Macroprudential Policy and Intra-Group Dynamics: The Effects of Reserve Requirements in Brazil[☆]

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Abstract

This paper examines whether intra-group dynamics matter for the transmission of macroprudential policy. Using bank-level data on the Brazilian banking system, we investigate the effect of reserve requirements targeting headquarter banks' deposit ratio on credit supply by their municipal branches. Exploiting this matched bank-branch data for identification purposes, we find a lending channel of reserve requirements for branches whose parent banks are more exposed to targeted deposits. The result is driven by the crisis period and state-owned banks, which also adjust the transmission of the policy depending on branches' traits. Our findings reveal limitations in current macroprudential policy frameworks.

Keywords: Macroprudential regulation, financial intermediation, intra-group dynamics.
JEL: F30, F65, G21, G28

[☆]We would like to thank Söhnke M. Bartram, Thorsten Beck, Manuel Buchholz, Vittoria Cerasi, Gamze Danisman, Martin Götz, Iftekhar Hasan, Mathias Hofmann, Michael Koetter, Elena Mazza, Felix Noth, Steven Ongena, and Iryna Stewen for helpful comments and suggestions. Furthermore, we thank conference and seminar participants at the Joint Research Centre of the European Commission in Ispra, DIW Berlin, the annual meeting of the European Economic Association in Lisbon, the 2017 FINEST conference in Trani, the 2017 MBF conference in Palermo, the 2018 Central Bank of Ireland Workshop on "Banking, Credit and Macroprudential Policy", the Halle Institute for Economic Research and the 6th Financial Economics Workshop in Bonn. All errors and inaccuracies are solely our own responsibility. Declarations of interest: none.

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1. Introduction

The global financial crisis highlighted that disruptions in the financial sector can have large negative effects on the real economy. To reduce systemic risk in financial markets, several changes in the regulatory framework of the banking system have been made. This policy consensus about the reform of banking supervision and regulation has been characterized by the introduction of macroprudential policies, a combination of policy tools aimed at reducing the risk of systemic imbalances by steering the cycle of banks' credit supply. One necessary condition for macroprudential policies to be effective is in such a context their capacity to tighten or loosen banks' funding constraints (Aiyar et al., 2014). Understanding how banks' funding structures influence the effectiveness of macroprudential policies is therefore crucial to assess their functioning and limitations.

Using data on the Brazilian banking system with granular information on bank holding companies, this paper assesses the link between macroprudential policies, banks' funding structures and credit supply within banking groups. The analysis focuses on a macroprudential policy that has been introduced in several countries worldwide and targets the funding side of the balance sheet, namely reserve requirements for demand (short-term) deposits. Exploiting rich regional banking data for identification purposes, we explore the effect of reserve requirements targeting headquarter banks' deposit ratio on credit supply by their municipal bank branches. Our results reveal a higher sensitivity of credit supply to reserve requirements for branches whose headquarter banks are more exposed to targeted deposits. Branch ownership and the stage of the economic cycle are central in explaining the result.

Although the literature suggests that bank funding structures and internal capital markets are important for the transmission of monetary policy to credit supply (e.g., Campello, 2002; Kishan and Opiela, 2000; Holod and Peek, 2010), there is limited evidence of whether a similar rationale applies to macroprudential policies. We thus contribute to previous studies analyzing the functioning of macroprudential policies (e.g., Aiyar et al., 2014; Claessens et al., 2013) by looking at a novel transmission mechanism of macroprudential policies, in our case reserve requirements, imposed on banks' headquarters (or parent banks) to credit supply by their regional bank branches.[1] Our analysis suggests that it is not only parent banks' funding structure that matters for transmitting the policy but also the profitability of the branch. By exploring these channels, our paper contributes to the literature by providing, to the best of our knowledge, first evidence of how bank-specific regulatory exposures affect the transmission of macroprudential policies to credit supply within banking groups.

We follow an identification strategy based on three main building blocks. First, we rely on data for the Brazilian banking system that include the network of regional bank branches of every banking conglomerate operating in the country. This reduces concerns about reverse causality by separating the corporate level at which reserve requirements are imposed from the level at which the credit supply is realized. This point is strengthened considering that reserve requirements are actively used by the Brazilian Central Bank to steer the local credit cycle when foreign capital shocks hit. Hence, changes in reserve requirements are likely to be exogenous from the perspective of regional bank branches, the level at which the analysis is performed. Second, we identify the effect of reserve requirements on branches' credit supply by making use of the fact that parent banks vary in their reliance on targeted demand deposits. Following similar approaches by Rajan and Zingales (1998) and Manganelli and Popov (2015), we argue that the heterogeneous effect of reserve requirements along the distribution of banks' demand deposit ratios can provide a proper identification of changes in credit supply triggered by reserve requirements. Third, we exploit the branch-level structure in the data to isolate credit supply from credit demand. We follow the literature (Carlson et al., 2013; Dursun-de Neef, 2018) by including quarter-municipality fixed effects in a panel model that absorb time-varying and municipality-specific changes in credit demand to which branches in a given region are commonly exposed.

[1] Hereafter, we refer to banks' headquarters as parent banks.

We implement this research design on hand-collected data for the Brazilian banking system covering balance-sheet information for every active bank in the country between 2008 and 2014. These data allow us to link individual parent banks with their regional branches aggregated at the level of Brazilian municipalities. In addition to providing the setting for our identification strategy, there are several advantages to relying on these data. The high reporting frequency of the data (compared to alternative data sources such as Orbis Bank Focus) allows us to properly track changes in banks' credit induced by adjustments in reserve requirements. Additionally, our analysis benefits from the fact that Brazil follows a floating exchange-rate regime with an inflation-targeting policy framework. This enables us to differentiate the effect of reserve requirements from monetary policy. Finally, we can exploit the large presence of foreign and state-owned banks in Brazil to explore whether results differ depending on banks' ownership structure, similar to Aiyar et al. (2014) and Coleman and Feler (2015). In this way, our study contributes to the scarce literature using bank-level data to identify the lending channel of macroprudential policies in emerging countries.

Our results are threefold and can be summarized as follows. First, we find robust evidence that reserve requirements targeting parent banks' funding side are transmitted into their affiliated branches' credit supply, whereas the effect of reserve requirements becomes stronger for banks largely exposed to demand deposits. These baseline results remain robust when controlling for monetary policy and a large range of other confounding factors. Branches' lending sensitivity to reserve requirements pertains at the aggregate level and is not netted out by borrowers' substituting credit between banks. Second, the result depends crucially on the stage of the economic cycle and bank ownership. It is driven by periods of economic downturns when reserve requirements are loosened and by branches belonging to state-owned parent banks. Third, for the sample of state-owned banking groups and the crisis period, we find that the loosening of the policy has contributed to the maintenance of credit supply by branches with low profitability. Hence, as concerns intra-group dynamics, the results show that both parent banks' exposure but also branch characteristics matter for the transmission of a policy change.

This paper contributes to three main strands of literature. First, there is an evolving literature on the effectiveness of macroprudential policies (see e.g., Claessens et al. (2013), Haldane et al. (2014)). A few papers have studied the heterogeneous effects of macroprudential policy by relying on bank-level data (Acharya et al., 2018; Barbone Gonzalez et al., 2018; Buch and Goldberg, 2017; Epure et al., 2017). For instance, Aiyar et al. (2014) use a sample of domestically-owned banks and foreign-owned branches and subsidiaries in the UK from 1998 to 2007 and find that stricter bank-specific capital regulation of domestic banks and foreign subsidiaries leaks to unregulated foreign branches, which increase their lending. The differential responses to home regulation of foreign branches versus subsidiaries located in the UK are found by Danisewicz et al. (2017).[2] Two main contributions differentiate our paper from these studies. First, we look at a different instrument of macroprudential policy —reserve requirements for demand deposits— in the context of an emerging country that uses this tool to steer the transmission of cycles of capital flows from abroad. Second, we analyze how the characteristics of banks' funding structures drive the effectiveness of reserve requirements within a banking group.

Second, our focus on banks' intra-group dynamics adds to the literature on the transmission of liquidity shocks via internal capital markets. Early literature on internal capital markets discussed the role of banking groups' strength for affiliates' lending and the internal transmission of monetary policy (see, e.g., Ashcraft, 2008; Campello, 2002; Dahl et al., 2002; Houston et al., 1997; Houston and James, 1998). More recent

[2]Other studies have relied on country-level data or descriptive analysis to evaluate the functioning of reserve requirements in Latin America (Montoro and Moreno (2011), Da Silva and Harris (2012)). Glocker and Towbin (2015) estimate structural VAR models to analyze the effect of monetary policy and reserve requirement on aggregate credit growth in Brazil. Tovar Mora et al. (2012) follow a similar approach with a sample of four Latin American countries. Dassatti Camors et al. (2015) study one increase in reserve requirements in Uruguay using credit register data and find evidence for a contraction of the loan supply. In contrast, our paper analyzes the effect of reserve requirements on intra-group dynamics for several changes in reserve requirements and using bank-level data.

studies have analyzed the cross-border transmission of liquidity or regulatory shocks within international bank holding companies (e.g., Aiyar et al., 2014; Buch and Goldberg, 2015; Cetorelli and Goldberg, 2012a,b; Danisewicz et al., 2017; De Haas and van Lelyveld, 2010; Frey and Kerl, 2015). Using also Brazilian branch-level data, Coleman et al. (2017) show that banks make use of internal liquidity management after liquidity shocks to support their branches' lending. We contribute to this literature by examining the transmission of macroprudential regulation within a banking group.

Finally, we add to a new strand of literature focused on understanding the interactions between macroprudential policy and monetary policy (Agur and Demertzis, 2015; Cecchetti, 2016; Gourinchas et al., 2012; IMF, 2011, 2013; Leduc and Natal, 2017; Tressel and Zhang, 2016; Zdzienicka et al., 2015). Our paper directly analyzes the effect of a macroprudential policy instrument on credit supply while controlling for monetary policy.

The paper is structured as follows. Section 2 discusses the use of reserve requirements in Brazil as a macroprudential tool. Section 3 describes the data and shows descriptive statistics. Section 4 explains the empirical estimation approach, discusses our identification scheme, and presents regression results. Section 5 concludes.

2. Reserve Requirements in Brazil

Reserve requirements are used as an important part of the macroprudential toolbox in Brazil and aim at maintaining overall financial stability (Da Silva and Harris, 2012).[3] In technical terms, reserve requirements define the ratio of the deposit base that must be held as reserves at the central bank.

These requirements serve to control two dimensions of systemic risk. First, a cross-sectional dimension is related to the availability of bank funding at one point in time. Banks' liquidity may be managed in case of a shock to a common funding source or

[3] "In Brazil, the percentage of financial assets that must be held as reserve requirements has been defined by the BCB [Banco Central do Brasil] with the aim of preserving the stability and soundness of the financial system, therefore allowing the sustained growth of credit." (Central Bank of Brazil, 2016).

sudden capital outflows. Given liquidity constraints, easing reserve requirements can free liquidity from banks' own balance sheets. This can mitigate a potential economic downturn caused by a shortage of credit supply as a response to funding squeezes. Second, reserve requirements also target a time dimension of systemic risk by steering the pro-cyclicality of credit growth over time. The higher the requirements, the more reserves domestic banks must hold at the central bank. On the one hand, this limits the amount of available funds that can be intermediated into loans, potentially dampening credit growth and thus economic overheating during a boom period. On the other hand, unremunerated reserve requirements act as a tax on financial intermediation in the form of forgone interest. This increases the marginal funding costs of deposits and may thus have negative effects on banks' credit supply.

One important aspect of reserve requirements is that their use relates to a traditional policy dilemma faced by monetary policy in emerging countries. In times of a credit boom, a typical recommendation implies implementing a counter-cyclical monetary policy by raising interest rates and thus lowering demand for credit. However, historically, this has not been a feasible option in emerging countries facing credit booms financed by capital inflows. The reason is that increased interest rates attract even more capital inflows, triggering a vicious circle of further increases in both local credit supply and asset prices (Glocker and Towbin, 2015; Montoro and Moreno, 2011). In such a context, the imposition of higher reserve requirements limits the amount of banks' liquidity that can be transformed into loans without attracting more capital inflows. This can be accompanied by an expansionary monetary policy that depresses interest rates and thus restricts incentives for capital inflows. This illustrates how the restrictions of monetary policy in emerging countries can provide a reasoning to explain the use of reserve requirements as a macroprudential tool.

In the context of a global financial crisis with large capital outflows and high local inflation, the aforementioned restrictions on monetary policy are even stronger. This was the case for Brazil during the 2008-2009 global financial crisis. In this scenario, reducing the interest rate of monetary policy to boost local credit may induce further capital outflows, depressing local investment, depreciating the local currency, worsening inflation and increasing the risk of a balance-of-payments crisis (Joyce and Nabar, 2009). Again, reserve requirements provide policy-makers with an alternative to increase market liquidity, to decrease lending rates and to support domestic credit demand without inducing further capital outflows. This rationale for relying on reserve requirements to steer credit cycles when facing reversals in capital flows is in line with the behavior of Brazilian reserve requirements both during and after the global financial crisis.

The Central Bank of Brazil changed its reserve requirements on numerous occasions around the global financial crisis. This setting offers a high degree of variation in the level of reserve requirements and allows us investigating whether symmetric effects of reserve requirements arise in the context of booms and busts in capital flows. Although we remain agnostic about the potential asymmetric effects of reserve requirements along the credit cycle, the discussion above tends to suggest that their effect could be stronger in periods of crisis when monetary policy faces stronger restrictions. This question is relevant given that our sample period includes the global financial crisis, during which several emerging countries such as Brazil changed reserve requirements to limit the risk of liquidity dry-ups in banking markets (see Montoro and Moreno, 2011). We thus address the differential effects of reserve requirements at different stages of the economic cycle in Section 4.4.

Figure 1 provides a general picture of the pattern of reserve requirements for short-term demand deposits and cross-border exposure in the Brazilian banking system. Before the global financial crisis, Brazil experienced a surge in capital inflows. Thus, reserve requirements were at elevated levels to limit the risk of the potential overheating effect on local credit markets (Montoro and Moreno, 2011). This trend changed after the 2008 collapse of Lehman Brothers, which induced a large contraction in global capital flows. The Brazilian central bank reacted by decreasing reserve requirements with the objective of decreasing liquidity shortages and supporting credit supply when the external shock represented by the crisis was at its height.[4] [5]

[Figure 1 about here.]

