on lending. At the intensive margin, we may expect liquidity constrained banks to quickly adjust their supply by reducing borrowing limits of their clients or refusing to rollover existing loans. In a perfectly competitive world, banks facing excess liquidity would fill this gap, by immediately increasing their lending to their clients who faced constraints at other banks. However, due to financial frictions, even unconstrained banks may decide to hold on to liquid assets, especially in a scenario of increased systemic uncertainty (Acharya et al., 2013). Relationship lending theories suggest that the asymmetrical effect of liquidity on lending may be even stronger at the extensive margin: while constrained banks may be forced to completely refuse lending to some of their existing clients, banks that have increased liquidity may not be able to quickly establish new lending relationships, due to a series of frictions, such as informational asymmetry or operational capacity.[13]

If the effect of liquidity on lending is asymmetrical as theory suggests, Equation (1) is misspecified. Figure 4 illustrates why one would be capturing a biased estimate for β in equation 1 in this case.

[Insert Figure 4 about here]

To tackle this potential misspecification and investigate whether the effect of bank liquidity on lending is asymmetrical across banks, depending on the direction of the liquidity shock (positive or negative), we create a dummy variable (*Increase*) that assumes 1 for banks that have $\Delta Deposits > 0$ during the crisis, and 0 otherwise, and interact it with *ΔDeposits*. Explicitly, we estimate the following equation:

$$\Delta Loans_{ij} = \Sigma\alpha_j + \beta\Delta Deposits_i + \omega\, \Delta Deposits_i \times Increase_i + \gamma' Controls_{i,j} + \varepsilon_{ij} \quad (4),$$

[12] Resolution 2.682 of the Brazilian National Monetary Council establishes minimum standards for provisioning loans based on the number of days a loan is due. This minimum regulatory provision is considered very conservative for loans to nonfinancial firms. With respect to this issue, in an interview given in November 2009 (Valor, 2009), Mario Torós, who sat at the board of the Central bank at the time of the crisis, reported that […] the problem [the bank run] was with the small and medium [banks]. […] Our supervision department had a good look at these banks' balance sheets. […] they had solid loan portfolios. […].

[13] One example of friction that may constrain the bank's ability to lend to new clients is the limited supply of skilled labor force. It is indeed plausible to assume that it is costly for unconstrained banks to quickly hire relationship managers and credit analysts from constrained banks.

More generally, the financial frictions described above would imply that lending is increasing in liquidity, but at a decreasing rate (in other words, the first derivative of lending with respect to liquidity is positive, and the second derivative is negative). We think that our specification (with a "kink" at $\Delta Deposits=0$) imposes less structure to the data and yields qualitatively similar, but more intuitive and directly interpretable estimates. Basically, our arguments are consistent with expected values as follows: $\beta > 0$; $\omega < 0$; $(\beta + \omega) \geq 0$.

3.2 Descriptive statistics

Table 1 shows the descriptive statistics for our sample. Panel A shows the bank level variables, splitting between banks that had negative versus positive change in deposits during the crisis. Banks that increase deposits are larger than the other banks, consistent with the idea of depositors running to implicitly guaranteed banks. The average ratios of loans and liquid assets relative to total assets is similar among the two groups of banks; the average capital ratio and ROA of the two groups of banks are also similar, and the proportion of loan loss provisions to total loans is smaller for the group of banks that lose deposits during the crisis.

[Insert Table 1 about here]

Panel B of Table 1 describes the loan-level variables. We also split between banks that experienced a negative versus a positive shock in liquidity, and by size of borrower. The change in loans for banks that increased deposits is 17%, whereas it is -15% for banks that had a decrease in deposits. The change in loans for large borrowers is 9 percentage points higher than for small and medium borrowers on average. This difference is even more striking in banks that faced a negative liquidity shock: the reduction in loans for small and medium borrowers is 16%, whereas for large borrowers the reduction is only 1%.

Finally, Table 1 – Panel C describes the pre-crisis fractions of each type of loan by bank-industry-size relationship. Banks that increase deposits during the crisis do not differ significantly from banks that decrease deposits in terms of the types of loans they supply to their borrowers prior to the crisis. We perform t-tests for the equality of means of the fractions of all types of loans, and all the tests fail to reject that the fractions are equal between the two groups of banks. This is another indication that the shift in deposits is not related to the loan portfolios of the banks (or, more specifically, to the type of loans they supply). The most striking differences we find with respect to the types of loans is between large borrowers and SMEs. Specifically, large borrowers uptake more export finance loans and less revolving credit lines as compared to SMEs on average, in both groups of banks.

[Insert Figure 5 about here]

Figure 5 – Panel A – shows the growth in deposits for each group of banks relatively to the shock period (i.e, relative to the values of September/2008). Figure 5 – Panel B does the same for the growth in loans. It is very clear that both groups of banks had similar trends before the shock, for both deposits and loans. The negative growth in deposits of the banks shown in Figure 5 – panel A (which by construction is different from the other group of banks) is very similar to the negative growth in loans (not obtained by construction). Panel A shows that, on average, banks negatively affected by the shock only recover their levels of deposits 12 months after the shock, possibly due to the new specially-insured deposit introduced in March of 2009.

4. Empirical results

We start by examining the effects of the deposit shock on loans. In Table 2, column 1, we first estimate equation 1 without any fixed effects or controls, and find a statistically and economically significant association between the change in total deposits and the change in loans. Standard errors are clustered at the bank level in this and all other regressions reported in the paper.

[Insert Table 2 about here]

Throughout the rest of the paper, all the following estimations include fixed effects (either at the industry or industry-size level). In columns 2 and 3, we restrict our sample to industries that uptake loans from more than one bank, and add respectively industry and industry-size fixed effects. The estimates for the coefficient of ΔDeposits are almost identical to the estimation in column 1, suggesting that the exclusion of industry-sizes with a single bank relationship does not introduce any bias to our sample. We find an economically and statistically significant effect of liquidity on lending: a 1% reduction (increase) in total deposits reduces (increases) loans by approximately 0.44%. In columns 4 and 5, we show that, if equation 1 is estimated using the change in regular deposits (i.e., disconsidering interbank deposits) instead of total deposits, the effect is slightly smaller, but still economically large and statistically significant.

To mitigate any concerns about the non-exogeneity of deposits, we estimate equation 1 using a reduced-form instrumental variable. As Oliveira et al (2014) show, the shift in deposits is explained by the systemic importance of banks, rather than by their fundamentals (including characteristics of the loan portfolio). We build a dummy variable that assumes 1 if a bank is classified as systemically important by Oliveira et al (2014), and 0 otherwise.[14] This variable arguably does not suffer from any possible endogeneity, since it is highly implausible that systemically important banks lend to better (or less risky) borrowers within the same industry and size category. The coefficients we obtain using this variable are also statistically significant and economically large: the change in loan supply of systemically important banks is 28.5 percentage points larger than that of other banks in the sample.

Columns 8 and 9 of table 2 show the results of the estimation of equation 1 including loan-level control variables. The coefficients are only slightly smaller than in columns 2 and 3, and we still find significant and economically large coefficients: a 1% change in total deposits causes a 0.42% change in loans in the same direction, using industry-size fixed effects (or 0.43% using industry fixed effects). Finally, the regressions shown in columns 10 and 11 of table 2 also include bank-level control variables. Although the coefficients are significantly smaller compared to the regressions with loan-level control variables (columns 8 and 9, respectively), they are still statistically significant and economically large.

The regression results also show that the pre-crisis fraction of export loans within the industry-size loan portfolio is negatively related to the change in loans, consistent with the idea of exporting firms uptaking less credit in the postcrisis period from banks that typically supplied these types of loans (i.e., firms in exporting industries reduced their demand for export loans relative to other types of credit, possibly due to the international economic downturn). We also observe that pre-crisis fractions of working capital and revolving credit loans is negatively related to the amount of supplied loans (although the

[14] Oliveira et al (2014) provide two alternative lists of systemic important banks: one of them is related to how important the banks are to the Brazilian Financial System, and the other is a broader definition, including the subsidiaries of banks that are systemically important from a global standpoint. In the reported regressions, we use the broader definition. In unreported regressions, we obtain qualitatively similar results by using their more restrictive definition.

coefficients are statistically significant only in some regressions), what is consistent with banks being able to reduce short-term, but not longer-term, loans.

