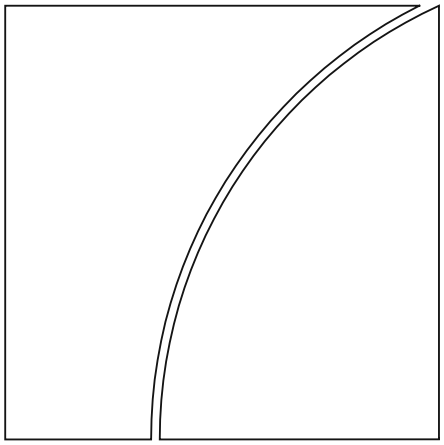
BANK FOR INTERNATIONAL SETTLEMENTS



BIS Working Papers

No 741

Reserve requirements and capital flows in Latin America

by Michael Brei and Ramon Moreno

Monetary and Economic Department

August 2018

JEL classification: C53, E43, E52, G21

Keywords: reserve requirements, monetary policy, capital flows

BIS Working Papers are written by members of the Monetary and Economic Department of the Bank for International Settlements, and from time to time by other economists, and are published by the Bank. The papers are on subjects of topical interest and are technical in character. The views expressed in them are those of their authors and not necessarily the views of the BIS.

This publication is available on the BIS website (www.bis.org).

ISSN 1020-0959 (print)
ISSN 1682-7678 (online)

Reserve requirements and capital flows in Latin America

Michael Brei* and Ramon Moreno♣

Abstract

The experience of a number of central banks in emerging economies indicates that capital flows can pose a dilemma. For example, raising policy rates can attract more capital inflows by raising deposit rates. It has been suggested, however, that raising reserve requirements instead of the policy rate can address this dilemma, as deposit rates will not necessarily increase, even if lending rates rise. To investigate this possibility, this paper examines how banks adjust loan and deposit rates in response to changes in reserve requirements. We use data on 128 banks from seven Latin American countries over the period 2000-14. Our results indicate that higher reserve requirements are associated with higher loan rates, whereas deposit rates remain unchanged during normal times and decrease during periods of large capital inflows. Reserve requirements may therefore be a way to mitigate the dilemma posed by capital inflows in some Latin American economies.

JEL classification: C53, E43, E52, G21.

Keywords: reserve requirements, monetary policy, capital flows.

* The University of the West Indies, Cave Hill Campus, and University Paris Nanterre. E-mail: michael.brei@uni-bonn.de.

♣ Formerly Bank for International Settlements. E-mail: ramon.moreno02@yahoo.com .

The authors wish to thank Enrique Alberola, Carlos Cantú García, Leonardo Gambacorta, Alfredo Schclareck, and Marcos Valli for valuable comments. This study also benefited from valuable feedback of Claudio Borio, Stijn Claessens and Enisse Kharroubi at the BIS Research Seminar in February 2017 and from an anonymous referee report. Julieta Contreras provided excellent research support. The paper was written while Michael Brei was visiting research fellow at the BIS Americas office. The opinions expressed in this paper are those of the authors and do not necessarily reflect those of the Bank for International Settlements.

Introduction

Reserve requirements have been actively used as a monetary policy instrument in a number of emerging market economies. Their use has been motivated by the fact that a single instrument, the interest rate, may not be sufficient to deal with both price and financial stability objectives. More specifically, when facing externally-driven large capital inflows, raising the interest rate to curb domestic credit growth can attract more inflows, which may in turn amplify the credit cycle. Raising reserve requirements can address this dilemma to the extent that deposit rates, which attract capital inflows, will not necessarily increase even if lending rates rise.

For a variety of reasons, reserve requirements are no longer used actively as monetary policy instruments in the advanced economies (Montoro and Moreno, 2011).[1] This is confirmed in the left-hand panel of Figure 1 which shows required reserve ratios for a number of advanced economies over the period 1994-2015. In contrast, monetary authorities in major emerging market economies have continued to use reserve requirements as an alternative to interest rates in pursuing financial stability objectives. As can be observed in the right-hand panel of Figure 1, five Latin American central banks out of the seven covered in this study (Argentina, Brazil, Colombia, Peru and Uruguay) have adjusted required reserve ratios quite frequently (see also Table 1).

Central banks have resorted to reserve requirements partly in response to challenges posed by capital inflows. For example, prior to the Lehman Brothers bankruptcy in September 2008, Brazil, Colombia and Peru confronted high capital inflows and economic overheating (high inflation coupled with domestic credit growth) and a policy dilemma: if they raised interest rates to control headline inflation and credit growth, they risked attracting even more capital inflows (see Montoro and Moreno (2011)). The events after the Lehman bankruptcy led to yet another dilemma. Gross capital inflows contracted sharply and financing conditions tightened, in both foreign exchange and domestic markets. With still high inflation, policymakers needed to stabilize financial markets and counter the sharp contraction in external demand while also ensuring that inflation expectations remained stable. Policymakers in the three countries partly addressed these dilemmas by raising reserve requirements in the expansion phase of the cycle and lowering them after the Lehman bankruptcy.[2] This pattern is confirmed in Figure 2 which shows changes in policy rates

[1] Central banks have shifted the focus of their operating procedures from controlling reserves or monetary aggregates to short-term interest rates. They have also been concerned with the potential costs associated with reserve requirements on financial intermediation. Moreover, financial innovations and the development of capital markets have reduced the effectiveness of this policy instrument.