This strategy was reversed when expansionary monetary policy in advanced countries —leading to excessive global liquidity— and the European sovereign debt crisis caused large capital inflows into Brazil (Da Silva and Harris, 2012). The reason for these capital inflows were the favorable return possibilities given spreads between advanced economies' low interest rates and Brazil's interest rates, which were among the highest in the world. High inflation rates attributable to, inter alia, high food prices, restricted the scope for lower interest rates. This fueled an increase in local credit provision. The Central Bank of Brazil increased reserve requirements as a response to this expansion in credit (Da Silva and Harris, 2012; Tovar Mora et al., 2012).

These dynamics of reserve requirements contain two features that are beneficial for identifying a credit supply channel of the policy tool. First, reserve requirements co-move with the global cycle of cross-border capital flows. Especially the loosening of reserve requirements during the global financial crisis and the tightening following the surge in capital flows to emerging markets are arguably driven by global factors. Second, reserve requirements are implemented in a counter-cyclical way to target credit supply. As credit demand operates in a pro-cyclical fashion, concerns that results merely reflect unobserved credit demand are reduced. We discuss the implications of the functioning of reserve requirements for our identification in Section 4.1.

[4]The Brazilian Central Bank states that "In the case of Brazil, the measures adopted by the Government and by the BCB to mitigate the effects of the crisis on the domestic banking system aimed primarily to offset the significant decline in financial markets liquidity [...]." (Central Bank of Brazil, 2016); see also Da Silva and Harris (2012).

[5]The decline in reserve requirements in October 2008 (July 2012) by 6 (11) percentage points corresponds to approximately 3800 (8400) millions of USD of aggregate demand deposits in our sample.

3. Data and Descriptive Statistics

3.1. Bank-level data

We obtain parent bank and branch-level data from the IWH Latin American Banking Database to create an empirical setting that allows us to investigate our research question.[6] This data set contains micro-level data on balance sheet and income statements for domestic banks and foreign subsidiaries located in Brazil. All bank-related information is collected by the Central Bank of Brazil as regulatory data with mandatory reporting. We use the granularity of the data and combine data at the level of the parent bank and regional branches, as well as we aggregate the monthly data to the quarterly frequency. Overall, our sample comprises 6081 domestic branches for the period from 2008Q1 to 2014Q1.[7] The branches are owned by 56 domestic and foreign-owned parent banks and operate in 1678 Brazilian municipalities (out of 3122 municipalities in which some banking activity is reported). Figure 4 shows the coverage of municipalities in the estimation sample. In the Data Appendix A, we provide a description of data sources and procedures used to construct the database.

[Figure 4 about here.]

To clean the bank-level data from outliers and unreasonable values, we conduct the following adjustments. First, we restrict the sample to branches reporting over the whole sample period to properly gauge the intensive margin of the effect of reserve requirements on credit supply. Second, we correct for outliers by winsorizing all parent- and branch-level variables at the one and ninety-nine percentiles. Finally, we only keep municipalities in which at least two different parent banks are represented via branches.

[6] The data have been used in Noth and Ossandon Busch (2016) as well as Noth and Ossandon Busch (2017). In addition, Coleman and Feler (2015) use the availability of bank and branch-level data to study government banks' lending behavior in Brazil during the financial crisis. Coleman et al. (2017) study internal liquidity management by parent banks and lending responses by branches after liquidity shocks.

[7] Note that balance sheet data for multiple branches operated by the same parent bank within a given municipality are summed to represent one entity in the sample, which we refer to as a "branch" throughout the paper.

This filter is important to control for time-varying common market or credit demand shocks affecting all branches operating in a single municipality (see Carlson et al., 2013; Dursun-de Neef, 2018).[8] Despite these restrictions, our sample still represents a reasonable share of the Brazilian credit market. On average, we observe 89.2 percent of total outstanding credit and 79.6 percent of total bank assets. Summary statistics are provided in Table 1. A detailed list of variables and correlation tables can be found in the Data Appendix A.

[Table 1 about here.]

As noted above, one important feature of the data is that it allows us to link individual parent banks with their regional branches aggregated at the level of Brazilian municipalities. We exploit this parent bank-branch setting to study how intra-group dynamics affect the transmission of reserve requirements targeting parent banks to branches' credit supply. The fact that there is a large variation in the number of branches owned by different types of parent banks (e.g. state-owned versus private, foreign versus domestic banks) ensures sufficient variation to identify effects and we explore the implications of banks' ownership in Section 4.4.[9]

The large presence of branches of foreign-owned parent banks allows us to explore whether reserve requirements are equally transmitted to the credit supply of branches owned by domestic banks versus foreign banks.[10] Foreign parent banks may differ in their funding structure with implications for the exposure to reserve requirements.

[8]Because we restricted our sample to municipalities in which at least two parent banks operate via their branches, we lose approximately 19.1 percent of our original branch-time observations. On average, the branches remaining in the sample are larger, most likely because we drop smaller municipalities with a less dense branch presence.

[9]E.g., Banco do Brasil, a domestic and state-owned bank, dominates in terms of the number of branches owned (1628). The foreign bank with the largest number of branches (171) is Banco Santander, the Brazilian subsidiary of a Spanish-owned bank.

[10]Approximately one-third of parent banks in the sample are foreign banks (15 out of 56), whereas 11.8 percent of branch-level observations stem from the branches of foreign parent banks (717 out of 6081 branches are operated by foreign banks). On average, foreign parent banks manage 35 percent of total assets over the sample period, whereas the average municipality has 2.9 percent of its assets managed by a branch operated by a foreign parent bank. The definition of foreign banks is partially based on Claessens and van Horen (2015).

Previous evidence suggests that macroprudential policies affect banks differently depending on their ownership with consequences for the effect of macroprudential policies on aggregate changes in credit supply (Aiyar et al., 2014). Heterogeneous responses of domestic and foreign banks would highlight the importance of the cross-country coordination of macroprudential policies. Another dimension of ownership that may result in differential responses across banks is state versus private ownership. This is a relevant issue in the case of Brazil. In our final estimation sample, 52.9 percent of branch-level observations stem from 9 state-owned parent banks (16 percent of parent banks), which operate 3220 out of 6081 branches. State-owned parent banks manage an average of 35.6 percent of total assets over time. The average municipality has three quarters of its assets managed by a state-owned bank, revealing state-owned banks' relevance to the Brazilian banking system.

Branch-level data are complemented with quarterly information on parent banks' balance-sheet characteristics. In our empirical model, we exploit parent banks' reliance on demand deposit funding —the item of the balance sheet targeted with the highest rate by reserve requirements— to assess whether increased funding constraints attributable to tighter reserve requirements can explain the pass-through of this policy to credit supply. Since we observe outstanding credit balances at the branch level, we use this data structure to ask whether branches adapt their credit supply differently as a response to reserve requirements and depending on their parent banks' funding structure. If the final outcome of reserve requirements depends on parent banks' funding structure, then macroprudential policies should be considered within a more general policy framework addressing the heterogeneous effect of these interventions. Keeping in mind that macroprudential policies aim at affecting aggregate developments that depend on individual banks' adjustments, this seems a relevant consideration.

The analysis below also sheds light on potential heterogeneous effects of reserve requirements conditional on parent bank characteristics, which might determine access to alternative funding sources. Table 2 reports summary statistics of the deposit ratio by different sub-samples. Differences arise when comparing domestic and foreign parent banks: foreign parent banks have a lower average demand deposit ratio, most likely because they find it more difficult to raise domestic demand deposits. Pronounced differences are revealed for state-owned versus private banks, with state-owned banks showing a higher average demand deposit ratio. In addition, parent banks with a lower liquid asset ratio and a higher capital ratio have, on average, a lower deposit ratio targeted by reserve requirements.

[Table 2 about here.]

3.2. Country-level data

Information on reserve requirements —that is, the share of deposits that parent banks must hold as reserves at the central bank— is provided by the Central Bank of Brazil. Depending on redeemability, different types of deposits are subject to individual rates. Similar to the study on reserve requirements in Uruguay by Dassatti Camors et al. (2015), we focus exclusively on non-remunerated reserve requirements for short-term funding targeting banks' demand deposits. The reason for this choice is that reserve requirements for demand deposits aim to affect short-term funding, that is, the part of funding that is the most volatile and thus is the most likely to cause systemic disruptions. This is also mirrored by the fact that reserve requirements for demand deposits show the highest reserve ratios compared to reserve requirements for term deposits.

We complement the data set by adding variables for monetary policy, including data on the policy rate (SELIC) and the monetary base. The SELIC rate is used as the main policy instrument by the central bank to maintain the inflation target of approximately 4.5 percent. Figure 2 shows the pattern of reserve requirements (solid line) and the policy rate (dashed line). There is a large fluctuation in the rates of both monetary policy and reserve requirements: For the sample period starting in 2008Q1, reserve requirements range from 44 to 55 percent and the SELIC rate ranges from 7.1 to 13.7 percent.[11] Some periods are characterized by similar patterns of tightening or loosening the relevant instrument (for example, the period between 2010 and 2013). In the following analysis, we thus verify that our results obtained for reserve requirements are neither driven by changes in monetary policy nor other macroeconomic developments.

[Figure 2 about here.]

Graphically, the relationship between reserve requirements and branches' credit supply is shown in Figure 3. Reserve requirements (solid line) are depicted on the left axis. The right axis shows the average quarterly change in credit supply by branches. The figure shows that, in general, changes in reserve requirements occur with a lag to changing trends in credit supply induced by reversals in capital flows. For example, because of the financial crisis and capital outflows, the decline in credit growth at the end of 2008 has been followed by a loosening of reserve requirements. Whereas credit growth increased during 2009, a tightening in reserve requirements only occurred in 2010. Finally, during the European sovereign debt crisis and globally depressed growth patterns, quarterly credit growth in Brazil showed a downward trend until the end of 2012 and stagnated. Reserve requirements nevertheless remained at elevated levels until mid-2012 because of elevated capital inflows.

[Figure 3 about here.]

4. Estimation Approach

We proceed as follows to test the predictions made in the previous sections. First, we estimate the effect of reserve requirements on branches' credit supply conditional on parent banks' reliance on demand deposits, that is, their exposure to the policy. This provides insights into whether macroprudential policies result in dynamics within

[11] Additionally, it is noteworthy that compared to, e.g., the Euro Area, which recently had reserve requirements of one percent on deposits with a maturity shorter than 2 years, reserve ratios on short-term deposits are quite high in Brazil.

a banking group that affect branches' credit supply. Second, we conduct extensive robustness tests to address identifications concerns related to credit demand shocks, anticipation effects, and confounding events. Third, we extend our baseline model to test for asymmetric effects of reserve requirements and the relevance of bank ownership.

4.1. Identification

Our identification strategy is based on three considerations related to (i) the counter-cyclicality of reserve requirements, (ii) the heterogeneous impact of this macroprudential policy across banks, and (iii) the disentangling of credit supply from credit demand.

(i) Counter-cyclicality of reserve requirements. Section 2 has revealed a co-movement between reserve requirements and cross-border capital flows. The reason is that the central bank makes use of reserve requirements to respond to changes in foreign capital flows such as the capital outflow due to the collapse of Lehman Brothers or the inflow following the European sovereign debt crisis. Adjustments in reserve requirements are hence critically influenced by major economic events triggered outside Brazil, which reduces concerns about reverse causality between single banks' credit supply and the level of reserve requirements.[12] Furthermore, we estimate credit supply at the level of individual bank branches. Narrowing down the organizational level at which credit supply is estimated dissociates the decision level between the policy-maker and banks even further.

(i) Heterogeneous impact across banks. A second pillar of our identification strategy is that reserve requirements are likely to affect banks conditional on the exposure of their balance sheet to the targeted demand deposits. Therefore, our analysis is based

[12]The importance of external factors driving capital flows to emerging economies has been shown by e.g. Calvo et al. (1993); Gavin et al. (1995); Kim (2000) next to country-specific determinants (Papaioannou, 2009). Forbes and Warnock (2012) show that reversals in capital movements are not significantly related to local economic conditions but to global factors such as risk aversion or global growth. Amiti et al. (2017) confirm that, during crisis times, idiosyncratic factors hitting the creditor country determine capital flows to borrower countries rather than local demand effects. Also, Jara et al. (2009) write that "[...] the shock originated in the financial sector of advanced economies rather than in Latin America or another emerging market region."

on exploring the effect of reserve requirements along the distribution of banks' demand deposits to total assets ratio. The idea of identifying the effect of an aggregate variation by focusing on heterogeneous responses at a narrower level of observation resembles the approach by Rajan and Zingales (1998), more recently applied by Klapper et al. (2006), Manganelli and Popov (2015), and Heider et al. (2018). In addition to its methodological advantages, this type of identification adds to the understanding of how banks' funding restrictions influence the effectiveness of macroprudential regulation.

(iii) Disentangling credit supply from demand. Central for our identification is disentangling credit supply effects from credit demand shocks. Even if we observe an effect of reserve requirements on credit growth, unobserved demand shocks may provide an alternative explanation for this relationship. For instance, branches from banks that are relatively more exposed to a macroprudential policy may be simultaneously more affected by demand shocks that then explain the observed changes in credit growth. Since we aim at interpreting our results as supply-driven, we have to address this concern.

An omitted variable bias due to unobserved credit demand shocks becomes a problem if two conditions hold: First, since we identify the effect of reserve requirements along the distribution of parent banks' deposit ratio, there would need to be a systematic correlation between this ratio and credit demand. To preliminarily investigate the presence of this type of systematic correlation, we collect different proxies for credit demand at the municipality-level and analyze whether it varies across branches owned by parent banks in different quartiles of the deposit ratio distribution. For this purpose, we compute quarterly growth rates in total bank assets, job creation (i.e. new contracts signed), and GDP.[13] We then take the average of these demand proxies across municipalities in which branches owned by parent banks that have e.g. a deposit ratio in the 25th percentile of the distribution are located. The results from this exercise

[13]Total bank claims are computed by aggregating the bank-level data. Information on job creation and GDP comes from different administrative records (see Data Appendix A for detailed information on the construction of the variables).

are reported in Table A.3 in Data Appendix A and show that the average trends in credit demand do not significantly differ between branches owned by parent banks with different deposit ratios. This evidence indicates that if credit demand plays a role, it does not work via banks' exposure to deposits targeted by reserve requirements.