The economic rationale for including bank-level variables in the regression is twofold: first, some balance sheet characteristics might reveal an expected larger or smaller sensitivity to the shock, and are quite intuitive. For example, one might argue that more profitable banks are able to lend at higher margins, and thus cutting an extra dollar of loans would have a larger marginal decrease in profit for these banks than for low-profit banks. Our results show that, in most of the regressions, the coefficients for the pre-crisis balance sheet (bank-level) characteristics, such as loans loss provisions, asset liquidity, capital, ROA and Deposits/Assets are insignificant and economically small.

We also observe that the change in loan supply is larger for governmental banks and foreign banks[15] than for private domestic banks. In addition, pre-crisis bank size is also positively associated to the change in loan supply. The economic rationale for including these variables (governmental bank, foreign bank and bank size) is that ownership type and size may affect the decision to supply loans. For example, the positive sign for governmental banks might indicate that these banks increased loans in an attempt to mitigate the credit crunch and the adverse effects of the crisis on economic activity. Larger banks may be more flexible to find alternative sources of funding (and thus the positive sign) and so on. However, we must bear in mind that these three characteristics (governmental bank, foreign bank and bank size) are highly correlated with the change in deposits. In fact, they might be considered determinants of the change in deposits as they capture some features that define systemic importance. As such, the fact that we obtain smaller coefficients for ΔDeposits in regressions 10 and 11 of table 2, as compared to the regressions without these controls (columns 2-3 and 8-9), are not surprising, and are possibly related to the collinearity between our variable of interest and these control variables. We do not re-estimate columns 6 and 7 including control variables precisely because these three variables are almost perfectly collinear to the systemic importance dummy. In other words, whenever we include bank-level control variables, the coefficients for ΔDeposits are underestimated, and have very conservative (large) standard errors. Nevertheless, as we will see in the further tests, regression coefficients with and without bank-level controls yield qualitatively similar inferences, and the

[15] In some regressions, the coefficient for foreign banks is positive and statistically significant. However, these results are not robust to using our alternative measure of change in loans (see appendix).

coefficients only differ by economic magnitudes. Regressions including bank-level controls are thus useful in providing a lower boundary for our coefficient of ΔDeposits.

From this point on, we will only report our estimations using the change in total deposits as our variable of interest, since this is the most direct and intuitive measure of change in liquidity. Unreported regressions using the change in regular deposits yield qualitatively similar results. In addition, we report regression estimates with and without bank-level control variables, but we always keep in mind that the regressions with these controls have inflated standard errors and possibly introduce a downward bias to the coefficient of ΔDeposits, since they may suffer from the collinearity problem discussed above.

4.1.The asymmetric effect of liquidity on lending

The results from the previous section have shown that there is a causal relationship between bank liquidity and loan supply. In Table 3 we examine if this relationship is asymmetric, i.e., if negative and positive liquidity shocks have different effects on loan supply. Columns 1 and 2 of table 3 show the results of the estimation of Equation 2 using industry and industry-size fixed effects. The results of column 2 show that a 1% decrease in total deposits causes a reduction of 0.816% in loans. However, the coefficient for the $\Delta Deposits \times Increase$ interaction term is a negative 0.758. This means that the expected change in loans for a 1% increase in deposits is only $\beta + \omega = 0.816\% - 0.758\% = 0.058\%$. The F-test for the sum $\beta + \omega$ indicates that this effect is not significantly different from zero at usual levels. Columns 3 and 4 show the estimation of equation 2 adding loan-levels controls, and the results are only marginally altered. In columns 5 and 6 we add bank-level controls. Although the coefficients are reduced in magnitude, we find qualitatively identical results: in the regression with industry-size fixed effects and bank-level controls (column 6), there is a significant 0.375% reduction in lending for a 1% negative change in deposits, while the expected effect of a 1% increase in deposits is 0.375% – 0.257% = 0.118% (F-Test indicates that the sum of these coefficients is not significantly different from zero).

[Insert Table 3 about here]

The results in columns 1 to 6 of Table 3 show that there is indeed an asymmetrical effect of liquidity on lending, as we conjectured: a negative liquidity shock forces banks to reduce lending, whereas a positive liquidity shock causes a small, if any, effect on lending supply.

We then check for heterogeneous effects of liquidity on lending across borrower size. In column 7 of Table 3 we introduce a dummy for small and medium borrowers (SMEs), and use industry fixed effects, since industry-size fixed effects would mute this dummy. While our previous results for ΔDeposits and ΔDeposits × Increase are only slightly decreased in magnitude, we find that the change in loan supply to small and medium firms is 13.6 percentage points smaller than for large firms. When we add loan-level and bank level controls (columns 8 and 9 of table 3), the coefficient for SMEs is slightly increased (in absolute value) relative to the regression without controls. In line with the results of Khwaja and Mian (2008), Schnabl (2012) and Iyer et al. (2014), we find that smaller firms are the most negatively affected by the liquidity shock. Although it is arguably harder to claim that the effect we find in these tests is purely supply-driven, the very large economic magnitude of the coefficient, and the fact that we control for heterogeneous demand effects across industries are suggestive that at least part of this effect of the liquidity shock on lending is causal and driven by supply-side forces.

We then investigate whether this relative shortage in loan supply for smaller firms is concentrated in the banks that lose deposits, or if banks that experience a positive liquidity shock also reduce loans to smaller firms. If large firms obtain more loans relative to SMEs in unconstrained banks, a crowding-out effect may be in place. There are at least two non-exclusive rationales for such a crowding-out effect. First, domestic and international capital markets – typically used only by large firms – were virtually closed during the crisis, possibly increasing the demand of large firms for bank loans. Second, if loan supply in constrained banks is cut across the board (i.e., through large and small firms equally), large firms would shift towards unconstrained banks more easily than small firms. This may happen for reasons related to the economies of scale of banks in establishing new lending relationships. If unconstrained banks can price loans to take advantage from this decreased competition in loan supply to large firms by raising interest rates charged for these loans, they may shift supply from small to large firms. Again, we are particularly not able to identify a purely supply-driven effect with these tests, but this heterogeneous effect of the liquidity shock on lending across firm size and type of banks – arguably a combination of supply and demand effects – is still economically important to be investigated, regardless of causality.

We add an interaction term *SMEs* × *Increase* to capture differential effects of the change in loans to SMEs across banks that experience a positive and a negative shock. Results shown in Column 10 of Table 3 indicate that the expected change in loans to SMEs is 26.6 percentage points smaller than for large firms in the banks that lose deposits during the crisis. For banks that experience a positive shock in deposits, the expected differential within-industry effect between large firms and SMEs is 17.9 – 26.6 = -8.7 percentage points (F-test indicates that this sum is significantly different from zero only at the 0.13 level). In columns 11 and 12 of table 3, we report the results of regressions adding loan-level and then bank-level controls respectively. The expected within-industry differential change in loans between large firms and SMEs in the banks that experienced increase in deposits is 13.5 and 18.1 percentage points, depending on the specification.[16] The F-tests for these estimates indicate statistical significance at the 10% level. These results strongly suggest that smaller firms may have experienced a credit supply restriction relative to large firms even in banks that have increased deposits during the crisis. As we argue above, this is possibly due to a crowding-out effect, and cannot be attributed to a purely supply-side effect.

4.2.The extensive margin

We then analyze whether the asymmetric effects of liquidity on lending found in the previous section derives from constrained banks decreasing the number of clients they lend to, or just occur at the intensive margin (i.e. reducing the amount they lend to clients). We start by re-estimating equation 1, but changing the dependent variable to capture extensive margin effects. We test the effect at the extensive margin using the variable *ΔN*, computed as follows:

$$(\Delta \mathrm{N})_{ij} = 2 * \left[\frac{n_{\mathrm{Postcrisis}} - n_{\mathrm{Precrisis}}}{n_{\mathrm{Postcrisis}} + n_{\mathrm{Precrisis}}}\right], \text{where} \quad \textbf{(5)}$$

$$n_{\mathrm{Postcrisis}} = \left[\frac{\sum_{\mathrm{Dec\ 2008}}^{\mathrm{Jun\ 2009}} (\text{number of borrowers from industry} - \text{size } \mathbf{j} \text{ in bank } \mathbf{i})}{3}\right. \quad \textbf{(6)}$$

$$n_{\mathrm{Precrisis}} = \left[\frac{\sum_{\mathrm{Dec\ 2007}}^{\mathrm{Jun\ 2008}} (\text{number of borrowers from industry} - \text{size } \mathbf{j} \text{ in bank } \mathbf{i})}{3}\right. \quad \textbf{(7)}$$

[16] The effects are computed as follows: i) 31.4 -17.9 = 13.5 pp (column 11); ii) 11.3 + 6.8 = 18.1 pp (column 12).