[2] See also Mesquita and Toros (2010). Reserve requirements have also been used for other purposes that are not the main focus of this paper. These include (1) preserving financial stability. For example, reserve requirements have been lowered in Brazil after the 2008 Lehman bankruptcy to counter liquidity pressures, notably by offering rebates on reserve requirements when banks bought assets from other (smaller, less liquid) banks or USD (offsetting the effects of USD sales by the Banco do Brasil on local currency liquidity). For a different example, in Peru and Uruguay reserve requirements have been used to reduce dollarization, or in Argentina to reduce currency mismatches (Cayazzo et al., 2006). Reserve requirements have also been used for (2) countercyclical policy and to strengthen the monetary policy transmission in Uruguay and Colombia (see Camors and Peydro (2013) and González-Rozada and Sola (2014) for Uruguay, Vargas et al. (2010) for Colombia, and Armas et al. (2014) and Dancourt (2012) for Peru).

and reserve requirements as a function of capital flows. Those central banks that do not use reserve requirements actively (Chile and Mexico) tended to raise policy rates during periods of large capital inflows and reduce them during periods of large outflows. This stands in contrast to the other central banks, which tended to adjust reserve requirements during large capital flow episodes keeping policy rates unchanged (in some cases outside the region, the policy rate was lowered at the same time as the required reserve was increased).

Despite their frequent use, the pass through of changes in reserve requirements to interest rates on the bank-level remains largely unexplored.[3] As will be discussed in more detail below, most studies either explore the transmission mechanism using theoretical models (Betancourt and Vargas, 2008; Bianchi, 2011; Glocker and Towbin, 2012; Kashyap and Stein, 2012; Medina and Roldós, 2014; González-Rozada and Sola, 2014; Agénor et al., 2015) or they focus on the macroeconomy (Reinhart and Reinhart, 1999; Vargas et al., 2010; Montoro and Moreno, 2011; Tovar et al., 2012; Cordella et al., 2014; Federico et al., 2014; Hoffman and Loeffler, 2014). Notable exceptions that focus on the effect of changes in required reserve ratios on the bank-level include Camors and Peydro (2013) on Uruguay and Alper et al. (2016) on Turkey, both focusing on loan supply. To the best of our knowledge, this is the first bank-level study that focuses on the pass through to loan and deposits rates within a cross-country setting.

The main contributions of our paper are as follows. First, we calculate bank-specific and remuneration-adjusted required reserve ratios taking into account the maturity and currency composition of individual banks' deposits. This procedure is important to the extent that the effective reserve requirement differs across the type of deposits and across banks. Moreover, adjusting for their remuneration allows us to account for banks' effective cost of required reserves. Second, we study the pass through of both policy rates and reserve requirements to loan and deposit rates side-by-side using dynamic panel regressions that allow us to control for other bank-specific (e.g. market power) and macroeconomic determinants. And third, we investigate whether the pass through differs across different types of banks and during periods of large capital inflows.

Our results suggest that both policy rates and changes in reserve requirements are major determinants of interest rates set by banks. While increases in policy rates are associated with both higher loan and deposit rates, we find robust evidence of an asymmetric response to changes in reserve requirements. More specifically, banks respond to higher reserve requirements by raising loan rates, but they tend to keep deposit rates unchanged during normal times, while they decrease deposit rates during periods of large capital inflows. This finding is in line with the 'cost-channel hypothesis' according to which higher reserve requirements that are remunerated below market rates drive a wedge between the rate a bank pays its depositors and its cost of funds. All else equal, this compresses banks' net interest margin to which they respond by raising loan rates while keeping deposit rates unchanged, or if the external financial environment allows even decreasing them. Our results thus confirm the view that the active use of reserve requirements can resolve the policy dilemma posed by conventional interest rate policy when dealing with capital flows in emerging markets.

[3] Federico et al. (2014) estimate that, in contrast to industrial countries, approximately two thirds of developing countries have used reserve requirements as a macroeconomic (countercyclical) stabilization tool.

The remainder of the paper is organised as follows. Section 1 reviews the related literature and describes the main channels through which reserve requirements influence banks' pricing decisions. Section 2 presents the empirical analysis. It describes the underlying data and, to set the context, the reserve regulation in the countries over the period under investigation. It then presents the econometric framework and discusses the main empirical results. The conclusion highlights the main findings and their implications.