Second, credit demand shocks would pose a problem if they are positively correlated with the credit supply effect that we attempt to identify. In this case, any estimated coefficients would be potentially upward biased, inflating our results (see a similar discussion in Khwaja and Mian, 2008). To shield against this concern, out setting exploits the fact that reserve requirements operate in a counter-cyclical fashion, meaning that we expect a negative effect on credit supply in a period when total credit supply and demand go up (or vice versa). This feature of reserve requirements reduces concerns that significant effects on credit growth only reflect unobserved credit demand, as credit demand moves in the opposite direction and works against the effect we aim at identifying. In other words, the credit demand bias would in our setting reduce the size and statistical significance of the estimated effect of reserve requirements.

These considerations reduce concerns that results will merely reflect unobserved credit demand shocks. In the empirical estimation, we go one step further to separate credit supply and demand. Making use of the matched parent banks-branches data, we estimate credit growth by simultaneously controlling for time-varying municipality fixed effects in a within-region panel regression (see Section 4.2). This identification approach is similar to studies by Carlson et al. (2013) and Dursun-de Neef (2018) for the US with branches operating in metropolitan statistical areas (MSAs). It allows comparing the reaction of two or more branches that operate in the same municipality such that local demand effects are controlled for. Furthermore, it rules out that our estimation of credit supply reflects economy-wide fluctuations or regional time-invariant characteristics. In Section 4.3, we explore the validity of the assumptions behind this approach and re-conduct the analysis with alternative controls for credit demand.

4.2. Reserve requirements and credit supply

We begin by analyzing the effect of reserve requirements on branch-level credit supply. For this purpose, we compute quarterly changes in outstanding credit as follows:

$$\text{Credit Growth}_{b,m,t} = \frac{\text{credit}_{b,m,t} - \text{credit}_{b,m,t-1}}{\text{credit}_{b,m,t-1}} \tag{1}$$

Credit $\text{Growth}_{b,m,t}$ is defined as the quarterly growth rate of outstanding credit of branch b in municipality m and quarter t.[14] The effect of macroprudential regulation on quarterly credit growth has also been analyzed by Buch and Goldberg (2017) and Ohls et al. (2017). This allows exploiting the high reporting frequency of the data while taking into account that balance sheet items may not change instantaneously.

The baseline regression equation is then specified as follows:

$$\begin{aligned}\text{Credit Growth}_{b,m,t} = {} & \beta_1 \left(\text{dep.ratio}_{p,t-1}\right) + \beta_2 \left(\text{dep.ratio}_{p,t-1} \times \text{RR}_{t-1}\right) \\ & + \gamma_1 X_{b,m,t-1} + \mu_{b,m} + \nu_{t,m} + \varepsilon_{b,m,t}\end{aligned} \tag{2}$$

where $\text{dep.ratio}_{p,t-1}$ is the one quarter lagged ratio of demand deposits to total assets of parent bank p that owns branch b, which measures the relative exposure to the precise item in the balance sheet targeted by reserve requirements. This variable is additionally interacted with the level of reserve requirements RR_{t-1} of the previous quarter. Time-varying branch and parent bank characteristics are controlled for by $X_{b,m,t-1}$. We lag all explanatory variables by one quarter to reduce simultaneity concerns (in Section 4.3 we allow for alternative lag structures.).

Structural and time-invariant differences in branches and parent banks' balance-sheet characteristics are captured by branch-level fixed effects ($\mu_{b,m}$). As previously discussed, we introduce quarter-municipality fixed effects ($\nu_{t,m}$) to control for credit demand in a municipality. Quarter fixed effects, that is, a proxy for macroeconomic

[14] Outstanding credit corresponds to total credit operations subtracting agricultural credit. The reason is that the central bank specifies separate rules for the intermediation of demand deposits into agricultural credit.

developments affecting all banks in Brazil, are implicitly captured by $\nu_{t,m}$. Standard errors are clustered by parent bank and quarter, which reduces concerns about serial correlation within a banking group and over time. To facilitate the interpretation of the coefficient of the interaction term, we standardize the bank-level control variables.[15]

The main underlying assumption behind the fixed effects approach to control for credit demand is that local economic conditions in a small geographic area like the municipalities in our sample affect homogeneously the different branches operating in that region. However, since credit demand remains unobserved, a natural concern would be that branches operate, for example, in different credit market segments so that $\nu_{t,m}$ does not fully absorb a demand-bias. To account for this concern, we implement several empirical tests that are discussed in Section 4.3. For example, we compute a branch-level credit demand proxy following Aiyar (2012) that accounts for branches' individual exposure to specific segments of the credit market in each municipality. We also run Eq. 2 for a sub-sample of banks that we expect to face similar demand. Moreover, and as discussed in Section 4.1, we preliminary test in Table A.3 whether municipality-level demand trends differ for branches of parent banks with a differential exposure to demand deposits.

Because of the fixed-effects structure introduced in the model, the direct effect of reserve requirements is not measurable as such. The reason is that the reserve ratio is equal to all banks and therefore captured by quarter-municipality fixed effects ($\nu_{t,m}$) together with any other macroeconomic factors. The effect of reserve requirements on credit supply is therefore identified by the coefficient of the interaction term ($\text{dep.ratio}_{p,t-1} \times \text{RR}_{t-1}$). A negative and statistically significant coefficient β_2 would reveal that, if reserve requirements tighten, branches' credit supply declines by more given the parent bank is funded to a relatively larger extent by demand deposits and thus more affected by the reserve policy. To better assess the functional form of the

[15] Coefficients of standardized variables represent the marginal effect of a one standard deviation increase from the mean in the predictor.

coefficient of the interaction term, we report estimates without quarter-municipality fixed effects so that the baseline coefficient of RR_{t-1} becomes visible.

As concerns the variables included in $X_{b,m,t-1}$, we control for the parent banks' capital and funding structure. This is important given that the exposure to reserve requirements depends on the structure of the liability side of parent banks' balance sheet. The relevance of banks' capital ratio is highlighted by papers studying the transmission of monetary policy. For example, Kishan and Opiela (2000) find that lending by well-capitalized banks is less sensitive to changes in monetary policy, an argument that may also apply to reserve requirements. Thus, we include the capital ratio capturing parent banks' ability to offset the effect of reserve requirements by tapping non-deposit funding. It should be noted that in our sample, only parent banks hold capital in their balance sheet, whereas branches are funded by a combination of deposit and interbank liabilities. Further controls include parent banks' size (log of total assets), the liquid assets ratio and a proxy for cost efficiency (administrative costs / total costs). Also, we control for the size of branches as well as branches' liquidity ratio and demand deposit ratio. Branches' return on assets (RoA) proxies for the profitability of the asset portfolio, considering that more profitable branches may also have more market power and lending capacities.

Our baseline results are reported in Table 3. In Column (1), we only include reserve requirements as the explanatory variable. This regression, included for completeness, shows a negative association between reserve requirements and branch-level credit growth, which is in line with theoretical considerations. In Column (2), we add the interaction with the parent bank's demand deposit ratio. The coefficient of the interaction term ($\text{dep.ratio}_{p,t-1} \times \text{RR}_{t-1}$) directly addresses our research question by shedding light on whether heterogeneous effects of reserve requirements exist alongside the distribution of parent banks' demand deposit ratio. The regression in Column (3) includes branch and quarter fixed effects. Due to the latter, the reserve requirements rate can no longer be included in the model. To rule out the possibility that parent bank or branch characteristics drive the results, in Columns (4) and (5), controls are added. In Column (6), we estimate our preferred model as described in Eq. 2, which includes quarter-municipality fixed effects to control for local demand conditions.

[Table 3 about here.]

We find the coefficient of the interaction term to be negative and statistically significant. Thus, branches from parent banks with a higher reliance on demand deposits are significantly more responsive to reserve requirements: the negative sign of the interaction coefficient implies that compared to branches owned by parent banks with a lower demand deposit ratio, these branches are more likely to adjust credit supply downwards given a tighter reserve policy.[16] While this result is obtained when considering the entire regulatory cycle, in Section 4.4, we assess whether results differ when looking at periods of increases or decreases in reserve requirements. Furthermore, we test in Section 4.5 whether effects are also present at the municipality level and do not cancel out due to borrowers substituting credit from more to less affected branches.

Graphically, our main finding is depicted in Figure 5, which shows the marginal effect of a unit change in the level of reserve requirements on branches' credit growth depending on parent banks' demand deposit ratio. The increase in the absolute value of the marginal effect confirms our hypothesis that the parent bank's exposure to macroprudential regulation is significant for the transmission of macroprudential policies to regional branches' credit growth.[17]

[Figure 5 about here.]

[16]The effect is also of economic significance: Comparing two branches that differ by one standard deviation in their parent banks' deposit ratio, an average increase in reserve requirements by 8 percentage points implies that the sensitivity of those branches to adjust credit growth differs by $-0.192 * 0.08 = -0.015$ (or -1.5 percentage points). This differential effect corresponds to 50 percent of the average credit growth rate and 8.67 percent of the standard deviation of the credit growth rate.

[17]For example, in the case of a parent bank with approximately 6 percent demand deposit funding, an increase of reserve requirements by one percentage point reduces the credit growth rate at the branch level by more than 0.293 percentage points. For the average increase of reserve requirements by 8 percentage points, this translates into a decline of the credit growth rate by more than 2.34 percentage points.

Finally, in Column (7), we test the alternative hypothesis of branch-level demand deposit ratios driving the results. Testing for this alternative explanation is important because we have argued that intra-group dynamics between a parent bank and its network of regional branches transmit macroprudential policies. This would not be the case if the individual branch exposure to demand deposit funding were to drive the results. Indeed, this would reflect that local conditions in branches' deposit base channel the effects of reserve requirements to branches' credit supply. Alternatively, it may capture the fact that parent banks allocate the burden of reserve requirements to branches, depending on their share of demand deposit funding.

Therefore, we perform a regression in which reserve requirements are interacted with the demand deposit ratio at the branch level. If the effects of reserve requirements are transmitted within a banking group depending on the aggregate exposure of the parent bank and independent of the funding structure of single branches, we should expect the coefficient on this interaction term to be not statistically significant. The results reported in Column (7) show that this is indeed the case. Consequently, the result is similar to findings on the internal capital market, for example, Houston and James (1998) find that lending of banks affiliated with a larger group is less responsive to the bank's own balance sheet compared to standalone banks. Instead, it is the group's positions that matter (Dahl et al., 2002; Houston et al., 1997).[18]

In sum, these results support the conclusion that macroprudential policies targeting parent banks can translate into adjustments in credit supply by bank branches. Provided parent banks report a relatively large exposure to demand deposits funding and thus to reserve requirements, regulatory decisions are transmitted to branches' credit supply. To the best of our knowledge, this is the first evidence on how dynamics in a banking group affect the transmission of macroprudential policies.[19]

[18]The results of Table 3 remain robust when excluding the capital regions Sao Paulo and Rio de Janeiro where most of the parent banks are located.

[19]With respect to the transmission of monetary policy or dynamics within multinational banks, the importance of internal capital markets has been shown by e.g. Campello (2002), De Haas and van Lelyveld (2010), and Cetorelli and Goldberg (2012b).

At least three implications can be derived from our analysis. First, we find that reserve requirements can be a successful tool in influencing credit growth. Hence, when applied in a counter-cyclical way, this policy tool can be useful in steering the occurrence of credit cycles in emerging countries caused by capital waves attributable to globally changing conditions. Second, our results show that funding structure, and thus banks' differential exposure to the policy, is significant for the transmission of macroprudential policies. This implies that countries may benefit from a more general framework of macroprudential policies in which different tools are used to influence the behavior of different banks. Finally, the finding suggests that to assess macroprudential policies it is not sufficient to look at the behavior of parent banks as standalone entities; instead responses within the whole banking group must be considered to trace out aggregate effects.

4.3. Robustness tests

In this section, we explore the sensitivity of our baseline findings along three dimensions, which include possible estimation biases arising (i) from credit demand shocks, (ii) from banks delaying or anticipating the response to reserve requirements, and (iii) from banks' exposure to other macroeconomic shocks.

Credit demand shocks. We first examine whether our baseline results are biased by not properly accounting for the role of credit demand in branches' adjustment to reserve requirements. Our approach of saturating Eq. 2 with quarter-municipality fixed effects to control for demand shocks assumes that credit demand is homogeneously distributed across branches within a municipality. This assumption can be challenged if, for example, certain branches focus on specific credit segments, such as commercial or mortgage loans, which experience specific credit demand dynamics. It becomes a concern in our setting if a systematic correlation between parent banks' deposit ratio and credit demand exists. Moreover, demand shocks would need to be positively correlated with the identified effect to inflate our results. However, since reserve requirements are implemented in a counter-cyclical fashion, (pro-cyclical) credit demand shocks would lead to an upward bias in the coefficient β_2 (i.e. they would make β_2 “less negative”), making our results a rather conservative estimation of the true effect of the policy.

Even though these latter considerations make it less likely that Eq. 2 suffers from a credit demand bias, we implement several tests that shed light on the validity of the underlying assumptions. First, we compare our benchmark estimation with a regression that replaces the fixed effects structure by branch, municipality and quarter fixed effects. This result is reported in Column (2) in Panel A of Table 4 and it allows us to compare our coefficient of interest (replicated in Column (1)) once we exclude the credit demand control via quarter-municipality fixed effects. The estimated coefficient differs only marginally and a test of normalized differences (Imbens and Wooldridge, 2009) confirms that it is not statistically significantly different from our benchmark result. Hence, the credit demand bias if proxied by the difference between these coefficients seems not to be a reason of major concern.

[Table 4 about here.]

Next, we compute a branch-level credit demand control following Aiyar (2012), where market shares in specific credit market segments are used to pin-down banks' exposure to segment-specific credit demand shocks. For each branch (b, m), we compute the growth rate of credit demand in municipality m as $\Delta\text{Demand} = \sum_{j \varepsilon J} s_{b,m,j} \Delta TBC_j$, where ΔTBC is the quarterly growth rate in total bank credit in segment j by all branches but (b, m) at time t. The sectoral growth rates are weighted by the share of sector j in the credit portfolio of branch (b, m) which is expressed as $s_{b,m,j}$. The sectors j encompass commercial, consumer, and mortgage loans. Controlling for this credit-portfolio-weighted aggregate growth rate in credit in Columns (3) and (4) leaves our results robust. Finally, we perform a test by estimating the model within the sample of state-owned banks to look at a group of banks that share a similar type of borrowers. Column (5) shows that our main result holds also when looking at an estimation within a relatively homogeneous group of banks.