This variable approximates the traditional log change in the number of borrowers for small variations, and thus the regression results can also be interpreted as elasticities. It has the main advantage of considering observations in which the number of borrowers is zero in the pre or postcrisis periods, which have to be dropped if the traditional log change measure is used. These observations are particularly important for the analysis at the extensive margin, as they capture banks terminating or establishing new lending relationships with firms in a given industry-size.

For robustness, we also use a dummy variable, Entry, that is equal to 1if a bank increases the number of borrowers from a given industry-size from the pre to the post crisis period, and 0 otherwise. Formally:

$$(Entry)_{ij} = 1, if\ n_{Postcrisis} \geq n_{Precrisis}\ \text{, and 0 otherwise} \qquad \textbf{(8)}$$

The results in Column 1 of Table 4 show the estimation of equation 1, using the percent change in the number of borrowers of bank i per industry-size j ($\Delta N_{i,j}$) as the dependent variable. [17] The expected change in the number of borrowers caused by a 1% variation in deposits is 0.31% (statistically significant at 1%). When we add controls (column 2), the coefficient slightly decreases to 0.27, but remains economically large.

The results of columns 3 and 4 of Table 4, in which we add the interaction term Δ*Deposits* × *Increase*, show that the effect is quite asymmetric between banks, according to the direction of the liquidity shock. In the regression with (without) controls, a 1% decrease in deposits implies a statistically significant expected decrease of 0.49% (0.62%) in the number of borrowers, whereas a 1% increase in deposits implies a 0.04% increase (0.01% decrease)[18] in the number of borrowers (F-tests indicate that these effects are not statistically different from zero). The coefficient estimates reported in columns 1 to 4 of Table 4 suggest that the asymmetric effect of liquidity on the amount of loan supply, reported in the previous section, derives mostly from the extensive, rather than the intensive margin.

[Insert Table 4 about here]

[17] We only report the results using industry-size fixed effects. We obtain very similar results using industry fixed effects.

[18] The expected effect on loans of a 1% increase in deposits for banks that increase deposits are computed as the sum of the coefficients of Δ*Deposits* and Δ*Deposits x Increase*. Explicitly, the computations are: i) 0.617% – 0.626% ≈ -0.01%; ii) 0.493% – 0.449% ≈ 0.04%.

We then look at the effect of the liquidity shock on the probability of increasing the number of borrowers in a given industry-size. The results in columns 5 and 6 of Table 4 show that there is a positive and significant relationship between the change in deposits and the probability of increasing the number of borrowers. In columns 7 and 8, we again show that this relationship is asymmetrical: in the regression with (without) controls, a 1% decrease in deposits reduces by 0.17% (0.35%) the probability of increasing the number of borrowers (results statistically significant at 5% and 1%), whereas a 1% increase in deposits causes an expected increase of 0.11% (0.08%) in the probability of increasing the number of borrowers (results not statistically different from 0, according to F-tests).

We also perform other robustness checks, reported in the appendix. First, we use an alternative measure for the change in the amount of loans that allows us to consider observations with loans equal to zero either in the pre or postcrisis periods. The results we obtain with this alternative measure are practically identical to the ones previously reported in Table 3 (in which the traditional log change in loans is used).

Finally, we perform a series of unreported robustness checks, namely: i) changing the time window considered for the measurement of the change in deposits. ii) estimate equation 4 using the change in regular deposits, instead of total deposits as our variable of interest; iii) use industry fixed effects (instead of industry-size) in the estimation of the effects at the extensive margin shown in Table 4; iv) use alternative values for the "kink" of figure 4, such as the median and terciles of the deposit change distribution; v) use a granular measure of systemic importance, following Gropp et al. (2011) and Oliveira et al. (2014), instead of the change in deposits, in the estimation of equation 1. All our inferences stand up to these robustness checks.

5. Concluding remarks

This study investigates if shocks to bank liquidity affect loan supply. We use an exogenous shock to the liquidity of Brazilian banks: the run observed in small and medium Brazilian banks after the announcement of bailouts to systemically important banks across many developed countries following the failure of Lehman Brothers. This shock resulted in an almost purely distributional effect on bank deposits: depositors fled from small and medium banks to systemically important banks, that were perceived as enjoying an implicit guarantee (Oliveira et al, 2014). This redistribution in liquidity is unrelated to pre-crisis bank fundamentals, including types of loans supplied and quality of borrowers. Therefore, unlike most of the recent studies that use one-sided (generally negative) bank liquidity shocks, we use a shock that causes some banks to become liquidity constrained, whereas other banks passively receive excess liquidity. This is the ideal experimental setting to identify whether firms are able to substitute their borrowing from constrained to unconstrained banks. We find that changes to bank liquidity have indeed a large effect on loan supply, but this effect is asymmetrical, depending on the direction of the liquidity shock. Our estimates indicate that the effect of a 1% decrease in bank liquidity is a statistically significant and economically large reduction in loan supply by 0.4-0.8% (depending on the specification), whereas a similar increase in bank liquidity has a much smaller, if any, effect on bank loan supply. This effect is causal, i.e., supply-driven, since we compare loans within firms in the same industry and with similar sizes. The asymmetric effect seems to be driven mostly at the extensive margin (i.e., firms that borrowed from constrained banks not being able to establish new banking relationships with unconstrained banks), although our tests are not able to fully identify the dominance of the effects at the extensive over the intensive margin.

The effect of the liquidity shock on lending is also heterogeneous across firm size. We find that the change in loans to small and medium firms is approximately 14 to 19 percentage points smaller than for large firms, on average. More importantly, this effect is verified not only in banks that face a negative liquidity shock, but also in unconstrained banks, although with less intensity. One possible explanation for this finding is that, since there was a shutdown in other sources of funding for large firms (e.g. capital markets), these firms have increased their demands for bank loans. Unconstrained banks may have taken advantage of decreased competition on the supply side to charge higher interest rates from these firms, causing a crowding-out effect.

Our results have several implications. First, it appears that nonfinancial firms (particularly SMEs) are not able to quickly switch borrowing from constrained to unconstrained banks. This result points to the importance of theories that view banks as relationship lenders. Second, since the extent to which banks were affected by the shock is related to their systemic importance, this adds another layer to the discussion on the regulation of systemically important banks. Their inability to fill the credit gap caused by the reduction in liquidity in other banks is another type of negative externality that has not been yet considered by academics and regulators. Finally, our results indicate that the attempts to spread liquidity throughout the system were only partially successful in reducing the negative effects of the liquidity shock to credit. It is arguable that these effects could have been even worse absent the Central Bank measures.

Measures to avoid the negative effects of the liquidity shock could either involve attempts to reduce the probability of occurrence of such a shock, such as the extension of insurance to the liabilities of non-systemic banks, or actions to induce lending by unconstrained banks during the crisis (such as the reduction in capital and reserve requirements conditional on lending). Both types of measures come at a tradeoff. The extension of deposit insurance potentially increases moral hazard issues, and inducing lending could lead to allocation inefficiency (underpriced loans to existing clients), especially if banks are reluctant to establish new lending relationships, as our results at the extensive margin suggest. Balancing the costs and benefits of such measures is a difficult task for governments and regulators, and further research in this area seems to be necessary to give good guidance on regulatory actions.

References

Acharya, V., Almeida, H., Campello, M., Agregate Risk and the Choice between Cash and Lines of Credit. *Journal of Finance*, v. 68, n. 5, p. 2059-2116, 2013.

Allen, F., Carletti, E. An overview of the crisis: causes, consequences, and solutions. *International Review of Finance*, v. 10, n. 1, p. 1-26, 2010.

Ashcraft, A. New evidence on lending channel. *Journal of Money, Credit, and Banking*, v.38, n. 3, p. 751-775, 2006.

Banco Central Do Brasil (BCB). *Relatório de Estabilidade Financeira*. Available at <http://www.bcb.gov.br/?RELESTAB200905>, v. 8, n. 1, 2013.

Berger, A. N., Udell, G. F. Relationship lending and lines of credit in small firm finance. *Journal of Business*, v. 68, p. 351-381, 1995.

Bernanke, B. S., Gertler, M. Agency costs, net worth, and business fluctuations. *American Economic Review*, v. 79, p. 14-31, 1989.

Bernanke, B. S., Blinder, A. S. The federal funds rate and the channels of monetary transmission. *American Economic Review*, v. 82, p. 901-921, 1992.

Bertrand, M., Duflo, E., Mullainathan, S. How much should we trust difference in differences estimates? *Quarterly Journal of Economics*, v. 119, p. 249-275, 2004.

Bharath, S., Dahiya, S., Saunders, A., Srinivasan, A. So what do I get? The bank's view of lending relationships, *Journal of Financial Economics*, v. 85, p. 368–419, 2008.