1. Reserve requirements as a monetary policy instrument

Central banks have used reserve requirements to complement conventional monetary policy (Gray, 2011; Montoro and Moreno, 2011; Agénor et al., 2015). Depending on the country and period, reserve requirements have supported at least three policy objectives: reduce bank liquidity and solvency risks (microprudential), affect market rates and monetary aggregates (monetary control), and manage system-wide liquidity (macroprudential/financial stability).

The microprudential objective refers to situations in which central banks set reserve requirements to ensure that banks hold sufficient liquidity to withstand unexpected withdrawals of reservable liabilities (deposits, short-term funds). Central banks can impose differential reserve ratios depending on the maturity and currency denomination of the liabilities subject to regulation. For example, a central bank can impose a higher reserve requirement on demand or foreign-currency deposits if it is concerned that bank reliance on such deposits is excessive. If reserves are remunerated below market rates, bank reserve holdings would be relatively more expensive and, all else equal, compress banks' net interest margins. As a result, banks will have incentives to adjust the composition of deposits to offset this compression.

Reserve requirements have also been used to manage credit and liquidity countercyclically in a number of emerging market economies.[4] A large body of recent empirical literature suggests that reserve requirements have been particularly useful during episodes of externally-driven large capital inflows (resulting from quantitative easing or changes in risk aversion).[5] The main reason is that interest rate policy may not be enough to deal with conflicting objectives. For instance, when facing large capital inflows, a central bank might want to target price stability, but also curb domestic credit growth. However, although price stability might be achieved by raising the policy rate, the interest rate hike could attract additional capital inflows and magnify the credit cycle and appreciation of the domestic currency.[6] To overcome this dilemma, a number of central banks have used reserve requirements as a supplementary monetary policy tool. Ultimately, the effectiveness of this policy

[4] We refer to a countercyclical use if reserve requirements are raised during credit booms and decreased during busts.

[5] See, among others, Montoro and Moreno (2011) on Brazil, Colombia and Peru for 2006-10; Alper et al. (2016) on Turkey for 2010-15; Camors and Peydro (2013) on Uruguay for 2007-08; Hoffmann and Loeffler (2014) on 28 emerging markets for 1998-2012; Armas et al. (2014) on Peru for 2003-12; Tovar et al. (2012) on Brazil, Chile, Colombia, Mexico and Peru for 2004-11; Cordella et al. (2014) and Federico et al. (2014) on 52 countries (15 industrial and 37 developing) for 1970-2011.

[6] As argued by Bruno and Shin (2015) the appreciation of the currency can set in motion a feedback loop by strengthening the balance sheets of domestic borrowers and encouraging additional lending.

depends on whether higher reserve requirements tighten domestic credit conditions without attracting additional foreign capital.

Reserve requirements may help resolve the policy dilemma posed by capital flows if higher policy rates are associated with increases in both bank deposit and loan rates but higher reserve requirements only increase lending rates.[7] If so, domestic credit growth, aggregate demand, and inflation would be contained without encouraging additional short-term capital inflows.[8]

The pass through of changes in reserve requirements to bank interest rates depends on a number of factors. According to the traditional view ('cost channel'), higher reserve requirements represent an implicit tax on bank intermediation (if remunerated below market rates), and drive a wedge between the rate a bank pays its depositors and its cost of funds. All else equal, this compresses bank net interest margins. Profit-maximizing banks would have incentives to restore their margins through adjustments in the funding and pricing structure. If central bank credit is a close funding substitute of deposits, banks will reduce the demand for deposits and increase the demand for central bank credit (Betancourt and Vargas, 2008; Vargas et al., 2010; Tovar et al., 2012; Alper et al., 2016).[9] For a given policy rate, banks' marginal funding costs would be unaffected and, thus, they would have incentives to reduce deposit rates while keeping lending rates unchanged.[10]

If deposits and central bank credit are imperfect substitutes, higher reserve requirements will not be fully accommodated by increases in bank borrowing from the central bank.[11] Depending on the market structure, banks will attempt to restore the interest margin through adjustments in the volume and pricing of loans, deposits or both. If deposit supply is relatively inelastic (e.g. because of switching costs) or banks have market power on the deposit market, the cost of higher reserve requirements would be passed on to depositors in the form of lower deposit rates (Montoro and Moreno, 2011; Tovar et al., 2012; Agénor et al., 2015). If, on the other hand, loan demand is relatively inelastic and banks exert market power in the loan market, some of the cost of higher reserve requirements would be passed on to

[7] Higher policy rates tend to increase other interest rates in an economy with a stronger effect on short-term interest rates (Fransson and Tysklind, 2016).

[8] Using aggregate macroeconomic data, Reinhart and Reinhart (1999) provide empirical evidence that the response of loan and deposit rates to changes in reserve requirements is asymmetric in developing countries. Other studies highlight or provide empirical evidence on the usefulness of higher reserve requirements in mitigating credit growth in emerging markets (Montoro and Moreno, 2011; Tovar et al., 2012; Izquierdo et al., 2013; Armas et al., 2014; Cordella et al., 2014; Federico et al., 2014; Glocker and Towbin, 2015).