Response over time. Our benchmark results could also be affected by banks delaying their response to reserve requirements over time or by anticipation effects. To account for longer-term adjustments to reserve requirements, we include not only the first lag of the interaction term but the first to fourth lag of reserve requirements interacted with the pre-determined deposit ratio in $t-5$ and report the sum and joint significance of $\sum_{k=1}^{4} \text{dep.ratio}_{p,t-5} \times \text{RR}_{t-k}$ (see also Kashyap and Stein (2000) or Aiyar et al. (2014)). This time structure also recognizes that credit supply adjustments may take place with a certain delay. The results from these regressions are reported in Columns (2) and (3) in Panel B of Table 4 and show that the cumulative effect does not differ much from the baseline results such that adjustments seem to take place rather quickly.[20] In case banks anticipate changes in reserve requirements and react ex ante, we would underestimate the full response. To account for this, we run regressions in which we replace either the reserve requirements variable or the complete interaction term by the respective value in $t+1$. The results in Columns (4) and (5) show that β_2 losses its explanatory power such that anticipation effects seem to be of minor concern.

Confounding events. A further concern relates to a potential correlation between adjustments in reserve requirements and other macroeconomic events if they are time-clustered with changes in the reserve policy and also impact on credit supply in a counter-cyclical fashion. The problem would be strengthened if banks' exposure to those alternative shocks is systematically correlated with the deposit ratio, which measures the exposure to reserve requirements. An example of the above could be monetary policy. If the monetary policy rate increases, banks whose balance sheets are more directly exposed to monetary policy might decrease lending. If this monetary policy shock is time-clustered with increases in reserve requirements and banks more exposed to monetary policy are also the ones with a high deposit ratio, then our results could be capturing a monetary policy shock.

[20] The estimated cumulative coefficient is not statistically significantly different from the benchmark estimate.

To rule out the possibility that our results are driven by monetary policy, we extend the model to perform a "horse race" between our baseline interaction term $\left(\text{dep.ratio}_{p,t-1} \times \text{RR}_{t-1}\right)$ and the interaction between the deposit ratio and proxies for the stance of monetary policy. We obtained data on the monetary base (M0), which proxies for the change in the aggregate amount of circulating currency in the economy, and the SELIC rate, which is the overnight interest rate set by the Central Bank of Brazil for monetary policy purposes. The results in Column (2) of Table 5 show that the explanatory power of our coefficient of interest remains statistically significant, while the coefficient of the interaction term with the monetary policy control M0 is not significant. In Column (3), we use instead the quarterly change in the policy rate with our finding remaining again robust. Hence, controlling for changes in monetary policy, reserve requirements are still transmitted from parent banks' balance sheets to branches' credit supply. To test for interaction effects between macroprudential and monetary policy, in Columns (4) and (5), we study whether our results change when including a triple interaction between our interaction term of interest and one of the monetary policy measures. The triple interaction term shows an insignificant coefficient suggesting that the effectiveness of macroprudential policy does not depend on the stance of monetary policy.

[Table 5 about here.]

We implement a series of further robustness tests to ensure that our benchmark estimates are not capturing the occurrence of other macro shocks that could affect bank behavior. We include interaction terms between banks' deposit ratio and variables capturing other macroeconomic shocks such as the Reais/ US dollars exchange rate, the sovereign yield, the sovereign spread vis-à-vis the US treasury bonds, and foreign funding to rule out that the interaction term of reserve requirements and the demand deposit ratio only captures the exposure of banks with a higher demand deposit ratio to foreign funding shocks such as reversals in capital flows.[21] While the exchange rate can affect capital inflows as well as Brazil's competitiveness, a higher sovereign yield and sovereign spread reveal potential distress within the government sector with potential implications for bank stability (see Aiyar et al., 2014; Gennaiolo et al., 2014). The results reported in Columns (2) to (5) in Panel A of Table 6 show that our benchmark estimates remain unaltered by the inclusion of these interaction terms.

[Table 6 about here.]

Also political uncertainty and changes in policies that target capital flows may act as confounders. We thus add an interaction term between banks' deposit ratio and the quarterly political uncertainty index by Baker et al. (2016), finding that our results remain in place (Column (2) in Panel B). In Columns (3) and (4), we add an interaction between the deposit ratio and an indicator variable being one in periods in which other macroprudential interventions were implemented in Brazil. We thereby consider the introduction of reserve requirements on banks' foreign exchange (FX) positions and the implementation of a tax on banks' foreign borrowing, both in 2011. In Column (5), we finally control for banks' political connections by adding a competing interaction term between reserve requirements and parent banks' share of deposits from the public sector. Across all alternative specifications, the exposure of the parent bank to reserve requirements still matters but there is a weakening effect in case the parent bank holds more public sector deposits (Column (5)).

4.4. The anatomy of reserve requirements' transmission

Having established the robustness of our main result, we extend the analysis to gain a deeper understanding of the underlying mechanisms. Understanding the financial market structures that affect the transmission of macroprudential policies is of utmost importance when it comes to the derivation of policy implications.

[21] We compute the aggregate growth rate in foreign funding by aggregating the bank-level data on banks' interbank borrowing from non-residents.

Asymmetric effects across periods. We first investigate whether our baseline results vary across time. Even though one important contribution of our analysis is that we look at the complete cycle of increases and decreases in reserve requirements, we aim at shedding light on the differential effects of reserve requirements across the cycle. We divide the sample period into three sub-periods and run separate regressions based on our preferred specification. The first period covers 2008Q1 to 2010Q1, including the decrease in reserve requirements aimed at unfreezing liquidity during the global financial crisis (Column (2)). The second period, from 2010Q2 to 2011Q1, captures the tightening of reserve requirements as a reaction to foreign capital inflows in the search for yield after the global financial crisis (Column (3)). The third period (2011Q2 to 2014Q1) relates to the loosening of reserve requirements given a stagnation of capital inflows, in part driven by the end of the commodities super cycle combined with depressed economic growth (Column (4)).

Table 7 reveals that the baseline results (Column (1)) are primarily driven by the periods in which reserve requirements are loosened. The absolute size of the coefficient of the interaction term is largest during the global financial crisis. In contrast, the coefficient of the interaction term becomes statistically insignificant during the period of capital inflows that followed the global financial crisis revealing a limited effectiveness of the policy tool in periods of credit expansion and large capital inflows. This result is in line with findings by Bhaumik et al. (2011) on the asymmetric transmission of monetary policy across the economic cycle. Similar asymmetries seem to prevail for macroprudential policies, a result also found by Jiménez et al. (2017) studying dynamic provisioning and credit supply in Spain and by Barroso et al. (2017) analyzing the functioning of reserve requirements based on Brazilian credit registry data.[22]

[Table 7 about here.]

[22] The result also confirms the findings by Vegh and Vuletin (2014) that Latin American countries have been successful to move from pro-cyclical to counter-cyclical policy responses following crises.

How can we explain the insignificant result for the period characterized by capital inflows and economic boom? Our analysis has consistently shown that the transmission of reserve requirements to credit supply operates via banks' funding structure and in particular via banks' reliance on targeted deposits. This test delves further into this important aspect of macroprudential policies. In periods of capital inflows, banks may have easier access to alternative funding sources that allow them to circumvent tighter reserve requirements. In addition, the result may hide the fact that the increase in reserve requirements has simply been too low compared to the wave of inflowing capital. Alternatively, policy-makers may want to consider the implementation of complementary policy tools. Counter-cyclical capital buffers and regulatory caps on banks' foreign funding can be considered as a potential alternative to enhance policy-makers' ability to steer credit growth in times of boom.

Bank ownership. Previous studies provide evidence that the transmission of monetary policy depends on banks' liquidity and balance-sheet management. To the extent that similar arguments may apply to the transmission of macroprudential policies, our results could also be weakened or strengthened depending on bank traits. For example, we saw in Table 2 that demand deposit ratios differ depending on bank ownership.

We first address the question of whether the effect of reserve requirements conditional on parent banks' funding structure depends on whether branches belong to domestic or foreign parent banks. Previous evidence suggests that differential effects can occur. Jeon and Wu (2014) show at the country level that foreign bank penetration was associated with a weaker transmission of monetary policy during the crisis. Wu et al. (2011) provide bank-level evidence pointing in the same direction. These findings may be well explained by internal capital markets providing alternative funding sources to foreign banks' subsidiaries located in Brazil, which help circumvent local policy shocks (see De Haas and van Lelyveld, 2010). Moreover, global banks' role in transmitting monetary policy actions across countries may lead foreign banks' subsidiaries to be less sensitive to local macroprudential policies (see Rajan, 2014; Rey, 2016). In line with this, Aiyar et al. (2014) find that foreign-owned banks located in the UK are less responsive to local macroprudential policies compared to domestic banks.

In Table 8, Column (2), we show that branches' credit supply sensitivity increases (in absolute terms) when foreign banks are excluded from the sample. This finding suggests that foreign banks may indeed have access to alternative funding and be less affected by reserve policies. This is confirmed in Column (3) showing that the effect of reserve requirements is insignificant in case a branch is owned by a foreign bank.

[Table 8 about here.]

Second, we differentiate between branches of state-owned versus private banks. The theoretical analysis by Andries and Billon (2010) finds that state-owned banks are likely to be less responsive to changes in monetary policy because of their better capacity to obtain additional (government-sponsored) deposit funding than private banks. Empirical evidence also suggests that state-owned banks could react less to changes in monetary policy because of a generally less pro-cyclical credit supply (Ferri et al., 2014) and differences in their corporate governance compared to private banks (Bhaumik et al., 2011). The role of state-owned banks can be especially relevant in our setting considering their large presence in Brazil. In addition, previous findings show that state-owned banks in Brazil are less likely to transmit funding shocks to the regions in which they operate (see Coleman and Feler, 2015).

We conduct the analysis for the sample of state-owned versus private banks and results are reported in Columns (4) and (5). The coefficient of the interaction term is significant and larger in absolute terms for branches of state-owned banks, however, insignificant in case of private ownership revealing that our results are driven by state-owned banks. This contrasts with the aforementioned findings of state-owned banks being less responsive to changes in monetary policy. Following Coleman and Feler (2015) studying government banks' lending behavior in Brazil during the financial crisis, we can also rule out the possibility that the results are driven by branches of state-owned banks being located in regions with, e.g., more favorable economic conditions.

Two arguments may explain that the responsiveness to reserve requirements seems to be driven by branches of state-owned parent banks. First, state-owned banks' larger reliance on demand deposits (see Table 2) implies that reserve requirements are more likely to affect them than other banks. In other words, by restricting the analysis to state-owned banks, we look exclusively at the right-hand side of the deposit ratio distribution from which our baseline results originate. Second, the political economy of credit supply by state-owned banks is likely to play a role. In particular, a political decision that pushes state-owned banks to act counter-cyclically may reinforce the effect of their exposure to demand deposits. This is supported by the fact that, as shown in Table (7), our results are stronger during the global financial crisis. Therefore, a counter-cyclical policy action via state-owned banks may lead these institutions to transmit the effects of reserve requirements to their branches' credit supply more emphatically than other banks. This interpretation would be in line with the finding of Coleman and Feler (2015) that regions in Brazil with a large share of government banks benefited from increased loan supply, weakening the effects of the financial crisis.

One could still argue that the government induces changes in the lending policy of state-owned banks at the same time when reserve requirements are changed. However, it should be noted that when estimating Eq. 2 within the sample of state-owned banks the heterogeneous effect of reserve requirements along the deposit ratio distribution remains in place (see Table 4, Panel A). This approach allows identifying heterogeneous responses to reserve requirements within state-owned banks when controlling for political influence within the municipality. Furthermore, we have tested whether reserve policies matter less for branches with stronger political ties approximated by the parent bank's public sector deposit ratio (Table 6, Panel B), finding that our baseline conclusions remain unaltered.[23]

[23]In Table A.4, we split the sample depending on branches' liquid assets ratio (Columns (1)-(2)) and internal funding ratio (Columns (3)-(4)) as well as parent banks' liquid assets ratio (Columns

Dynamics within state-owned banks during the crisis. Previous tests have shown that the baseline effect is driven by the financial crisis period and the response of branches of state-owned parent banks. Next, we are interested in the intra-group dynamics taking place within a state-owned banking group during crisis times. We first restrict the sample accordingly and Column (1) in Table 9 shows that during crisis times — when reserve requirements are loosened — branches of state-owned banks that are more exposed to the policy are more likely to increase credit supply. Second, we ask which branches are particularly affected by the transmission of reserve requirements within a banking group. For example, following the literature on internal capital markets, one may expect that parent banks loosen liquidity constraints for profitable branches to ensure a positive revenue stream for the whole group (Cetorelli and Goldberg, 2012b).

[Table 9 about here.]

We thus test whether branches sensitivity to the reserve policy depending on the parent's exposure differs by branch profitability (Columns (2) and (3)). To do so, we run the estimations for sub-samples of branches with high versus low profitability whereas the branch indicator that determines the sample split takes a value of one for branches with an average profitability above the sample median and zero otherwise. Again, branches owned by more exposed parents are more sensitive to the reserve policy. However, the effect is much stronger (in absolute terms) for branches with a low profitability.[24] Hence, given a loosening in the reserve policy, less profitable branches show a stronger and significant sensitivity towards increasing credit supply. For the US, Nguyen (2019) shows that closures of bank branches reduce local credit supply, in particular during the recent financial crisis. Our results lead to the conclusion that the loosening of reserve requirements during the financial crisis period has induced

(5)-(6)) and capital ratio (Columns (7)-(8)). The cut point for the sample split is the 75th percentile of the respective variable in 2008Q1. Across all sample splits, a consistent result emerges, namely that reserve requirements transmit through the demand deposit ratio in particular in the presence of liquidity or capital constraints.

[24] The coefficient of the interaction term takes a value of -0.109 for highly profitable compared to a value of -0.252 for weakly profitable branches.

parent banks to allocate freed-up liquidity to less profitable branches such that those branches could maintain credit supply within their municipality, potentially reducing the widening of regional disparities. The finding is in contrast to Cetorelli and Goldberg (2012b) but might be explained by state-ownership of branches.