Bloomberg. EU Nations Commit 1.3 Trillion Euros to Bank Bailouts. Available at http://www.bloomberg.com/apps/news?pid=newsarchive&sid=azerJ573HcbI, 13 Oct 2008.

Campello, M. Internal capital markets in financial conglomerates: evidence from small bank responses to monetary policy. *Journal of Finance*, v.57, n. 6, p. 2773-2805, 2002.

Diamond, D. W., Rajan, R. G. Liquidity shortages and banking crises. *Journal of Finance*, v. 60, n. 2, p. 615-647, 2005.

Gatev, E., Strahan, P. Banks´ advantage in hedging liquidity risk: theory and evidence from the commercial paper market. *Journal of Finance*, v. 61, n. 2, p. 867-892, 2006.

Holmstrom, B., Tirole, J. Financial intermediation, loanable funds and the real sector. *Quarterly Journal of Economics*, v. CXII, n. 3, p. 663-691, 1997.

Imai, M., Takarabe, S. Transmission of liquidity shock to bank credit: evidence from the deposit insurance reform in Japan. *Journal of the Japanese and International Economies*, v. 25, p. 143-156, 2011.

Iyer, R., Lopes, S., Peydro, J., Schoar, A. Interbank liquidity crunch and the firm credit crunch: evidence from the 2007-2009 crisis. *Review of Financial Studies*, 27, 1, p. 347-372, 2014.

Kashyap, A. K., Stein, J. C, Wilcox, D. W. Monetary policy and credit conditions: evidence from the composition of external finance. *American Economic Review*, v. 83, n. 1, p. 78-98, 1993.

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

Khwaja, A. I., Mian, A. Tracing the impact of bank liquidity shocks: evidence from emerging market. *American Economic Review*, vol. 98, n. 4, p. 1413-1441, 2008.

Mesquita, M., Torós, M. Brazil and the 2008 panic. In: The global crisis and financial intermediation in emerging market economies. *BIS Papers*, n. 54, p. 113-120, 2010.

Moreno, R. The global crisis and financial intermediation in emerging market economies: an overview. In: The global crisis and financial intermediation in emerging market economies. *BIS Papers*, n. 54, p. 1-10, 2010.

Oliveira, R. F., Schiozer, R., Barros, L. A. B. C. Depositors´ perception of "too-big-to-fail". *Review of Finance*, forthcoming 2014.

Ongena, S., Peydró, J. L., Van Horen, N. Shocks abroad, pain at home? Bank-firm level evidence on the international transmission of financial shocks. *De Nederlandsche Bank Working Paper*, 2013.

Paravisini, D. Local bank financial constraints and firm access to external finance. *Journal of Finance*, v. 63, n. 5, p. 2161-2193, 2008.

Peek, J., Rosengren, E. S. Collateral damage: effects of the Japanese bank crisis on real activity in the United States. *American Economic Review*, v.90, n. 1, p. 30-45, 2000.

Schiozer, R., Brando, J. A. P. A oferta de trade credit pelas empresas brasileiras de capital aberto. *Revista Brasileira de Finanças*, vol. 9, n. 4, p. 585-615, 2011.

Schnabl, P. The international transmission of bank liquidity shocks: evidence from an emerging market. *Journal of Finance*, vol. 68, n. 3, p. 897-932, 2012.

Stein, J. An Adverse-Selection Model of Bank Asset and Liability Management with Implications for the Transmission of Monetary Policy. *Rand Journal of Economics*, 29 (3), 466-86, 1998.

Valor Econômico. Brasil enfrentou ataque e corrida bancária na crise, by Cristiano Romeiro and Alex Ribeiro, 13 November 2009.

Figure 1 – Distribution of the change in deposits during the crisis

This figure shows the distribution for the log change in regular (checking +savings + time) deposits and total deposits (regular + interbank) from June to December/2008 for the 102 banks in our sample (100 banks for regular deposits).

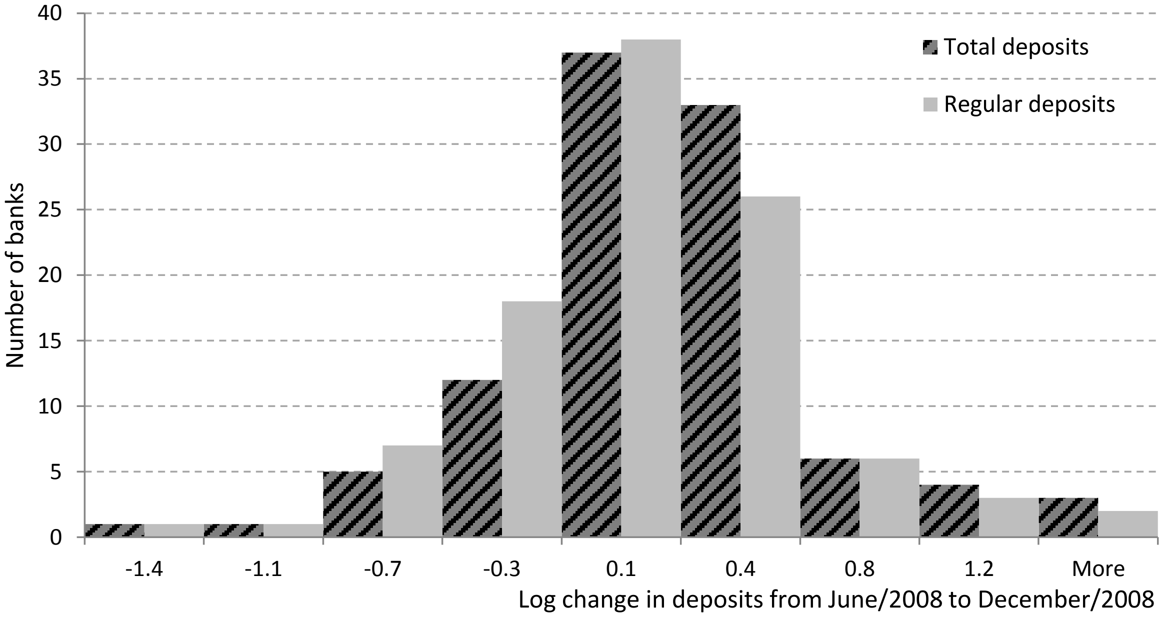
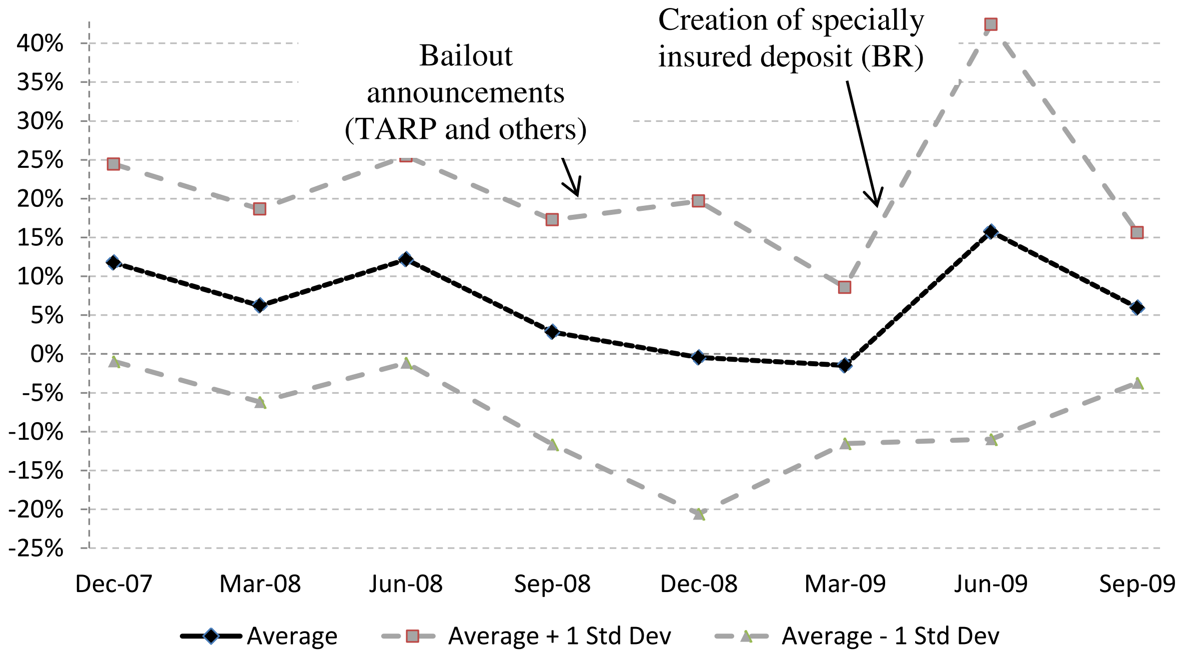


Figure 2 – Evolution of deposits

The solid black line in **Panel A** shows the average quarterly change in total (checking +savings + time + interbank) deposits across banks from Dec/2007 to Sep/2009 (we excluded observations below the percentile 5% and observations above the percentile 95%). The two dashed lines show the average plus and minus one standard deviation, respectively. **Panel B** shows the total amount of deposits in the sample for Mar/2007 to Dec/2009.