[9] In an inflation targeting regime, the central bank usually offers the liquidity necessary for the market to clear at the policy rate. In a quantitative monetary regime, in contrast, reserve requirements would have a direct effect on the money multiplier and thus on monetary aggregates and bank credit (Vargas et al., 2010; Tovar et al., 2012).

[10] Similar outcomes would be obtained with other forms of financing, as long as they are funding substitutes for deposits. For instance, in the small-open economy model of Edwards and Végh (1997), banks increase borrowing from the rest of the world by selling bonds in response to tighter reserve requirements.

[11] Betancourt and Vargas (2008) showed that, in the presence of risk averse banks and interest rate risk, central bank credit and deposits are not perfect substitutes. The substitutability would be lower when financial markets are underdeveloped, information frictions are high, or when the supply of liquidity from the central bank is not perfectly elastic at the policy rate (as in the case of a discount window stigma effect (Armantier et al., 2013), or because of imperfections in the interbank market).

borrowers in the form of higher lending rates (Montoro and Moreno, 2011; Tovar et al., 2012). In less competitive and underdeveloped financial markets, where financial frictions tend to be high, banks will most likely respond by adjusting both lending and deposits rates.

Some recent work has highlighted two additional channels through which changes in reserve requirements may affect banks' pricing and funding decisions (Vargas et al., 2010; Alper et al., 2016). The first refers to situations in which banks substitute longer-term deposits with shorter-term central bank borrowing in response to tighter reserve requirements ('interest rate risk channel'). To the extent that this adds to a bank's interest rate risk, a risk averse bank would have incentives to tighten lending conditions and increase its financing via deposits (Betancourt and Vargas, 2008; Vargas et al., 2010). The second transmission channel ('liquidity channel') is based on the idea that banks have to pledge unencumbered securities as collateral for central bank borrowing.[12] All else equal, an increase in central bank borrowing is associated with a decline in banks' (unencumbered) liquidity holdings, which may tighten lending conditions and increase bank reliance on deposits (Alper et al., 2016). The two transmission channels would thus reinforce any positive effect of the cost channel on lending rates and mitigate any negative effect on deposit rates.

The overall effect of changes in reserve requirements depends as well on the magnitude and expected duration of the change, reserve remuneration, excess reserve holdings, and whether average or marginal reserve requirements are modified. For example, if the magnitude of the change is small, expected to be in place for a short period, reserves are remunerated close to market rates, and only marginal reserve requirements are modified, banks' responses should be moderate.

Recent theoretical contributions that study the macroprudential role of reserve requirements using general equilibrium models provide insights that go beyond the partial equilibrium effects of reserve requirements described so far. Bianchi (2011), Glocker and Towbin (2012), Kashyap and Stein (2012), Medina and Roldós (2014), and Agénor et al. (2015) show that higher reserve requirements increase the effective cost of deposits and in their models banks lower deposit rates. Bianchi (2011) showed that, prior to a crisis, capital and reserve requirements may have similar effects from a macroprudential perspective, as both act as a tax, increase the cost of borrowing and reduce the likelihood and negative externalities of excessive credit growth. Glocker and Towbin (2012) showed that higher reserve requirements (as an additional policy instrument for financial stability objectives) become most effective in the presence of financial frictions and foreign currency debt, in contrast to conventional interest rate policies.[13] Kashyap and Stein (2012) showed that a central bank can use required reserve policies to tax the negative systemic externality created by excessive short-term borrowing of financial intermediaries. Medina and Roldós (2014) provide

[12] Even though the collateral framework varies across countries (BIS Market Committee, 2013), there are some common principles such as Bagehot's principle: lend against good collateral at an appropriate price, while managing the risk associated with such activity.

[13] The reason is that higher policy rates (e.g. in response to lower world interest rates) are associated with domestic currency appreciation, because banks increase deposit rates which leads to additional capital inflows. The appreciation lowers borrowing costs by increasing borrowers' net worth (lowering the domestic currency value of debt), thus offsetting the contractionary effect of the interest rate hike. Higher reserve requirements, on the other hand, are associated with currency depreciation, because banks decrease deposit rates in response which discourages capital inflows. This negatively affects borrowers' net worth, increases the external finance premium, and dampens the credit cycle.

evidence that a conventional inflation-targeting framework augmented by countercyclical reserve requirements can reduce welfare losses associated with temporary declines in world interest rates. Similar results are obtained by Agénor et al. (2015) who show theoretically that a credit-based reserve requirement rule may be effective as a countercyclical instrument, in a setting of imperfect capital mobility and sterilized intervention.[14]

2. Empirical analysis

Data

This study makes use of annual bank-level data from BankScope for major Latin American banking systems. Where possible, we gather consolidated financial statements of banks on the assumption that banks manage their entire set of banking activities on a consolidated basis. If no such statement exists (as in the case of foreign subsidiaries), we use the unconsolidated financial statement reported for the bank.