In Columns (4) and (5), we differentiate by the importance of the branch for the banking group and split the sample across branches with an average asset share in group assets above the group's median and those below the median. Branches' sensitivity is stronger (in absolute terms) in case the sub-sample with relatively less important branches within banking groups are considered. This fits together with the results on profitability and indicates that banking groups exploit the loosening of the reserve policy to stabilize smaller group members during crisis times.

4.5. Effect on total credit

The previous sections contribute to the understanding of how reserve requirements affect credit supply. However, macroprudential policies aim at affecting not only individual banks but rather aggregate credit supply. Therefore the question remains whether the identified effect at the bank level translates into adjustments in the aggregated supply of credit in those municipalities in which branches operate. Given higher reserve requirements, credit constraints and relationship banking may restrict borrowers' capacity to access liquidity in branches whose parent banks are targeted more by the policy. However, if bank borrowers tap liquidity from less exposed branches, regulators' intended effect on aggregate credit supply can be netted out.

To address these concerns and to investigate whether reserve requirements affect aggregate credit supply, we replicate our baseline analysis based on data aggregated at the municipality level. Following Khwaja and Mian (2008), we therefore include all active branches in the 1678 municipalities of the baseline sample and compute credit growth as in Eq.1 but using the total outstanding credit of all branches in each municipality. Control variables are then computed by constructing a weighted average (based on branches' market shares in the municipality) of the bank-level variables.

This procedure allows us to obtain a measure of each municipality's exposure to reserve requirements, which is increasing in the local market share of branches owned by parent banks with a higher reliance on targeted demand deposits.

We exploit this setting to estimate Eq.2 at the municipality level, including quarter and municipality fixed effects. As noted in studies proceeding similarly (Khwaja and Mian, 2008; Jiménez et al., 2017), we cannot longer include combined quarter-municipality fixed effects to rule-out credit demand considerations. However, it should be noted from Columns (1) and (2) in Table 4 that controlling for credit demand only marginally affects our estimated coefficients (point estimates change from -0.195 to -0.192 when quarter-municipality fixed effects are included). Hence, although the results at the municipality level should be interpreted with caution, Table 4 suggests that a credit demand bias should not be a large concern.

Results in Table 10 show that also at the aggregate level, we can confirm a significant sensitivity of credit growth to reserve requirements conditional on the weighted average of the demand deposit ratio. This result holds when including quarter or quarter and municipality fixed effects. To test the robustness of the results, we compute the municipality market shares using branches' total assets (Columns (1) and (2)) or total outstanding credit (Columns (3) and (4)), obtaining similar results. Our findings in Table 10 confirm that the sensitivity to the lending channel of reserve requirements is not netted out by borrowers' substituting credit between banks.

[Table 10 about here.]

5. Conclusion

Reversals in global capital flows can threaten the stability of emerging countries. Macroprudential policies applied in a counter-cyclical manner can be a useful tool for protecting the domestic economy against global cycles. This paper documents how intra-group dynamics between a parent bank and its network of regional branches, combined with parent banks' funding structure, explain the transmission of macroprudential policies to credit supply. Using parent bank and branch-level data for the Brazilian banking system and the period from 2008 to 2014, we show that reserve requirements for demand deposits imposed on parent banks are transmitted to credit-supply responses by individual bank branches.

We rely on an identification strategy that is based on three main building blocks and carefully addresses numerous estimation concerns. First, policy changes in reserve requirements are triggered by external conditions in global capital markets and the policy targets the parent bank, while the analysis is performed at the branch level. Second, we exploit the fact that banks are differently exposed to reserve requirements depending on their reliance on demand deposits. This may lead to heterogeneous responses related to credit supply. Third, by observing multiple branches operating in Brazilian municipalities over time, we can control for quarter-municipality fixed effects to interpret our results as supply-driven.

By following this conservative estimation approach, we find that the effect of reserve requirements applied at the parent bank level is transmitted to branches' credit supply. However, the sensitivity of credit supply to reserve requirements is higher for branches whose parent banks are more exposed to targeted deposits. The result remains robust when controlling for simultaneous changes in monetary policy and a large range of potentially confounding factors. Extending the analysis, we can show that the result is driven by periods in which reserve requirements have been loosened and by branches of state-owned parent banks. For the latter sample of banks, we find evidence that during loosening period, reserve requirements help maintain credit supply by smaller branches with low profitability.

Our findings contribute to the literature by providing evidence that parent banks' exposure to macroprudential policies results in differential responses within a banking group. Two central policy implications of our analysis can be drawn. First, the aggregate outcome of reserve requirements is driven by the heterogeneity of banks' responses to macroprudential policies and dynamics within a banking group. Second, our results show that macroprudential regulation can be an effective tool for emerging economies to mitigate the negative effects of exogenously driven periods of capital outflows on credit growth. While the loosening of the policy can help maintaining credit supply by weaker branches of parent banks during crisis periods, analyzing the consequences for allocative efficiency is an interesting avenue for future research.

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Figures and Tables

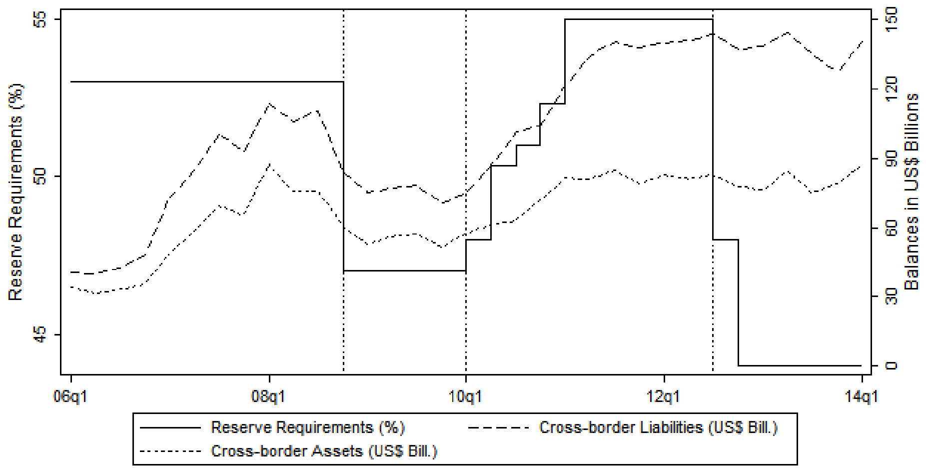

Figure 1: Reserve Requirements and Cross-Border Banking Claims. This graph describes the pattern of the reserve requirements for demand deposits (in %, solid line - left axis) as provided by the Central Bank of Brazil. The dashed (dotted) line describes the evolution of quarterly cross-border liabilities (assets) of the Brazilian banking system (in billions of USD), as obtained from the Locational Banking Statistics of the Bank for International Settlements.

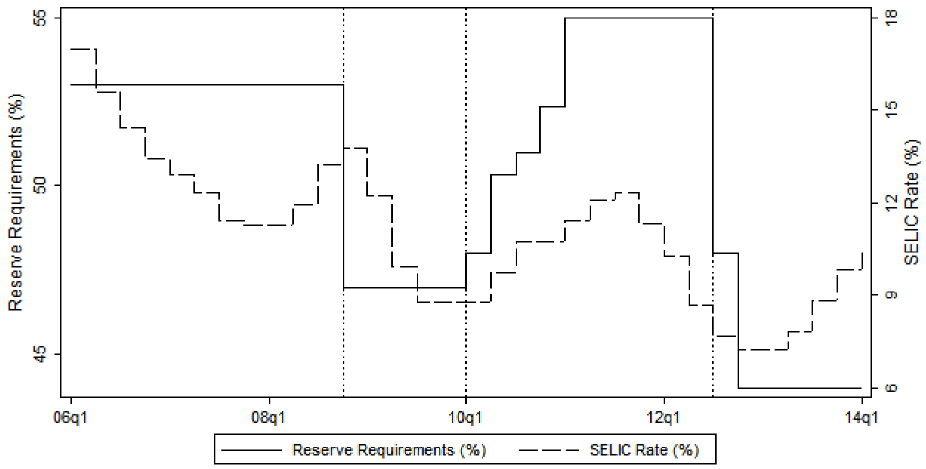

Figure 2: Reserve Requirements and Monetary Policy Rate: This graph describes the pattern of the reserve requirements for demand deposits (in %, solid line - left axis). The dashed line (right axis) describes the evolution of the SELIC rate (in %), which is the policy interest rate set by the Central Bank of Brazil. Data are obtained from the Central Bank of Brazil.

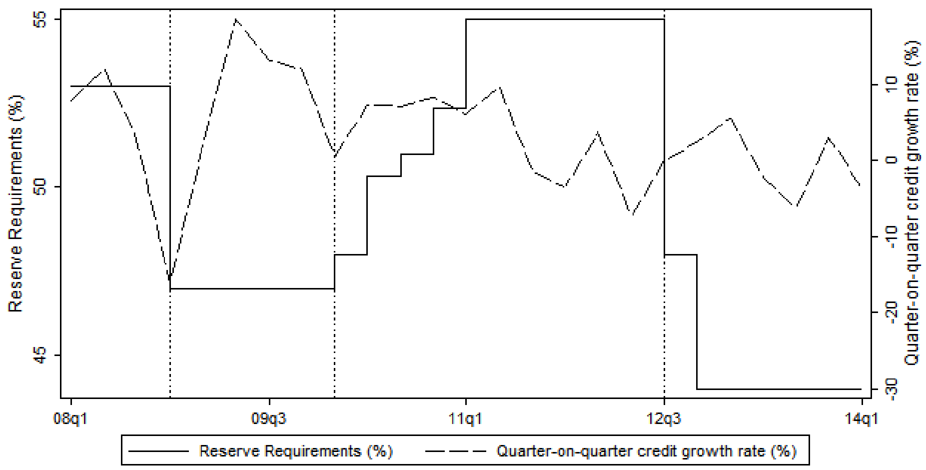

Figure 3: Reserve Requirements and Average Credit Supply (Quarterly Change). This graph shows the evolution of the quarterly growth rate of outstanding credit (in %, dashed line - right axis) averaged over all branches during the sample period together with the time series of the reserve requirements for demand deposits (in %, solid line - left axis).

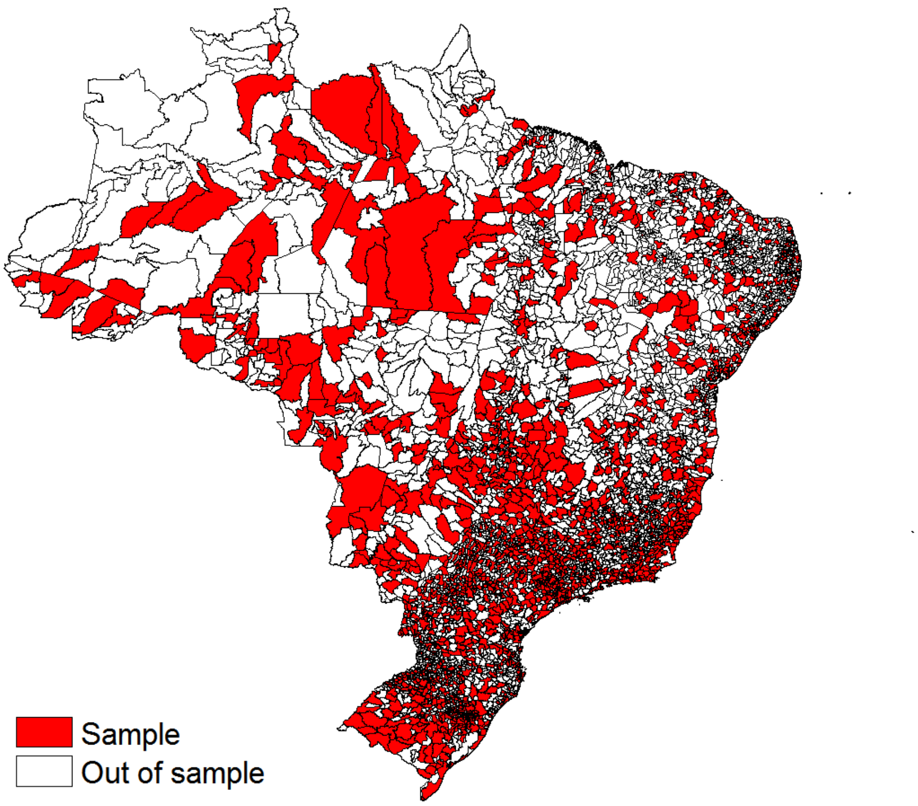

Figure 4: Municipality Coverage. This graph shows (in red) the municipalities in which at least two parent banks operate branches over the full sample period and that are therefore included in the sample.

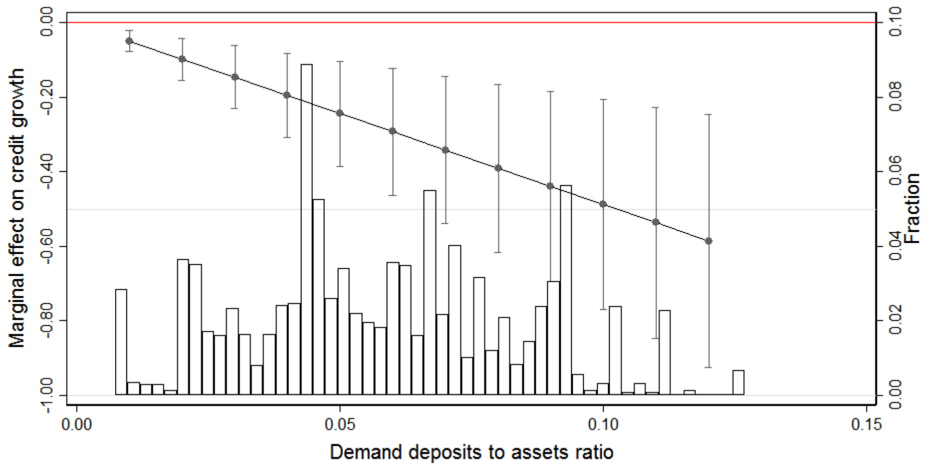

Figure 5: Marginal Effect of Reserve Requirements on Credit Supply. This graph shows the marginal effect of a unit change in the level of reserve requirements on branches' credit growth conditional on parent banks' demand deposit ratio surrounded by 95 percent confidence bands (solid line, left axis). On the right axis, the distribution of parent banks' demand deposit to assets ratio is depicted.