Panel A – Change in total deposits



Panel B – Total deposits in the sample (BRL billions)

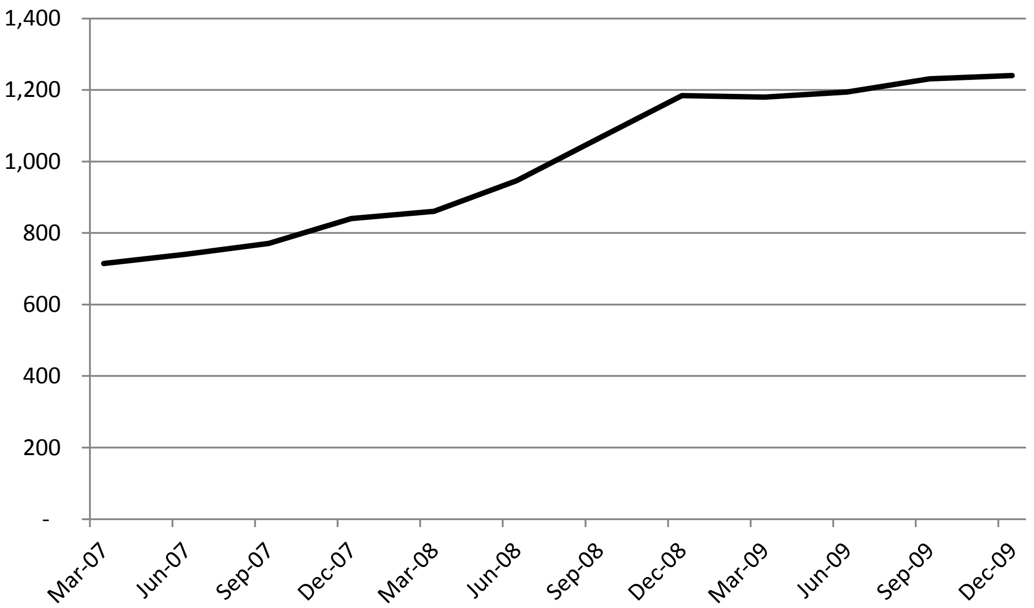
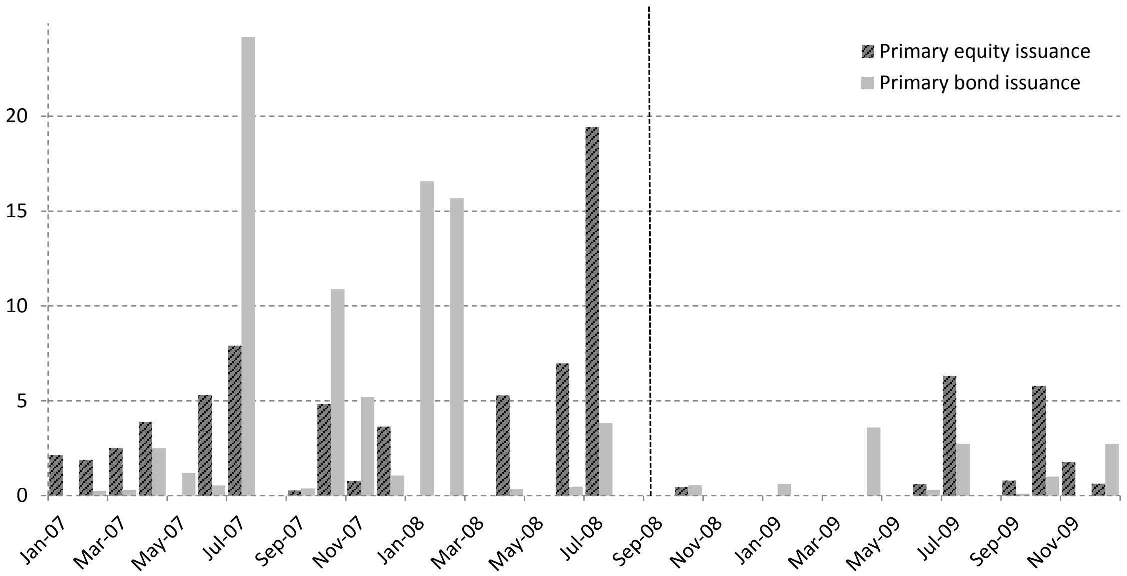


Figure 3

Panel A – Primary issuance of bonds and equity (BRL billion)

This figure shows the monthly amount of primary equity (darker bars) and bonds (lighter bars) issuance in the Brazilian market from 2007 to 2009. The vertical dashed line marks the failure of Lehman Brothers.



Panel B – Rollover rate

This figure shows the quarterly figures of the aggregate rollover rate of Brazilian nonfinancial firms' foreign debt. The rollover rate is defined as the ratio between the total issuance of foreign debt and the amortization of foreign debt. A rollover rate over 100% indicates that, on aggregate, firms are increasing foreign debt, whereas a rollover rate smaller than 100% indicates that firms are amortizing more than the amount issued.

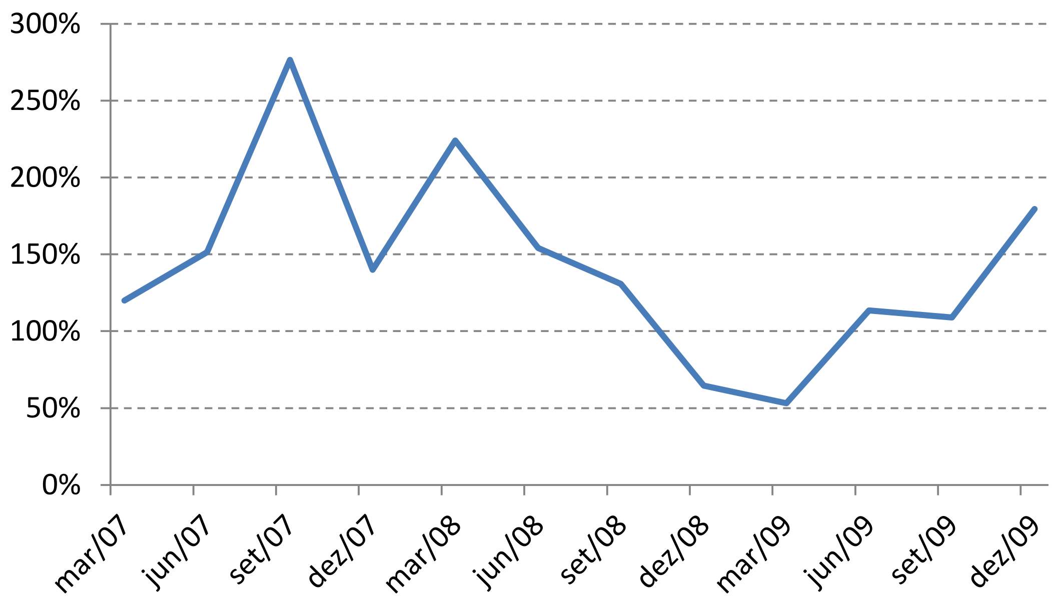


Figure 4 – Potential misspecification in estimating liquidity-loan elasticity

This figure illustrates the potential misspecification in the estimation of the elasticity of loan supply to bank liquidity if a homogeneous linear effect across all (positive and negative) change in liquidity levels is assumed.