Our study focuses on the interest rates set by deposit-taking entities so we exclude non-bank entities from the sample.[15] We also have to eliminate banks and countries from the study for which we were unable to obtain relevant information to compute the implicit interest rates or other variables to parameterize the empirical model. After applying our filters, the final sample covers 128 deposit-taking entities over the period 2000-14 that operate in Argentina, Brazil, Chile, Colombia, Mexico, Peru and Uruguay.[16] Of the 128 banks, 76 are domestically owned and 52 are subsidiaries of foreign banks.

Table 2 reports summary information for the countries. At the end of 2014, total assets amounted in total to 3.1 trillion US dollars which corresponds to 75 percent of the assets reported in the Top 200 Latin American Banks Ranking of The Banker magazine. Banks in our sample face different monetary policy conditions in the countries in which they operate. While policy rates tended to be low in Chile, Colombia, Mexico and Peru, they have been higher in Argentina, Brazil and Uruguay. Moreover, the way reserve requirements are regulated differ in type, magnitude and remuneration. These factors have to be taken into account in our analysis, because

[14] As the authors note, for the reserve requirement policy to be effective, central bank borrowing and deposits cannot be perfect funding substitutes. In their model, banks can borrow from the central bank only at a penalty rate above the policy rate (depending on the ratio of central bank borrowing to deposits) due to a discount window stigma effect (see also Armantier et al., 2013). They show that the positive relationship between the reserve policy and macroeconomic and financial stability is nonmonotonic, which means that beyond a certain threshold, too large changes in reserve requirements can increase the volatility of business and financial cycles.

[15] We cross-reference the list of financial institutions obtained from BankScope with the registry of licensed banking entities reported by the various central banks to distinguish deposit-taking entities from the other types of financial firms (that are classified by BankScope as commercial banks).

[16] The initial sample included 217 commercial, savings and cooperative banks, bank holdings, and specialized governmental credit institutions from 11 major Latin American economies. Bolivia and Paraguay had to be excluded due to insufficient information on the monetary policy indicators, Ecuador and Venezuela were excluded due to structural differences in their monetary policy framework, and data on Argentina were excluded during the convertibility regime prior to 2002.

each bank faces a different required reserve ratio depending on the composition of deposits.[17]

Colombia and Mexico have a single reserve requirement that applies to all deposits, while in the other countries reserve regulation depends on the maturity and/or currency composition.[18] When regulation depends on the type of deposits, central banks set higher reserve requirements on short-term deposits and those denominated in foreign currency (Table 3), which means that they discourage banks from relying too much on this type of funding.[19] For example, in Argentina and Uruguay, two countries that experienced domestic liability dollarization and liquidity crises, there are six required reserves ratios and a bank's amount of required reserves is calculated as follows:

$$RR_{kct} = \sum_{i=dem,sav,time} \tau^{i}_{l,ct} D^{i}_{l,kct} \quad + \quad \sum_{j=dem,sav,time} \tau^{j}_{f,ct} D^{j}_{f,kct} \qquad (1)$$

where k refers to banks, c to countries and t to years. The subscripts l and f stand for local and foreign currency, and $i = D^{dem}, D^{sav}$, and D^{time} are demand, savings and time deposits. The required reserve ratios for each type of deposit are denoted by τ. Reserve requirements are in most of the countries applied to the stock of deposits, but there are cases in which on top marginal reserve requirements are imposed on new deposit inflows.[20]

As a result of this weighting, each bank in our sample faces a different effective required reserve ratio. Banks that rely heavily on demand deposits will tend to have a higher reserve requirement than banks with a longer-term maturity structure. For example, although reserve requirements on demand deposits in Brazil are very high, averaging 45 percent over the sample, the impact on total required reserves is mitigated by the relatively low fraction of demand deposits (16 percent of deposits), implying required reserves of 7.2 percent of total deposits for this category (see Table 3). In contrast, in Uruguay the lower reserve requirements on demand deposits of 18

[17] Peru requires reserves not only on deposits, but also on short-term external liabilities (Armas et al., 2014). Similar, Colombia has an additional requirement on certificates of deposits and bonds with a maturity of less than 18 months (Tovar et al., 2012).

[18] Mexico has had two types of requirements. One is a zero-average reserve requirement system (Yacaman, 2000). Over a 28-calendar-day maintenance period, each bank strives to manage the balances on its current account at the central bank so that they average zero at the end of each period. If the accumulated balance is negative, a bank has to pay a high interest rate on the balance. Another type of requirement is the so-called Depósito de Regulación Monetaria. This is not a fractional reserve system. Instead, relatively infrequently, the Bank of Mexico sets a nominal fixed amount of required deposits at the central bank. For example, at this writing, the last time the amount was adjusted was in 2014. The text used by the central bank suggests that they interpret this as being different from the reserve requirements used by other central banks (see Banxico, 2010). However, in practice the restrictions have some similarities with reserve requirements so for purposes of the present analysis, we will treat these required deposits as required reserves.