	Mean	Median	SD	Min	Max
Branch-level					
ΔCredit	0.030	0.022	0.130	-0.274	0.523
Log(Assets)	3.166	3.000	1.312	0.518	7.551
Liquidity ratio	0.015	0.009	0.015	0.000	0.084
Deposit ratio	0.137	0.120	0.086	0.006	0.440
RoA	0.009	0.008	0.007	-0.005	0.033
ΔDemand	0.027	0.021	0.077	-0.771	0.221
Parent-level					
Deposit ratio	0.035	0.017	0.046	0.000	0.236
Log(Assets)	7.798	7.712	2.290	3.641	12.919
Liquidity ratio	0.004	0.000	0.006	0.000	0.030
Capital ratio	0.156	0.136	0.096	0.023	0.499
Adm. cost / total cost	0.004	0.003	0.005	0.000	0.036
Public sector deposit ratio	0.003	0.000	0.016	0.000	0.192
Country-level					
Reserve requirements	0.497	0.492	0.042	0.440	0.550
Δ SELIC rate	-0.001	0.000	0.010	-0.023	0.013
Δ M0	0.022	0.017	0.040	-0.037	0.117
Exchange rate	1.896	1.801	0.226	1.594	2.316
Sovereign yield	0.120	0.123	0.014	0.093	0.156
Sovereign spread	2.338	2.206	0.680	1.638	4.243
Δ Foreign funding	0.014	-0.002	0.083	-0.170	0.204
Political uncertainty	131.261	133.567	45.553	62.962	275.073
Municipality-level					
Δ Agg. claims	0.024	0.029	0.090	-0.386	0.321
Δ Job creation	0.011	0.005	0.339	-1.394	1.557
Δ GDP	-0.067	0.006	0.248	-1.000	0.977
Observations	145,944				

Table 1: Summary Statistics. This table shows summary statistics of the variables used in the analysis. The variables are listed according to their entity level of observation. The table distinguishes between variables at the branch, parent bank, country and municipality level. The sample is based on quarterly data from 2008Q1 to 2014Q1. A detailed description of the variables can be found in the Data Appendix A.

Parent banks sub-samples	**mean**	**median**	**sd**	**min**	**max**
Foreign	0.022	0.013	0.028	0.000	0.126
Domestic	0.039	0.019	0.050	0.000	0.236
State-owned	0.095	0.086	0.061	0.005	0.236
Private	0.023	0.013	0.030	0.000	0.229
High liquid assets	0.129	0.097	0.069	0.041	0.236
Low liquid assets	0.028	0.015	0.034	0.000	0.229
High capital ratio	0.025	0.014	0.032	0.000	0.229
Low capital ratio	0.057	0.039	0.060	0.000	0.236
Total	0.035	0.017	0.046	0.000	0.236

Table 2: Deposit Ratio of Parent Banks for Sub-Samples. This table lists descriptive statistics for the ratio of parents' demand deposits to total assets. The descriptive statistics are presented by groups of parent banks divided into foreign and domestic as well as state-owned and private parent banks. The table also reports summary statistics for this variable for parent banks with a high or low liquidity ratio as well as a high or low capital ratio. In case of liquidity and capital, the sample is split for the respective variable by the 75th percentile of the parent banks' sample distribution in 2008Q1.

	Reserve requirements (1)	Dep. ratio interaction (2)	Branch and quarter FE (3)	Parent controls (4)	Branch controls (5)	Quarter X Mun. FE (6)	Branch dep. ratio (7)
Reserve requirements	-0.220***	-0.126***					
	(0.008)	(0.011)					
Deposit ratio		0.098***	0.052	0.094***	0.097***	0.099**	-0.014
		(0.007)	(0.036)	(0.006)	(0.006)	(0.039)	(0.130)
Deposit ratio X Reserve requirements		-0.181***	-0.114*	-0.180***	-0.195***	-0.192***	0.162
		(0.014)	(0.068)	(0.011)	(0.011)	(0.070)	(0.256)
Parent controls							
Log(Assets)				0.061***	0.125***	0.133***	0.112***
				(0.008)	(0.009)	(0.047)	(0.041)
Liquidity ratio				0.027***	0.025***	0.026***	0.026***
				(0.002)	(0.002)	(0.008)	(0.008)
Capital ratio				0.101***	0.101***	0.101***	0.098***
				(0.004)	(0.004)	(0.030)	(0.030)
Adm. costs / total costs				-0.033***	-0.028***	-0.030	-0.024
				(0.005)	(0.005)	(0.022)	(0.023)
Branch controls							
Log(Assets)					-0.058***	-0.061***	-0.060***
					(0.003)	(0.012)	(0.012)
Liquidity ratio					0.842***	0.877***	0.867***
					(0.053)	(0.082)	(0.082)
Deposit ratio					0.052***	0.066***	
					(0.007)	(0.019)	
RoA					-32.286***	-27.208**	-27.402**
					(12.379)	(13.688)	(13.597)
Branch FE	No	No	Yes	Yes	Yes	Yes	Yes
Quarter FE	No	No	Yes	Yes	Yes	Yes	Yes
Quarter X Mun. FE	No	No	No	No	No	Yes	Yes
Obs	145,944	145,944	145,944	145,944	145,944	145,944	145,944
R2	0.005	0.007	0.369	0.375	0.383	0.542	0.542

Table 3: Baseline Results. This table lists the regression results from estimating Eq.2. Column (1) presents the result when including only reserve requirements. The second column includes the interaction term of reserve requirements and the demand deposit ratio. Starting from Column (3), the model is estimated with branch and quarter fixed effects. Column (4) adds parent controls and Column (5) adds branch controls. Quarter-municipality fixed effects are included in Column (6). Column (7) replaces parent banks' demand deposit ratio with the demand deposit ratio at the branch level. The dependent variable is the quarter-to-quarter growth rate of outstanding credit. The sample period spans 2008Q1-2014Q1. *Deposit ratio* abbreviates the demand deposit ratio of parent banks. *Reserve requirements* corresponds to the reserve requirements rate on demand deposits. For more information on the data definition, see the data description. Explanatory variables at the branch and parent level are standardized. All explanatory variables enter the model lagged by one quarter. Standard errors are clustered by parent bank and quarter. *** indicates significance at the 1% level; ** at the 5%; * at the 10%.

Panel A: Credit demand

	Baseline		Demand control		Within
	full FE	partial FE	partial FE	full FE	state banks
	(1)	(2)	(3)	(4)	(5)
Deposit ratio	0.099**	0.097***	0.097***	0.097***	0.148***
	(0.039)	(0.035)	(0.035)	(0.037)	(0.055)
Deposit ratio X	-0.192***	-0.195***	-0.196***	-0.178***	-0.243**
Reserve requirements	(0.070)	(0.061)	(0.062)	(0.069)	(0.098)
ΔDemand			0.020***	-0.331***	
			(0.007)	(0.042)	
Branch FE	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes
Mun. FE	Yes	Yes	Yes	Yes	Yes
Quarter X Mun. FE	Yes	No	No	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes
Obs	145,944	145,944	145,944	145,944	65,760
R2	0.542	0.383	0.383	0.605	0.652

Panel B: Cumulative/ anticipated effect

		Cumulative effect		Lead of reserve policy	
	Baseline	partial FE	full FE	RR_{t+1}	Int_{t+1}
	(1)	(2)	(3)	(4)	(5)
Deposit ratio	0.099**	0.112**	0.116**	0.093	0.067
	(0.039)	(0.046)	(0.055)	(0.066)	(0.065)
Deposit ratio X	-0.192***	-0.185**	-0.190**	-0.191	-0.173
Reserve requirements	(0.070)	(0.084)	(0.100)	(0.128)	(0.127)
Branch FE	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes
Mun. FE	Yes	Yes	Yes	Yes	Yes
Quarter X Mun. FE	Yes	No	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes
Obs	145,944	145,944	145,944	139,863	139,863
R2	0.542	0.384	0.544	0.541	0.541

Table 4: Robustness – Credit Demand & Response over Time. Panel A shows robustness tests using alternative controls for credit demand. The baseline model is shown in Column (1). Column (2) re-estimates the baseline model without quarter-municipality fixed effects. In Columns (3) and (4), a demand control similar to Aiyar (2012) is included. Column (5) estimates the baseline model only within branches of state-owned banks. Panel B shows robustness tests controlling for responses over time. In Columns (2) and (3), the cumulative effect of $\sum_{k=1}^{4} \text{dep.ratio}_{p,t-5} \times \text{RR}_{t-k}$ is reported including different fixed effects. In Column (4), the reserve requirements (RR_{t+1}) are included with a lead. In Column (5), the whole interaction term with the deposit ratio (Int_{t+1}) is included with a lead. The dependent variable is the quarter-to-quarter growth rate of outstanding credit. The sample period spans 2008Q1-2014Q1. *Deposit ratio* abbreviates the demand deposit ratio of parent banks. *Reserve requirements* corresponds to the reserve requirements rate on demand deposits. For more information on the data definition, see the data description. Explanatory variables at the branch and parent level are standardized. All explanatory variables enter the model lagged by one quarter if not indicated otherwise. Standard errors are clustered by parent bank and quarter. *** indicates significance at the 1% level; ** at the 5%; * at the 10%.

Type of model:		Horse race:		Triple interaction:	
	Baseline	M0	SELIC	M0	SELIC
	(1)	(2)	(3)	(4)	(5)
Deposit ratio	0.099**	0.098***	0.097***	0.077**	0.097***
	(0.039)	(0.038)	(0.038)	(0.037)	(0.037)
Deposit ratio X Reserve requirements	-0.192***	-0.194***	-0.185***	-0.151**	-0.185***
	(0.070)	(0.070)	(0.067)	(0.070)	(0.067)
Deposit ratio X Monetary policy		0.107	-0.563*	1.743	0.235
		(0.126)	(0.341)	(1.325)	(4.116)
Dep. ratio X RR X MP				-3.300	-1.613
				(2.564)	(8.163)
Branch FE	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes
Quarter X Mun. FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes
Obs	145,944	145,944	145,944	145,944	145,944
R2	0.542	0.543	0.543	0.543	0.543

Table 5: Robustness – Monetary Policy. This table shows robustness tests controlling for monetary policy by running a horse race with M0 and the SELIC rate (Columns (2)-(3)) and by including triple interactions with these monetary policy controls (Columns (4)-(5)). The dependent variable is the quarter-to-quarter growth rate of outstanding credit. The sample period spans 2008Q1-2014Q1. *Deposit ratio* abbreviates the demand deposit ratio of parent banks. *Reserve requirements* corresponds to the reserve requirements rate on demand deposits. For more information on the data definition, see the data description. Explanatory variables at the branch and parent level are standardized. All explanatory variables enter the model lagged by one quarter. Standard errors are clustered by parent bank and quarter. *** indicates significance at the 1% level; ** at the 5%; * at the 10%.

Panel A: Macro confounders

	Baseline (1)	Ex. rate (2)	Sov. yield (3)	Sov. spread (4)	Foreign funding (5)
Deposit ratio	0.099**	0.103***	0.127***	0.119**	0.094**
	(0.039)	(0.038)	(0.046)	(0.046)	(0.037)
Deposit ratio X Reserve requirements	-0.192***	-0.200***	-0.174**	-0.210***	-0.182***
	(0.070)	(0.069)	(0.078)	(0.069)	(0.065)
Deposit ratio X Macro confounder		0.018	-0.275	-0.004	-0.024
		(0.027)	(0.325)	(0.006)	(0.046)
Branch FE	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes
Quarter X Mun. FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes
Obs	145,944	145,944	145,944	145,944	145,944
R2	0.542	0.543	0.543	0.543	0.543

Panel B: Political confounders

	Baseline (1)	Political uncertainty (2)	RR on foreign fund. (3)	Tax on foreign fun. (4)	Public dep. ratio (5)
Deposit ratio	0.099**	0.099**	0.099**	0.099**	0.096**
	(0.039)	(0.039)	(0.042)	(0.039)	(0.044)
Deposit ratio X Reserve requirements	-0.192***	-0.193***	-0.193**	-0.192***	-0.183**
	(0.070)	(0.070)	(0.077)	(0.070)	(0.083)
Deposit ratio X Political confounder		-0.000	0.000	-0.000	
		(0.000)	(0.005)	(0.004)	
Public dep. ratio X Reserve requirements					-0.013
					(0.060)
Branch FE	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes
Quarter X Mun. FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes
Obs	145,944	145,944	145,944	145,944	145,944
R2	0.542	0.542	0.542	0.542	0.543

Table 6: Robustness – Macro and Political Confounders. Panel A shows robustness tests controlling for macroeconomic confounders (exchange rate, sovereign yield, sovereign spread, foreign funding). Panel B shows robustness tests controlling for political confounders. These variables include the political uncertainty index of Baker et al. (2016), reserve requirements on foreign funding (RR on foreign fund.) and a tax on foreign funding (Tax on foreign fund.). Column (5) in Panel B differs from the other exercises in that it adds to Eq. 2 an interaction term between reserve requirements and the ratio of public sector to total deposits at the bank level (Public dep. ratio). The dependent variable is the quarter-to-quarter growth rate of outstanding credit. The sample period spans 2008Q1-2014Q1. *Deposit ratio* abbreviates the demand deposit ratio of parent banks. *Reserve requirements* corresponds to the reserve requirements rate on demand deposits. For more information on the data definition, see the data description. Explanatory variables at the branch and parent level are standardized. All explanatory variables enter the model lagged by one quarter. Fixed effects include branch fixed effects and quarter-municipality fixed effects if not indicated otherwise. Standard errors are clustered by parent bank and quarter. *** indicates significance at the 1% level; ** at the 5%; * at the 10%.