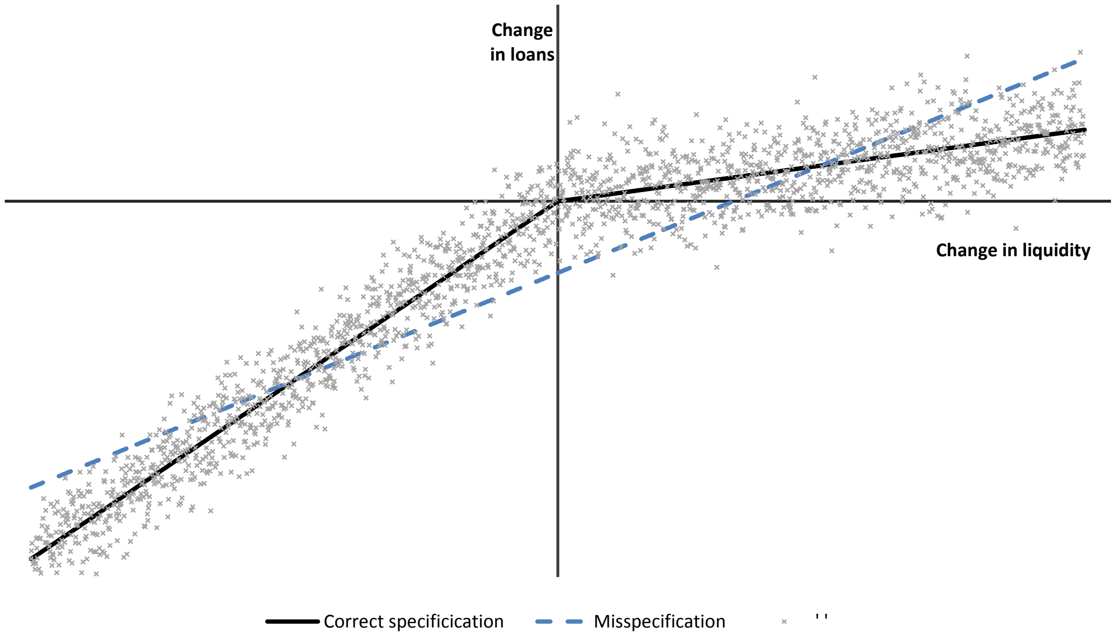
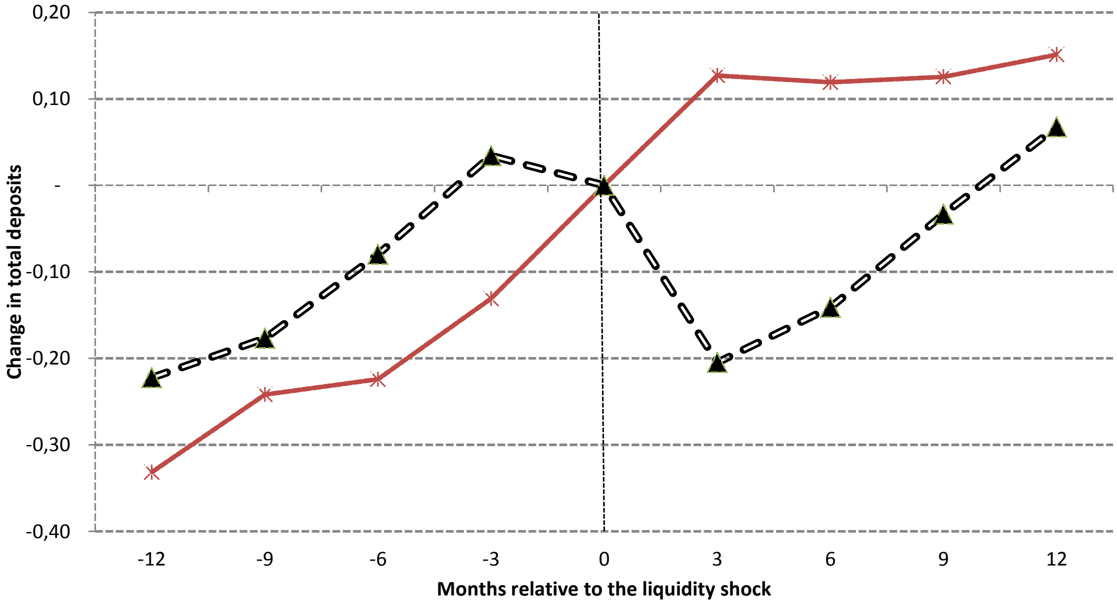


Figure 5 – The bank lending channel – change in deposits and change in loans
This figure illustrates the bank lending channel by comparing the evolution of deposits and loans for banks that faced a positive change in liquidity (red solid line) to banks that faced a negative change in liquidity (black dotted line). Changes in loans and deposits are calculated relative to the levels of Sep/2008, so that the vertical dashed line marks the reference date (and the change relative to this date is 0 by definition).

Panel A – Change in deposits



Panel B – Change in loans

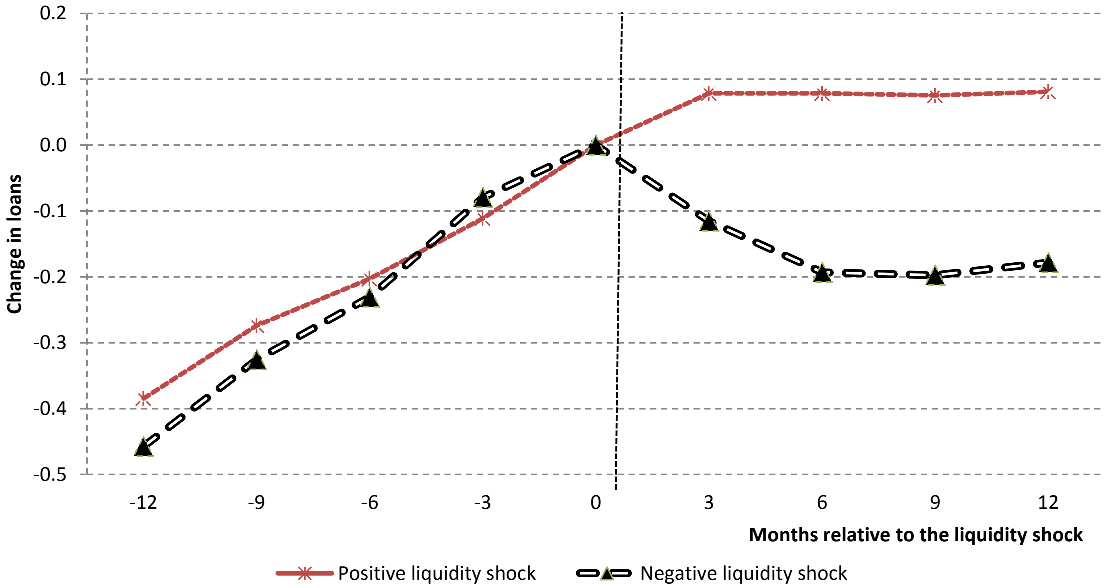


Table 1 – Descriptive Statistics

This table reports means and standard deviations (in italics) of key variables. We split all observations between banks that had a positive versus a negative change in total deposits between June and December/2008. **Panel A** shows bank-level variables. All variables are measured as of Jun/2008, except for *ΔDeposits*, which is the log change in total deposits between June and December/2008. *Total Assets* is the value of book assets. *Loans / Assets* is the ratio of total loans to total assets; *asset liquidity* is the ratio of cash, tradable securities and reserves to total assets; *equity* is the ratio of book equity to book assets; *ROA* is the quarterly return on book assets; *Deposits / Assets* is the ratio of total deposits to total assets and *Loan loss provisions* is the ratio of provisions to total loans. **Panel B** shows the change in loans pre to post crisis as defined in section 3. **Panel C** shows pre-crisis (Jun/2008) percentages values of the proportion of each type of loan on each bank-industry-size loan.