[19] In Peru, differential rates seek to encourage banks to internalize the risk of granting dollar-denominated loans to local income earners and to create a foreign exchange liquidity buffer, thereby reducing systemic liquidity risks (Quizpe and Rossini, 2010; Montoro and Moreno, 2011; Armas et al., 2014).

[20] Peru and Uruguay have applied marginal reserve requirements on local and foreign currency deposits during our sample period (BCRP, 2005, 2010, 2013; BCU, 2011, 2015). For instance, the Peruvian central bank tends to operate simultaneously with average and marginal reserve requirements (Castillo et al., 2016). Colombia used marginal reserve requirements only in 2007, whereas the remaining countries in our sample only used them in the early nineties (Reinhart and Reinhart, 1999; Vargas et al., 2010).

percent are offset by a very high share of demand deposits (51 percent), implying required reserves of 9 percent of total deposits.

The extent to which a bank reacts to changes in reserve requirements does not only depend on the reserve ratio, but also on whether reserve requirements are remunerated or not. All countries in our sample have remunerated required reserves in one way or the other. Some countries have linked the remuneration to the Libor rate (Peru), federal funds rate (Uruguay), CPI inflation or target (Chile and Colombia), policy rate (Brazil), overnight deposit/interbank rate (Peru and Mexico), or they have employed fixed rates of remuneration (Uruguay).[21] Depending on the country, reserves on deposits of short maturity have not been remunerated or have been remunerated at a very low rate (Brazil), only excess reserves have been remunerated (local currency deposits in Peru), or the remuneration differs for local and foreign currency deposits (Peru and Uruguay). When reserve requirements are remunerated (typically below market rates), the distortionary tax effect becomes smaller as does the impact of changes in the reserve requirement on the banking system (Montoro and Moreno, 2011). At the same time, the central bank assumes some cost when raising reserve requirements.

For purposes of analysis, required reserves must be adjusted to take into account the effects of remuneration, otherwise the reported reserves will not be comparable. Following Vargas et al. (2010), we calculate a remuneration-adjusted required reserve ratio that, without remuneration, yields the same equilibrium prices and quantities as the 'effective' reserve requirement that takes into account remuneration. The adjustment procedure departs from the marginal net benefit of a deposit for a competitive retail bank that is subject to a remunerated reserve requirement: [22]

$$i_L(1-\tau) - i_D + \tau \cdot i_\tau - C_D - (1-\tau)C_L \qquad (2)$$

where i_L is the loan rate, τ the required reserve ratio, i_D the deposit rate, i_τ the rate at which reserves are remunerated, and C_D and C_L are the marginal operational costs of deposits and loans, respectively. Under the remuneration-adjusted required reserve ratio, τ^*, the marginal net benefit of a deposit is:

$$i_L(1-\tau^*) - i_D - C_D - (1-\tau^*)C_L \qquad (3)$$

For a given equilibrium, at which prices and quantities in the two regimes are equal, the marginal net benefits must coincide. Equalizing the two and solving for the remuneration-adjusted required reserve ratio yields:

$$\tau^* = \tau \cdot \left(1 - \frac{i_\tau}{i_L\left(1-{C_L}/{i_L}\right)}\right) = \tau \cdot A \qquad (4)$$

where A is an adjustment factor. For example, if the marginal cost of a loan is zero and the lending rate is equal to the remuneration rate, the remuneration-adjusted reserve requirement would be zero, since holding reserves and extending a loan yield the same return. In countries in which demand deposits are not remunerated ($i_\tau = 0$), the official and adjusted ratios for those deposits would coincide as $A = 1$.

[21] Details are provided in Barth et al. (2013), BCRA (2007, 2014, 2016), BCRP (2005, 2010, 2013), BCU (2011, 2015), Banxico (2003, 2008, 2010), Glocker and Towbin (2012), Montoro and Moreno (2011), Robitaille (2011), Tovar et al. (2012), Vargas et al. (2010), and Yacaman (2000). In Colombia, remuneration was eliminated in 2009 (Montoro and Moreno, 2011). See also Table 2.

[22] The marginal benefit is derived from a simplified version of the Monti-Klein model in which a competitive bank finances a loan portfolio with deposits that are subject to a reserve requirement. Moreover, the bank's cost function is assumed to be separable in loans and deposits.

To determine the remuneration-adjusted ratio in equation (4), the required reserve ratio and the remuneration rate may be taken from country level (central bank reported) data. However, we have to rely on our bank-specific dataset to calculate banks' loan rate i_L and marginal cost of lending C_L.