	Sub-sample period:			
	Baseline (1)	Crisis (2)	Tightening (3)	Loosening (4)
Deposit ratio	0.099**	0.155	-0.140	0.149***
	(0.039)	(0.101)	(0.157)	(0.045)
Deposit ratio X Reserve requirements	-0.192***	-0.367*	0.155	-0.201***
	(0.070)	(0.187)	(0.290)	(0.068)
Parent controls				
Log(Assets)	0.133***	-0.073	-0.137	0.352***
	(0.047)	(0.096)	(0.329)	(0.117)
Liquidity ratio	0.026***	0.009	-0.043	0.014
	(0.008)	(0.013)	(0.031)	(0.012)
Capital ratio	0.101***	0.166***	-0.271***	-0.032
	(0.030)	(0.051)	(0.097)	(0.039)
Adm. costs / total costs	-0.030	0.004	0.030	-0.030
	(0.022)	(0.039)	(0.085)	(0.024)
Branch controls				
Log(Assets)	-0.061***	-0.064**	-0.095**	-0.073***
	(0.012)	(0.025)	(0.040)	(0.010)
Liquidity ratio	0.877***	1.637***	2.090***	1.300***
	(0.082)	(0.189)	(0.335)	(0.133)
Deposit ratio	0.066***	0.107***	0.104**	0.101***
	(0.019)	(0.033)	(0.042)	(0.026)
RoA	-27.208**	-129.887***	-104.342***	-1.921
	(13.688)	(46.916)	(39.075)	(6.057)
Branch FE	Yes	Yes	Yes	Yes
Quarter X Mun. FE	Yes	Yes	Yes	Yes
Obs	145,944	48,648	24,324	72,972
R2	0.542	0.639	0.508	0.535

Table 7: Periods. This table lists results from various sub-periods from our baseline model (Column (1)). In Column (2), the period spans 2008Q1-2010Q1. In Column (3), the period from 2010Q2 until 2011Q1 is covered. In Column (4), the sample spans 2011Q2-2014Q1. The dependent variable is the quarter-to-quarter growth rate of outstanding credit. *Deposit ratio* abbreviates the demand deposit ratio of parent banks. *Reserve requirements* corresponds to the reserve requirements rate on demand deposits. For more information on the data definition, see the data description. Explanatory variables at the branch and parent level are standardized. All explanatory variables enter the model lagged by one quarter. Standard errors are clustered by parent bank and quarter. *** indicates significance at the 1% level; ** at the 5%; * at the 10%.

	Baseline	Ownership sub-sample: Domestic	Foreign	State-owned	Private
	(1)	(2)	(3)	(4)	(5)
Deposit ratio	0.099**	0.158***	0.008	0.148***	-0.073
	(0.039)	(0.049)	(0.074)	(0.055)	(0.055)
Deposit ratio X Reserve requirements	-0.192***	-0.281***	-0.213	-0.243**	0.177
	(0.070)	(0.083)	(0.152)	(0.098)	(0.134)
Parent controls					
Log(Assets)	0.133***	0.201***	-0.031	0.216***	-0.018
	(0.047)	(0.059)	(0.068)	(0.062)	(0.059)
Liquidity ratio	0.026***	0.027***	0.019	0.020**	0.015
	(0.008)	(0.008)	(0.021)	(0.009)	(0.012)
Capital ratio	0.101***	0.129***	0.122**	0.126***	0.118***
	(0.030)	(0.045)	(0.052)	(0.039)	(0.039)
Adm. costs / total costs	-0.030	-0.033	-0.061	-0.002	-0.020
	(0.022)	(0.026)	(0.079)	(0.033)	(0.022)
Branch controls					
Log(Assets)	-0.061***	-0.077***	-0.023*	-0.078***	-0.058***
	(0.012)	(0.018)	(0.013)	(0.022)	(0.012)
Liquidity ratio	0.877***	0.842***	1.020	2.462***	1.326***
	(0.082)	(0.082)	(0.720)	(0.490)	(0.120)
Deposit ratio	0.066***	0.071***	0.071	0.022	0.071***
	(0.019)	(0.021)	(0.050)	(0.023)	(0.024)
RoA	-27.208**	-47.694**	-10.501	38.509*	-50.899*
	(13.688)	(22.490)	(7.752)	(20.544)	(26.513)
Branch FE	Yes	Yes	Yes	Yes	Yes
Quarter X Mun. FE	Yes	Yes	Yes	Yes	Yes
Obs	145,944	128,280	7,296	65,760	53,424
R2	0.542	0.566	0.641	0.652	0.598

Table 8: Ownership. This table lists results from various sub-samples from our baseline model (Column (1)). In Column (2), the sample covers only domestic banks. In Column (3), only branches of foreign parent banks are included. In Column (4), branches of state-owned parent banks and in Column (5) branches of private parent banks are included. The dependent variable is the quarterly growth rate of outstanding credit. *Deposit ratio* abbreviates the demand deposit ratio of parent banks. *Reserve requirements* corresponds to the reserve requirements rate on demand deposits. For more information on the data definition, see the data description. Explanatory variables at the branch and parent level are standardized. All explanatory variables enter the model lagged by one quarter. Standard errors are clustered by parent bank and quarter. *** indicates significance at the 1% level; ** at the 5%; * at the 10%.

Branch indicator:		RoA		Share in group assets	
	Baseline	High	Low	High	Low
	(1)	(2)	(3)	(4)	(5)
Deposit ratio	0.103	0.073	0.031	-0.020	0.629***
	(0.084)	(0.094)	(0.080)	(0.113)	(0.046)
Deposit ratio X Reserve requirements	-0.307**	-0.109	-0.252*	-0.099	-0.992***
	(0.141)	(0.161)	(0.132)	(0.190)	(0.064)
Parent controls					
Log(Assets)	0.654***	0.448**	0.568*	1.045***	0.870***
	(0.235)	(0.209)	(0.287)	(0.325)	(0.110)
Liquidity ratio	-0.028**	0.006	0.040*	-0.037**	-0.013
	(0.013)	(0.012)	(0.023)	(0.014)	(0.014)
Capital ratio	0.588***	0.145	1.021***	0.743***	1.337***
	(0.166)	(0.107)	(0.202)	(0.190)	(0.054)
Adm. costs / total costs	0.038	0.084**	-0.019	0.021	0.012
	(0.056)	(0.035)	(0.062)	(0.094)	(0.017)
Branch controls					
Log(Assets)	-0.078	-0.151***	-0.023	-0.173**	-0.028
	(0.069)	(0.044)	(0.101)	(0.078)	(0.086)
Liquidity ratio	5.687***	2.391	5.649**	7.151**	5.882**
	(1.506)	(1.488)	(2.814)	(2.731)	(2.734)
Deposit ratio	0.070	0.071	0.084	0.135**	-0.047
	(0.045)	(0.049)	(0.083)	(0.064)	(0.082)
RoA	9.534	-12.262	-183.920*	21.258	-24.603
	(56.662)	(32.276)	(102.086)	(81.996)	(84.488)
Branch FE	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes
Mun. FE	Yes	Yes	Yes	Yes	Yes
Quarter X Mun. FE	Yes	Yes	Yes	Yes	Yes
Obs	21,920	5,264	8,728	9,320	2,480
R2	0.731	0.800	0.735	0.690	0.855

Table 9: Dynamics within State-Owned Banks during the Crisis Period. This table lists results when focusing on the role of branch characteristics for the transmission process. The baseline model is shown in Column (1) for the sample of branches of state-owned parent banks and the crisis period 2008Q1-2010Q1. In Columns (2) and (3), results are shown for the sub-sample of high versus low profitability branches. *Branch indicator* : *RoA* takes a value of one for branches with an average profitability exceeding the sample median and zero otherwise. In Columns (4) and (5), results are shown for the sub-sample of branches with a high versus low share of group assets. *Branch indicator* : *Share in group assets* takes a value of one for branches with an average share in group assets exceeding the group's median and zero otherwise. The dependent variable is the quarterly growth rate of outstanding credit. *Deposit ratio* abbreviates the demand deposit ratio of parent banks. *Reserve requirements* corresponds to the reserve requirements rate on demand deposits. For more information on the data definition, see the data description. Explanatory variables at the branch and parent level are standardized. All explanatory variables enter the model lagged by one quarter. Fixed effects include branch fixed effects and quarter-municipality fixed effects if not indicated otherwise. Standard errors are clustered by parent bank and quarter. *** indicates significance at the 1% level; ** at the 5%; * at the 10%.

	Asset-based market shares		Credit-based market shares	
	Quarter FE	Time & Mun. FE	Quarter FE	Time & Mun. FE
	(1)	(2)	(3)	(4)
Deposit ratio	0.112***	0.019	0.105***	0.015
	(0.023)	(0.029)	(0.021)	(0.027)
Deposit ratio X Reserve requirements	-0.245***	-0.139***	-0.224***	-0.129***
	(0.046)	(0.052)	(0.042)	(0.048)
Parent controls				
Log(Assets)	-0.009**	-0.077***	-0.001	-0.056***
	(0.004)	(0.015)	(0.003)	(0.012)
Liquidity ratio	0.053***	0.049***	0.045***	0.039***
	(0.014)	(0.015)	(0.014)	(0.015)
Capital ratio	-0.023**	-0.030	-0.005	0.024
	(0.010)	(0.038)	(0.009)	(0.033)
Adm. costs / total costs	0.051***	0.018	0.058***	0.018
	(0.012)	(0.022)	(0.012)	(0.022)
Branch controls				
Log(Assets)	0.007***	-0.069***	0.006**	-0.072***
	(0.003)	(0.013)	(0.003)	(0.013)
Liquidity ratio	0.012***	0.003	0.013***	0.004
	(0.002)	(0.005)	(0.002)	(0.005)
Deposit ratio	0.005**	0.003	0.004**	0.005
	(0.002)	(0.005)	(0.002)	(0.005)
RoA	-0.007**	-0.023***	-0.008**	-0.023***
	(0.003)	(0.007)	(0.003)	(0.007)
Quarter FE	Yes	Yes	Yes	Yes
Municipality FE	No	Yes	No	Yes
Obs	38,615	38,615	38,615	38,615
R2	0.651	0.670	0.651	0.671

Table 10: Total Effect on Credit at the Municipality Level. This table lists results of our baseline model when accounting for aggregated effects at the municipality level. The dependent variable is the quarterly growth rate of outstanding credit. The sample period spans 2008Q1-2014Q1. *Deposit ratio* abbreviates the demand deposit ratio of parent banks. *Reserve requirements* corresponds to the reserve requirements rate on demand deposits. For more information on the data definition, see the data description. The standardized and lagged explanatory variables at the branch and parent level are weighted by asset- or credit-based market shares of branches to aggregate data to the municipality level. Fixed effects include municipality fixed effects and quarter fixed effects. Standard errors are clustered by municipality. *** indicates significance at the 1% level; ** at the 5%; * at the 10%.

Data Appendix A

Summary of data construction

To construct the dataset used in the analysis, we downloaded the balance sheets and income statements of banks and branches from the website of the Brazilian Central Bank (BCB) (https://www.bcb.gov.br/) These data were retrieved from two sources. For parent banks, we used the "Balancetes e Balanos Patrimoniais" (Bank Balances and Equity) database collected and publicly reported by the BCB. The data on branches comes from the "ESTBAN - Estadistica Bancaria Mensal por Municipio" (Monthly Banking Statistics by Municipality) database. In this latter database, the information is aggregated at the bank-municipality level, so that all individual municipal branches report as a single municipal entity. The definition of variables comes from the "Manual de Normas do Sistema Financeiro" (Manual of Financial System's Norms or COSIF), also available through the website of the BCB. To ensure the correct match between parent banks and branches, we relied on an identifier assigned by the BCB to all institutions. We also manually checked that the names of banks and branches correspond to the same institution. The BCB collects these data for regulatory purposes. Therefore all institutions with a banking license are mandated to report the respective information on a monthly basis. The data is reported in nominal Brazilian Reais, which we adjusted in order to work with millions of Brazilian Reais. We added to the main dataset information on banks' ownership status. For this purpose, we relied on banks' websites and on the Claessens and van Horen (2015) Bank Ownership Database.

Variable	Definition	Unit	Source
Branch-level			
ΔCredit	Quarter-to-quarter growth rate of outstanding total credit (excl. rural credit).	Growth rate	BCB
Deposit ratio	Ratio of demand deposits to total assets.	Fraction	BCB
Log(Assets)	Log of total branch-level assets in millions of Brazilian Reais.	Log	BCB
Liquidity ratio	Ratio of liquid assets (cash, gold and interbank deposits) to total assets.	Fraction	BCB
RoA	Ratio of net returns (total income - total costs) to total assets.	Fraction	BCB
Internal funding ratio	Ratio of intra-bank assets minus intra-bank liabilities to total branch assets.	Fraction	BCB
ΔDemand	Sum of quarter-to-quarter growth rates in segment-specific credit weighted by the share of each segment in a branch credit portfolio. The variable is computed using data on consumer, commercial and mortgage loans.	Growth rate	BCB
Branch indicator: RoA	Indicator equal to 1 if a branch reports a sample average of return on assets above the sample median and 0 otherwise.	1/0	BCB
Branch indicator: Share in group assets	Indicator equal to 1 if a branch reports a sample average of the share in group assets above the group's median and 0 otherwise.	1/0	BCB
Parent-level			
Deposit ratio	Ratio of demand (sight) deposits to total assets.	Fraction	BCB
Log(Assets)	Log of total (conglomerate-level) assets in millions of Brazilian Reais.	Log	BCB
Liquidity ratio	Ratio of liquid assets (cash, gold and interbank deposits) to total assets.	Fraction	BCB
Capital ratio	Ratio of total equity to total assets.	Fraction	BCB
Adm./total costs	Ratio of administrative expenses to total expenses.	Fraction	BCB
Foreign	Dummy equal to 1 for foreign-owned banks and 0 otherwise.	1/0	Claessens & van Horen (2015)
State-owned	Dummy equal to 1 for state-owned banks and 0 otherwise.	1/0	BCB
Public sector deposit ratio	Ratio of public sector deposits to total deposits.	Fraction	BCB

Table A.1: Variables Definitions. This table reports the definitions and sources of the variables used in the analysis. The variables are grouped by the respective entity-level of observation. These groups include branch, parent bank, municipality, and country level variables. BCB stands for Brazilian Central Bank, IBGE for the Brazilian Institute of Geography and Statistics and Brazilian ML for the Brazilian Ministry of Labor.