Panel A – Bank Level variables

	Banks that increase deposits	Banks that decrease deposits	All Banks
Total assets (BRL million)	44,400	4,543	24,900
	114,000	*10,700*	*84,000*
ΔDeposits (%)	40.5	-33.8	4.1
	49.9	*32.3*	*56.2*
Loans /Assets (%)	54.9	57.0	55.9
	22.3	*19.4*	*20.8*
Asset liquidity (%)	34.9	34.8	34.9
	23.4	*18.4*	*21.0*
Equity (%)	18.4	19.5	19.0
	17.6	*10.7*	*14.5*
ROA (%)	0.9	1.0	1.0
	1.5	*2.6*	*2.1*
Deposits / Assets (%)	32.7	42.0	37.3
	25.1	*16.9*	*21.9*
Loan Loss Provisions (%)	5.3	3.4	4.4
	7.1	*4.2*	*5.9*
Observations	52	50	102

Panel B – Change in loans (pre to post-crisis)

	Banks that increase deposits	Banks that decrease deposits	All Banks	Observations
Large Firms	0.23	(0.01)	0.16	1,939
	1.72	*1.19*	*1.59*	
Small and medium firms	0.17	(0.16)	0.07	24,415
	0.96	*1.13*	*1.03*	
All firms	0.17	(0.15)	0.07	26,354
	1.04	*1.13*	*1.08*	
Observations	18,354	8,000	26,354	

Panel C – Pre-crisis fraction of each type of loan in bank lending to large firms and SMEs (%)

		Banks that increase deposits	Banks that decrease deposits	All Banks	Observations
All Borrowers	Working capital	26 *32*	30 *40*	27 *34*	26,354
	Revolving lines	13 *23*	18 *32*	15 *26*	
	Export loans	4 *17*	6 *21*	5 *19*	
	Foreign currency	5 *18*	7 *22*	6 *20*	
Large Firms	Working capital	19 *34*	30 *42*	22 *37*	1,939
	Revolving lines	5 *18*	8 *24*	6 *20*	
	Export loans	25 *39*	33 *43*	27 *41*	
	Foreign currency	25 *39*	30 *42*	27 *40*	
SMEs	Working capital	26 *31*	30 *40*	27 *34*	24,415
	Revolving lines	14 *23*	19 *32*	15 *26*	
	Export loans	3 *13*	4 *17*	3 *14*	
	Foreign currency	3 *14*	5 *19*	4 *16*	
Observations		18,354	8,000	26,354	

Table 2 – The impact of liquidity on bank lending

This table reports regression results for the OLS estimation of equation 1 with and without controls, without any fixed effect (column 1), with fixed effects at the industry level (columns 2, 4, 6, 8 and 10) and at the industry-size level (columns 3, 5, 7, 9 and 11), using three different measures for the change in liquidity as indicated. Variables are defined as in section 3 of the paper. All regressions are estimated with standard errors clustered at the bank level. The symbols ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels.

	Dependent variable: Log change in loans (postcrisis – precrisis)										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Variables of interest											
Δ Total deposits	**0.453*** **	**0.446*** **	**0.436*** **					**0.433*** **	**0.417*** **	**0.252** **	**0.247** **
	(0.141)	***(0.144)***	***(0.142)***					***(0.148)***	***(0.146)***	***(0.112)***	***(0.111)***
Δ Regular deposits				**0.371*** **	**0.366*** **						
				(0.107)	***(0.102)***						
Sistemically important banks						**0.285*** **	**0.275*** **				
						(0.078)	***(0.072)***				
Loan-level control variables											
Working capital loans								-0.052	-0.068	-0.284***	-0.271***
								(0.086)	*(0.081)*	*(0.058)*	*(0.058)*
Revolving credit loans				-				-0.084	-0.102	-0.192**	-0.194**
								(0.106)	*(0.098)*	*(0.091)*	*(0.085)*
Export loans								-0.210**	-0.301***	-0.34***	-0.422***
								(0.095)	*(0.091)*	*(0.101)*	*(0.096)*
Foreign currency loans								-0.102	-0.058	-0.041	0.007
								(0.093)	*(0.086)*	*(0.098)*	*(0.097)*
Bank-level control variables											
Governmental bank dummy										0.386***	0.359***
										(0.092)	*(0.093)*
Foreign bank dummy										0.151**	0.154**
										(0.069)	*(0.067)*
Total assets										0.041**	0.036**
										(0.016)	*(0.015)*

Table 2 – The impact of liquidity on bank lending (continued)

This table reports regression results for the OLS estimation of equation 1 with and without controls, without any fixed effect (column 1), with fixed effects at the industry (columns 2, 4, 6, 8 and 10) and at the industry-size level (columns 3, 5, 7, 9 and 11), using three different measures for the change in liquidity as indicated. Variables are de as in section 3 of the paper. All regressions are estimated with standard errors clustered at the bank level. The symbols ***, ** and * indicate statistical significance at th 5% and 10% levels.

	Dependent variable: Log change in loans (postcrisis – precrisis)										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Loans / Assets										0.113	0.1
										(0.265)	*(0.26)*
Loan loss provision / loans										1.412	1.517
										(1.036)	*(1.027)*
Asset liquidity										0.358	0.322
										(0.259)	*(0.253)*
Capital										0.092	0.102
										(0.467)	*(0.465)*
ROA										3.606	3.896*
										(2.381)	*(2.335)*
Deposits / Assets										0.316	0.289
										(0.197)	*(0.199)*
Fixed effects	None	Industry	Ind-size	Industry	Ind-size	Industry	Ind-size	Industry	Ind-size	Industry	Ind-size
Observations	26,381	24,883	26,348	24,014	25,466	24,883	26,348	24,883	26,348	24,883	26,348
Number of fixed effects	-	1,182	1,383	1,182	1,383	1,182	1,383	1,182	1,383	1,182	1,383
Number of *clusters* (banks)	102	102	102	100	100	102	102	102	102	102	102
R^2	0.016	0.088	0.116	0.089	0.118	0.087	0.114	0.090	0.118	0.130	0.152

Table 3 – Asymmetric effect of liquidity in bank lending

This table reports regression results for the estimation of equation 4 with and without controls, with fixed effects at the industry level and at the industry-size level as indicated. Variables are defined as in section 3 of the paper. All regressions are estimated with standard errors clustered at the bank level. The symbols ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels.

	Dependent variable: Log change in loans (postcrisis – precrisis)											
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Variables of interest												
ΔTotal deposits	0.871***	0.816***	0.863***	0.805***	0.411**	0.375**	0.814***	0.802***	0.375**	0.578***	0.566***	0.440**
	(0.193)	*(0.186)*	*(0.196)*	*(0.188)*	*(0.175)*	*(0.172)*	*(0.185)*	*(0.044)*	*(0.171)*	*(0.190)*	*(0.190)*	*(0.194)*
ΔTotal deposits x Increase	-0.857**	-0.758*	-0.873**	-0.778**	-0.322	-0.257	-0.762*	-0.780**	-0.264	-0.681*	-0.701*	-0.253
	(0.396)	*(0.385)*	*(0.399)*	*(0.390)*	*(0.301)*	*(0.292)*	*(0.386)*	*(0.391)*	*(0.293)*	*(0.366)*	*(0.373)*	*(0.289)*
SMEs dummy							-0.136***	-0.186***	-0.163***	-0.266***	-0.314***	-0.113*
							(0.042)	*(0.044)*	*(0.043)*	*(0.063)*	*(0.063)*	*(0.061)*
Increase x SMEs										0.179**	0.179**	-0.068
										(0.084)	*(0.083)*	*(0.069)*
Loan-level controls												
Working capital loans			-0.067	-0.08	-0.281***	-0.268***		-0.08	-0.263***		-0.091	-0.263***
			(0.079)	*(0.076)*	*(0.057)*	*(0.058)*		*(0.074)*	*(0.059)*		*(0.071)*	*(0.059)*
Revolving credit loans			-0.092	-0.108	-0.189**	-0.191**		-0.095	-0.174**		-0.086	-0.174**
			(0.101)	*(0.093)*	*(0.089)*	*(0.083)*		*(0.093)*	*(0.085)*		*(0.093)*	*(0.085)*
Export loans			-0.219**	-0.308***	-0.337***	-0.420***		-0.268***	-0.371***		-0.262***	-0.371***
			(0.094)	*(0.091)*	*(0.101)*	*(0.095)*		*(0.090)*	*(0.092)*		*(0.081)*	*(0.092)*
Foreign currency loans			-0.096	-0.056	-0.04	0.007		-0.073	-0.012		-0.073	-0.012
			(0.099)	*(0.088)*	*(0.099)*	*(0.097)*		*(0.083)*	*(0.097)*		*(0.083)*	*(0.097)*
Bank-level controls	NO	NO	NO	NO	YES	YES	NO	NO	YES	NO	NO	YES
Fixed effects	Industry	Ind x size	Industry	Ind x size	Industry	Ind x size	Industry	Industry	Industry	Industry	Industry	Industry
Observations	24883	26348	24883	26348	24883	26348	26354	26354	26354	26354	26354	26354
Number of fixed effects	1182	1383	1182	1383	1182	1383	1182	1182	1182	1182	1182	1182
Number of *clusters* (banks)	102	102	102	102	102	102	102	102	102	102	102	102
R^2	0.094	0.120	0.096	0.122	0.130	0.152	0.082	0.084	0.113	0.084	0.086	0.113

Table 4 – The extensive margin

This table reports regression results for the estimation of equations 1 and 4 with and without controls, with fixed effects at the industry level and at the industry-size level as indicated. The dependent variables are the percent change in the number of borrowers, and a dummy indicating the increase in the number of borrowers from a bank in a given industry (or industry-size). Regressors are defined as in section 3 of the paper. All regressions are estimated with standard errors clustered at the bank level. The symbols ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels.