The interest rate on loans can be approximated by a bank's implicit lending rate (interest income on loans divided by total loans). However, an auxiliary regression is needed to estimate the marginal cost of loans using the same principle as for the estimation of the Lerner index (Lerner, 1934; Birchwood et al., 2017).[23] For this purpose, we estimate a trans-log cost function of the form:

$$\ln(TC_{kt}) = \alpha_0 + \alpha_1 \ln(Q_{kt}) + \frac{1}{2}\alpha_2 \ln(Q_{kt})^2 + \sum_{n=1}^{3} \beta_n \ln(w_{knt}) + \sum_{m=1}^{3}\sum_{n=1}^{3} \beta_{mn} \ln(w_{kmt} w_{knt}) + \sum_{n=1}^{3} \gamma_n \ln(Q_{knt}) \ln(w_{knt}) + \alpha_k + \varepsilon_{kt} \quad (5)$$

Total costs TC_{kt} of bank k in year t are measured by the sum of personnel expenses, other non-interest and interest expenses, output Q by total loans, and w are three input prices for labour (measured by the ratio of personnel expenses to total assets), physical capital (ratio of other non-interest expenses to fixed assets) and funding (ratio of interest expenses to total funds). The partial derivative of the cost function with respect to output then gives the formula for estimating the marginal cost:

$$C_{L,kt} = \frac{TC_{kt}}{Q_{kt}} (\alpha_1 + \alpha_2 \ln(Q_{kt}) + \sum_{n=1}^{3} \gamma_n \ln(w_{knt})) \quad (6)$$

Combining equations (1), (4) and (6), the remuneration-adjusted required reserve ratio for each bank from country c can be calculated as follows:

$$\overline{\tau^*_{kct}} = \sum_{i=dem,sav,time} \tau^i_{l,ct} \cdot A_{kct} \cdot \frac{D^i_{l,kct}}{D^{all}_{kct}} + \sum_{j=dem,sav,time} \tau^j_{f,ct} \cdot A_{kct} \cdot \frac{D^j_{f,kct}}{D^{all}_{kct}} \quad (7)$$

where τ^i_{ct} are the country-specific required reserve ratios for demand, saving and time deposits in local and foreign currency, A_{kct} the bank-specific adjustment factor for reserve remuneration, and D^i_{kct}/D^{all}_{kct} is the bank-specific proportion of each type of deposit in the total of deposits. The average estimated adjustment factor for our sample is with 0.88 highest for demand deposits in local currency and lowest for time deposits in foreign currency (0.79). This reflects that the remuneration of time deposits in foreign currency has been higher relative to demand deposits.

The empirical implementation of this procedure poses some difficulties. First, the adjustment factor is a function of a bank's loan rate, which would introduce a correlation between the adjusted reserve ratio and the loan rate in the regressions (Vargas et al., 2010). To avoid this, we use the annual country average of our banks' implicit lending rates as an instrument for the bank-specific lending rates. Second, the adjusted reserve ratio depends on the composition of deposits and the marginal cost of loans. Taking these into account would introduce variation into our measure on top of that due to monetary policy decisions. To overcome this, we use for each bank its average share of each type of deposit in total deposits and its average marginal cost. And third, BankScope does not provide a currency breakdown of deposits. While this is no problem for the countries that have the same reserve requirement for local and foreign currency deposits (Brazil, Chile, Colombia and Mexico), it is more important for the other countries, notably, if there are large volumes of foreign currency deposits. We reduce the effect of this measurement error

[23] Vargas et al. (2010) use average costs as an approximation for marginal costs.

in two ways. On the one hand, we gather bank-specific information on foreign currency deposits in Peru, where domestic liability dollarization is important (close to half of bank deposits are denominated in US dollars, see Table 3).[24] For Argentina and Uruguay, we do not have information on the bank-level and use the yearly country average for each bank.[25]

Figure 3 shows the different measures of required reserve ratios over time. The arithmetic and deposit-weighted average of the reserve ratio differ markedly, indicating that the simple average (based on equal deposit ratios) overestimates banks' effective required reserve ratios. This reflects that banks' deposit composition is skewed towards those that have lower reserve requirements. When adjusting for remuneration, the required reserve ratio drops further reflecting that most countries in our sample remunerated required reserves. Adjusting for the currency composition shifts the estimated reserve ratio up again, a result of the higher remuneration of foreign currency deposits.