Variable	Definition	Unit	Source
Municipality-level			
Δ Agg. claims	Quarter-to-quarter growth rate of outstanding assets by all branches per municipality.	Growth rate	BCB
Δ Jobs	Quarter-to-quarter growth rate of new job contracts signed per municipality and quarter.	Growth rate	Brazilian ML
Δ GDP	Quarter-to-quarter growth rate of municipal GDP. Variable computed from end-of-year data. We assign a weight of 0.25 to the end-of-year GDP of the last three quarters per period and a weight of 0.25 to the GPD of the year of the corresponding quarter. The variable corresponds to the growth rate of the volume resulting from adding up the weighted GDP data. Quarters between Q2 2012 and Q1 2014 dropped because of missing GDP data for 2013.	Growth rate	IBGE
Country-level			
Reserve requirements	Regulatory fraction of demand deposits to be held as reserves at the Brazilian Central Bank.	Fraction	BCB
Δ M0	Quarterly change in monetary base (total physical paper money and coins, in millions of Brazilian Reais).	Log difference	BCB
Δ SELIC rate	Quarterly change in the monetary policy rate set by the Brazilian Central Bank.	Percentage points	BCB
Exchange rate	Nominal exchange rate Brazilian Reais (BRL)/ US Dollars (USD).	Fraction	St. Louis Fed
Sovereign yield	Interest rate paid on sovereign bonds issued by the Brazilian government.	Rate	Datastream
Sovereign spread	Difference between the Brazilian and US sovereign bond yields.	Percentage points	Datastream
Δ Foreign funding	Quarterly change in aggregate foreign funding of banks (in millions of Brazilian Reais).	Log difference	BCB
Political uncertainty	Quarterly average of the Economic Policy Uncertainty Index for Brazil.	Index	Baker et al. (2016)
RR on FX positions	Dummy equal to 1 for the period between 2011Q1 and 2012Q4 in which a reserve requirement on banks' foreign exchange (FX) positions was introduced in Brazil. The variable equals 0 outside this period.	1/0	BCB
Foreign funding tax	Dummy equal to 1 for the period between 2011Q1 and 2014Q1 in which a tax on banks' volumes borrowed abroad was introduced in Brazil. The variable equals 0 outside this period.	1/0	BCB

Table A.1: Variables Definitions (continued). This table reports the definitions and sources of the variables used in the analysis. The variables are grouped by the respective entity-level of observation. These groups include branch, parent bank, municipality, and country level variables. BCB stands for Brazilian Central Bank, IBGE for the Brazilian Institute of Geography and Statistics and Brazilian ML for the Brazilian Ministry of Labor.

	Branch-level						Parent-level		
	ΔCredit	Size (log Assets)	Liquidity ratio	Deposit ratio	RoA	ΔDemand	Deposit ratio	Size (log Assets)	Liquidity ratio
Branch-level									
ΔCredit	1.000								
Size (log Assets)	-0.004	1.000							
Liquidity ratio	-0.007	-0.384*	1.000						
Deposit ratio	-0.001	-0.281*	0.310*	1.000					
RoA	0.023*	-0.236*	0.284*	0.144*	1.000				
ΔDemand	0.423*	-0.064*	0.071*	0.082*	0.090*	1.000			
Parent-level									
Deposit ratio	0.028*	-0.042*	-0.061*	0.441*	-0.100*	0.049*	1.000		
Size (log Assets)	-0.015*	0.129*	0.228*	-0.096*	0.081*	-0.053*	-0.117*	1.000	
Liquidity ratio	0.007*	-0.118*	0.050*	0.370*	-0.065*	0.040*	0.792*	0.021*	1.000
Capital ratio	-0.002	-0.095*	-0.056*	0.166*	0.024*	0.074*	0.022*	-0.546*	-0.178*
Adm. cost / total cost	0.073*	-0.110*	-0.320*	0.011*	-0.198*	0.065*	0.107*	-0.730*	0.064*
Public sector deposit ratio	0.053*	-0.026*	-0.062*	0.119*	-0.014*	0.019*	0.529*	-0.290*	0.442*
Country-/ municipality-level									
Reserve requirements	-0.070*	0.020*	0.011*	0.070*	0.030*	-0.126*	0.085*	0.014*	0.067*
Δ SELIC rate	-0.236*	0.021*	-0.002	0.039*	-0.037*	-0.372*	0.053*	0.016*	0.031*
Δ M0	-0.030*	0.022*	-0.007*	-0.012*	0.006	-0.052*	-0.007*	0.027*	0.027*
Exchange rate	0.101*	-0.035*	-0.018*	-0.092*	-0.043*	0.191*	-0.124*	-0.027*	-0.113*
Sov. yield	0.038*	-0.114*	0.027*	0.142*	0.037*	0.032*	0.204*	-0.126*	0.111*
Sov. spread	0.220*	-0.130*	0.015*	0.054*	0.028*	0.337*	0.076*	-0.133*	0.014*
Δ Foreign funding	0.005	0.043*	0.000	0.013*	0.006	-0.043*	0.025*	0.042*	0.020*
Volat. stock returns	0.099*	-0.094*	0.017*	0.069*	0.027*	0.138*	0.119*	-0.102*	0.058*
Uncertainty index	0.006	-0.081*	0.007*	0.014*	-0.014*	0.059*	0.010*	-0.084*	-0.027*
Δ Agg. claims	0.451*	-0.064*	0.032*	0.035*	0.066*	0.569*	0.019*	-0.002	0.020*
Δ Job creation	0.077*	0.001	0.003	-0.002	-0.006	0.099*	0.011*	-0.004	0.014*
Δ GDP	0.068*	-0.043*	0.031*	0.111*	0.035*	0.070*	0.150*	-0.044*	0.125*

Table A.2: Correlations. This table shows the correlation of the dependent and explanatory variables at the branch- and parent-level as well as the country- and municipality-level variables. The Bonferroni-adjusted significance levels are depicted with stars as follows: $^{*}\,p < 0.10$, $^{**}\,p < 0.05$, $^{***}\,p < 0.01$. See the data description in the Data Appendix A for more information on the variables.

	Parent-level		Country-/ municipality-level						
	Capital ratio	Adm. cost / total cost	Public sector deposit ratio	Reserve requirements	Δ SELIC rate	Δ M0	Exchange rate	Sov. yield	Sov. spread
Parent-level									
Capital ratio	1.000								
Adm. cost / total cost	0.356*	1.000							
Public sector deposit ratio	0.037*	0.165*	1.000						
Country-/ municipality-level									
Reserve requirements	0.016*	0.017*	0.041*	1.000					
Δ SELIC rate	-0.020*	-0.047*	-0.004	-0.010*	1.000				
ΔM0	-0.005	0.040*	-0.012*	-0.147*	0.088*	1.000			
Exchange rate	-0.015*	-0.051*	-0.047*	-0.755*	-0.218*	-0.008*	1.000		
Sov. yield	0.031*	0.121*	0.100*	0.195*	0.304*	0.057*	-0.124*	1.000	
Sov. spread	0.037*	0.089*	0.062*	-0.222*	-0.326*	0.005	0.564*	0.557*	1.000
Δ Foreign funding	-0.018*	0.020*	0.009*	0.184*	0.149*	-0.139*	-0.397*	-0.168*	-0.500*
Volat. stock returns	0.020*	0.081*	0.068*	0.028*	-0.153*	0.093*	0.203*	0.498*	0.611*
Uncertainty index	0.026*	-0.029*	0.026*	-0.098*	-0.128*	-0.406*	0.444*	0.320*	0.639*
Δ Agg. claims	-0.000	0.055*	0.020*	-0.163*	-0.342*	-0.029*	0.226*	-0.098*	0.231*
Δ Job creation	-0.000	0.019*	0.010*	-0.073*	-0.080*	0.140*	0.066*	0.021*	0.058*
Δ GDP	0.044*	0.091*	0.079*	0.595*	-0.129*	0.052*	-0.607*	0.354*	0.031*

	Country-/ municipality-level					
	Δ Foreign funding	Volat. stock returns	Uncertainty index	Δ Agg. claims	Δ Job creation	Δ GDP
Country-/ municipality-level						
Δ Foreign funding	1.000					
Volat. stock returns	-0.203*	1.000				
Uncertainty index	-0.515*	0.450*	1.000			
Δ Agg. Claims	-0.001	0.074*	0.005	1.000		
Δ Job creation	0.072*	0.153*	-0.042*	0.061*	1.000	
Δ GDP	0.330*	0.172*	-0.178*	-0.030*	0.090*	1

Correlations (*continued*). This table shows the correlation of the dependent and explanatory variables at the branch- and parent-level as well as the country- and municipality-level variables. The Bonferroni-adjusted significance levels are depicted with stars as follows: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. See the data description in the Data Appendix A for more information on the variables.

Deposit ratio percentile:	<25th	>25th & <50th	>50th & <75th	>75th
	(1)	(2)	(3)	(4)
Δ Agg. claims				
mean	-0.007	0.018	0.025	0.024
s.d.	0.160	0.121	0.087	0.089
diff.	-0.026	-0.007	0.001	0.032
test	-0.127	-0.045	0.006	0.172
Δ Job creation				
mean	0.012	0.019	0.010	0.011
s.d.	0.103	0.342	0.317	0.351
diff.	-0.007	0.009	-0.001	-0.001
test	-0.021	0.019	-0.001	-0.002
Δ GDP				
mean	-0.112	-0.100	-0.102	-0.100
s.d.	0.372	0.356	0.363	0.356
diff.	-0.011	0.002	-0.002	0.012
test	-0.022	0.004	-0.005	0.023
ΔDemand				
mean	0.020	0.032	0.020	0.030
s.d.	0.074	0.068	0.054	0.066
diff.	-0.012	0.012	-0.010	0.010
test	-0.119	0.134	-0.113	0.101

Table A.3: Credit Demand Proxies by Deposit Ratio. The table reports summary statistics for municipality-level credit demand proxies by quartiles of parent-banks' deposit ratio. The proxies for credit demand are represented by the municipal quarter-to-quarter growth rate in aggregate bank claims, in job creation (i.e. number of job contracts signed), GDP, and credit demand. This latter variable is computed from our branch-level data following Aiyar (2012). For each quartile per variable the table reports its mean, standard deviation (s.d.), and difference in means with respect to the next upper quartile (diff.). The table also reports a test of normalized differences in means by Imbens and Wooldridge (2009) (test). An absolute number of "test" above 0.25 means that demand proxies are statistically and significantly different across quartiles of deposit ratio. The test is conducted between a given quartile and the next upper one reported in the column on the right. For the last column, the test depicts the difference between the 75th and 25th percentile. The variables are defined in Table A.1 in the Data Appendix A.

	Branches characteristics				**Parent characteristics**			
	Liquid assets ratio		Internal funding ratio		Liquid assets ratio		Capital ratio	
	High	Low	High	Low	High	Low	High	Low
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Deposit ratio	0.058	0.127***	0.047	0.113**	0.053	0.155***	0.002	0.107**
	(0.049)	(0.041)	(0.037)	(0.046)	(0.084)	(0.052)	(0.055)	(0.048)
Deposit ratio X	-0.134	-0.234***	-0.121*	-0.225***	-0.021	-0.290***	0.028	-0.218**
Reserve requirements	(0.090)	(0.073)	(0.071)	(0.084)	(0.110)	(0.092)	(0.100)	(0.088)
Parent controls								
Log(Assets)	0.044	0.193***	-0.040	0.185***	0.325	0.120**	0.021	0.141***
	(0.060)	(0.048)	(0.049)	(0.050)	(0.265)	(0.050)	(0.074)	(0.054)
Liquidity ratio	0.041***	0.021***	0.032***	0.028***	-0.000	0.029***	0.004	0.042***
	(0.010)	(0.008)	(0.009)	(0.010)	(0.020)	(0.008)	(0.007)	(0.015)
Capital ratio	0.146***	0.076***	0.108***	0.114***	0.094	0.129***	0.081***	0.129***
	(0.049)	(0.021)	(0.030)	(0.036)	(0.103)	(0.035)	(0.027)	(0.047)
Adm. costs / total costs	-0.060**	-0.014	-0.007	-0.057*	0.054	-0.029	0.004	-0.062
	(0.026)	(0.022)	(0.021)	(0.032)	(0.043)	(0.022)	(0.015)	(0.046)
Branch controls								
Log(Assets)	-0.037***	-0.066***	-0.049***	-0.070***	-0.050***	-0.063***	-0.087***	-0.057***
	(0.011)	(0.013)	(0.012)	(0.020)	(0.010)	(0.013)	(0.017)	(0.013)
Liquidity ratio	1.024***	1.088***	0.876***	0.937***	1.320***	1.753***	0.900***	1.778***
	(0.086)	(0.133)	(0.301)	(0.090)	(0.152)	(0.249)	(0.117)	(0.281)
Deposit ratio	0.145***	0.044***	0.071**	0.071***	0.019	0.087***	0.058	0.064***
	(0.039)	(0.017)	(0.031)	(0.023)	(0.026)	(0.024)	(0.039)	(0.023)
RoA	-14.660	-36.863**	-27.494	-29.260*	-142.608***	0.261	-16.891	-23.165*
	(11.717)	(17.422)	(25.306)	(17.543)	(33.298)	(10.687)	(28.050)	(13.302)
Branch FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quarter X Mun. FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs	37,608	97,872	18,792	101,712	23,040	98,328	13,800	96,744
R2	0.578	0.588	0.595	0.552	0.678	0.589	0.612	0.571

Table A.4: Branch and Parent Characteristics. This table lists results of our baseline model when accounting for branches' or parents' liquidity and capital constraints. Sample splits are conducted by branches' *Liquid assets ratio* (Columns (1)-(2)) and *Internal funding ratio* (Columns (3)-(4)) and parents' *Liquid assets ratio* (Columns (5)-(6)) and *Capital ratio* (Columns (7)-(8)). The sample is split for the respective variable being larger or equal to the 75th percentile of the branch or parent bank sample distribution in 2008Q1. The dependent variable is the quarterly growth rate of outstanding credit. The sample period spans 2008Q1-2014Q1. *Deposit ratio* abbreviates the demand deposit ratio of parent banks. *Reserve requirements* corresponds to the reserve requirements rate on demand deposits. For more information on the data definition, see the data description. Explanatory variables at the branch and parent level are standardized. All explanatory variables enter the model lagged by one quarter. Fixed effects include branch fixed effects and quarter-municipality fixed effects. Standard errors are clustered by parent bank and quarter. *** indicates significance at the 1% level; ** at the 5%; * at the 10%.