Dependent Variables:	***Percent change in the number of borrowers (ΔN)***				***Increase in the number of borrowers dummy (Entry)***			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables of interest								
ΔTotal deposits	0.309***	0.273**	0.617***	0.493**	0.217***	0.139**	0.351***	0.169**
	(0.111)	*(0.119)*	*(0.176)*	*(0.194)*	*(0.074)*	*(0.059)*	*(0.082)*	*(0.076)*
ΔTotal deposits x Increase			-0.626**	-0.449			-0.271	-0.062
			(0.27)	*(0.277)*			*(0.189)*	*(0.134)*
Loan-level controls	NO	YES	NO	YES	NO	YES	NO	YES
Bank-level controls	NO	YES	NO	YES	NO	YES	NO	YES
Fixed effects	Ind x Size	Ind x Size	Ind x Size	Ind x Size	Ind x Size	Ind x Size	Ind x Size	Ind x Size
Observations	33,475	33,475	33,475	33,475	33,475	33,475	33,475	33,475
Number of fixed effects	1,467	1,467	1,467	1,467	1,467	1,467	1,467	1,467
Number of *clusters* (banks)	102	102	102	102	102	102	102	102
R^2	0.121	0.157	0.125	0.158	0.112	0.174	0.115	0.174

Appendix – Additional robustness checks

This appendix provides additional robustness checks and further description of our sample.

We start by showing that the change in deposits during the crisis is unrelated to the quality/riskiness of the loan portfolio. We run a simple OLS regression of the precrisis level of loan loss provisions on the change in deposits. In the result shown in Table A.1, we find that changes in deposits are positively (but not statistically significantly) associated to loan loss provision. This means that banks that suffered more withdrawals were not the ones with the riskier borrowers (if any, they had the less risky borrowers).

Table A.1. Simple regression Loan Loss Provision x Δ Total Deposits

This table reports for a simple OLS regression of loan loss provisions on the change in total deposits during the crisis, using standard errors corrected for heterocedasticty. The symbol *** indicates statistical significance at the 1% levels.

Dependent variable	Loan loss provisions
Δ Total deposits	0.023 *(0.014)*
Constant	0.042*** *(0.005)*
Observations	102
R^2	0.052

We then use an alternative measure for the change in loans. One possible issue with the traditional measure (the log change) is that it compels us to drop all observations (bank to industry-size lending) for which the amount lent is zero. This would be particularly concerning for the interpretation of our results if bank lending in the precrisis is industry-specific, i.e., if banks specialize in lending to certain industries, but industries that lend from banks that become constrained are able to switch to unconstrained banks in the post crisis. If this story holds, we would be dropping precisely these observations, which would lead us to underestimate the coefficient of the interaction term Δ*Deposits x*

Increase. To solve this potential problem, we use an alternative measure for the change in loans, described below:

$$(\Delta\text{Loans\_Alt})_{ij} = 2 * \left[\frac{\text{Loans}_{\text{Postcrisis;i,j}} - \text{Loans}_{\text{Precrisis;i,j}}}{\text{Loans}_{\text{Postcrisis;i,j}} + \text{Loans}_{\text{Precrisis;i,j}}}\right], \text{where} \qquad \textbf{(A.1)}$$

$$\text{Loans}_{\text{Postcrisis;i,j}} = \left[\frac{\sum_{\text{Dec 2008}}^{\text{Jun 2009}} (\text{Loans to industry (industry} - \text{size)}\ \mathbf{j}\ \text{from bank}\ \mathbf{i})}{3}\right] \qquad \textbf{(A.2)}$$

$$\text{Loans}_{\text{Precrisis;i,j}} = \left[\frac{\sum_{\text{Dec 2007}}^{\text{Jun 2008}} (\text{Loans to industry (industry} - \text{size)}\ \mathbf{j}\ \text{from bank}\ \mathbf{i})}{3}\right] \qquad \textbf{(A.3)}$$

$\Delta Loans\_Alt$ is bounded between -2 and +2, and approximates the traditional measure for small changes in loans[19]. As such, the economic interpretation for the coefficients is maintained (i.e., they are the elasticities of loans to liquidity). We show the results of the estimations using this variable in Table A.2. The coefficients for our variables of interest and controls differ only slightly relative to the regressions reported in Tables 2 and 3 of the paper (where we use the log change in loans), so that all our main inferences are maintained.

[19] For example, if loans change from $100 to $110, the log change is 0.09531 and the alternative measure is 0.09524. For changes in loans between -29% and +41% (where most of our observations lie), the difference between the two measures is less than 1%.

Table A.2 – Alternative measure for the change in loans

This table reports regression results for the estimation of equations 1 and 4 with and without controls, with fixed effects at the industry level and at the industry-size level as indicated. The dependent variable is the alternative measure for the change in loans, described in the appendix. Regressors are defined as in section 3 of the paper. All regressions are estimated with standard errors clustered at the bank level. The symbols ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels.

Dependent variable	**Alternative measure of change in loans (post – pre-crisis)**							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables of interest								
Δ Total deposits	0.458***	0.338**	0.857***	0.572***	0.873***	0.581***	0.719***	0.601***
	(0.133)	*(0.13)*	*(0.184)*	*(0.192)*	*(0.186)*	*(0.192)*	*(0.198)*	*(0.204)*
Δ Total deposits * Increase			-0.81**	-0.479	-0.825**	-0.495*	-0.78**	-0.491*
			(0.317)	*(0.292)*	*(0.32)*	*(0.294)*	*(0.31)*	*(0.292)*
SMEs dummy					-0.194***	-0.173***	-0.283***	-0.157**
					(0.036)	*(0.04)*	*(0.065)*	*(0.067)*
SMEs * Increase							0.129	-0.023
							(0.081)	*(0.086)*
Loan-level control variables								
Working capital loans		-0.528***		-0.524***		-0.538***		-0.537***
		(0.065)		*(0.066)*		*(0.065)*		*(0.065)*
Revolving credit loans		-0.477***		-0.475***		-0.47***		-0.471***
		(0.078)		*(0.078)*		*(0.079)*		*(0.079)*
Export loans		-0.512***		-0.509***		-0.487***		-0.488***
		(0.095)		*(0.094)*		*(0.095)*		*(0.095)*
Foreign currency loans		-0.122		-0.125		-0.203**		-0.203**
		(0.087)		*(0.089)*		*(0.096)*		*(0.096)*
Bank-level control variables								
Governmental bank dummy		0.354***		0.344***		0.346***		0.348***
		(0.099)		*(0.098)*		*(0.101)*		*(0.102)*
Foreign bank dummy		0.077		0.059		0.052		0.056
		(0.083)		(0.079)		(0.079)		(0.084)

Table A.2 – Alternative measure for the change in loans (continued)

This table reports regression results for the estimation of equations 1 and 4 with and without controls, with fixed effects at the industry level and at the industry-size level as indicated. The dependent variable is the alternative measure for the change in loans, described in the appendix. Regressors are defined as in section 3 of the paper. All regressions are estimated with standard errors clustered at the bank level. The symbols ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels.

Dependent variable	**Alternative measure of change in loans (post – pre-crisis)**							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Total assets		0.043**		0.043**		0.044**		0.044**
		(0.017)		*(0.017)*		*(0.017)*		*(0.017)*
Loans / Assets		0.189		0.167		0.155		0.15
		(0.341)		*(0.336)*		*(0.335)*		*(0.341)*
Loan loss provision / loans		0.225		0.265		0.275		0.299
		(1.06)		*(1.032)*		*(1.032)*		*(1.056)*
Asset liquidity		0.397		0.305		0.286		0.291
		(0.306)		*(0.311)*		*(0.31)*		*(0.308)*
Capital		0.385		0.464		0.467		0.447
		(0.528)		*(0.518)*		*(0.522)*		*(0.526)*
ROA		3.275		2.855		2.754		2.88
		(2.714)		*(2.578)*		*(2.581)*		*(2.712)*
Deposits / Assets		0.403*		0.331		0.329		0.34
		(0.21)		*(0.221)*		*(0.221)*		*(0.22)*
Fixed effects	Ind x Size	Ind x Size	Ind x Size	Ind x Size	Industry	Industry	Industry	Industry
Observations	33,475	33,475	33,475	33,475	33,483	33,483	33,483	33,483
Number of fixed effects	1,467	1,467	1,467	1,467	1,213	1,213	1,213	1,213
Number of *clusters* (banks)	102	102	102	102	102	102	102	102
R^2	0.123	0.166	0.128	0.168	0.082	0.124	0.083	0.124