Econometric framework

To compare the effects of reserve requirements and the policy rate on bank deposit and loan rates, we estimate the following benchmark model:

$$i_{kct} = \alpha_0 + \alpha_1 i_{kct-1} + \beta \cdot CB_{ct} + \gamma \cdot \overline{\tau^*_{kct}} + \Phi C_{ct} + \Psi X_{kct-1} + \vartheta_k + \varepsilon_{kct}$$

where i refers to banks' implicit deposit rate in one set of regressions and banks' implicit lending rate in the other regressions. We index individual banks with *k*, countries where banks are located with *c*, and years with *t*.[26]

The two monetary policy indicators are the central bank policy rate (CB) and the remuneration-adjusted, deposit-weighted required reserve ratio $\overline{\tau^*_{kct}}$ (see equation (7)). The coefficients β and γ, respectively, measure the responsiveness of bank loan and deposit rates to the policy rate and reserve requirements, after controlling for the macroeconomic environment and bank-specific conditions. While the policy rate enters the regression in levels, the adjusted required reserve ratio is expressed in annual changes. For our purpose of analysis, we consider the change in the required reserve ratio (rather than the level), because most central banks in our sample have adjusted reserve requirements actively in response to domestic credit conditions, inflationary pressures, and/or the external environment (Argentina, Brazil, Colombia, Peru and Uruguay). The level, on the other hand, has been used for other prudential purposes mainly to reduce the reliance on short-term deposits (Brazil) or to reduce the incidence of dollarization (Argentina, Peru and Uruguay). Nonetheless, in the robustness tests, other specifications are examined using the cumulative change or level of the adjusted reserve ratio.

A number of policy and macroeconomic control variables are included in vector C. The first set of regressors controls for other possible monetary policy instruments

[24] The information was obtained from various issues of the Nota Semanal. See BCRP, Annex 3F on domestic liabilities of depository corporations in foreign currency.

[25] The adjustment is important for Uruguay, where foreign currency deposits amounted to 75 percent in 2014 (Uruguay, 2014). For Argentina, where we excluded the convertibility regime from the regressions, the ratio of foreign currency deposits has been moderate as a result of the corralito, amounting to 7 percent in 2014 (BCRA, 2014. Table: Información diaria sobre principales pasivos de las entidades financieras).

[26] The exact definitions of the variables are provided in Table 4.

including the annual change in capital controls and a dummy variable for marginal reserve requirements, which is equal to one when central banks imposed marginal reserve requirements and zero otherwise. The second group of regressors controls for the macroeconomic environment and it includes the growth rate of real GDP, CPI inflation, net private capital inflows as a percentage of GDP, currency depreciation, and the annual change in foreign currency denominated BIS cross-border liabilities. All these control variables characterize banks' domestic and external environment, and as such they are likely to affect banks' loan and deposit rates.

In order to take into account bank characteristics, we include bank-fixed effects υ and a vector of bank-specific indicators (X). Our modelling strategy relies on the hypothesis that certain bank-specific characteristics, including cost efficiency and credit defaults, also influence how banks set loan and deposit rates. Moreover, we allow for the possibility that banks differ in their ability to shield themselves from shocks. For example, following monetary policy changes, banks may differ in the extent to which they are able to adjust their interest rates. Less cost-efficient banks with higher non-performing loan ratios, which are penalised by markets, face a higher cost in raising non-secured deposits and they may therefore react to monetary policy changes more strongly. Larger banks, on the other hand, might find it easier to access funds from the capital market and cushion the effects of changes in monetary policy. However, they might just as well take advantage of their market power and transfer the higher burden of tighter monetary policy to bank borrowers and/or depositors. Taking into account these considerations, the vector X contains bank size, the average cost ratio and non-performing loan ratio. Moreover, we also include a dummy variable that indicates whether a bank reports under IFRS as opposed to local GAAP.[27]

One possible identification problem is endogeneity. Bank conditions and interest rate setting could affect monetary policy decisions. We address this potential problem by lagging all bank-specific characteristics by one year and by using the dynamic System Generalized Method of Moments (S-GMM) panel methodology, which reduces endogeneity bias and takes into account the heterogeneity in the data caused by unobservable factors affecting individual banks. The endogeneity problem, however, may not be as serious in our setting owing to the characteristics of our sample. While aggregate banking conditions could influence monetary policy, the response of any given bank is less likely to affect central bank decisions (Borio et al., 2017).

The baseline model is augmented to allow for possible asymmetric responses across banks of different types (reserve-constrained, foreign, savings and cooperative, government-owned, market power) and the macroeconomic environment. In the baseline case, we distinguish banks according to their reserve holdings. A bank that has reserves in excess of the regulatory minimum is likely to react less to changes in required reserve ratios than banks that are close to the minimum. Banks with large reserve holdings could conceivably lower or not change deposit rates in response to higher reserve requirements, whereas liquidity-constrained banks may increase deposit rates to attract depositors. Similarly, unconstrained banks may not have incentives to increase loan rates immediately in response to an increase in required reserves, preferring market share over profits, while constrained banks may consider increasing loan rates to reduce loan demand and refinancing. Moreover, we distinguish between normal times and periods of large capital inflows to examine

[27] The IFRS dummy controls for changes in the measurement of certain balance sheet items and other differences in accounting due to the introduction of the IFRS standards.

whether banks respond differently to monetary policy changes. This allows us to test whether reserve requirements are effective in resolving the policy dilemma central banks face during periods of large capital inflows: (i) increasing policy rates to cope with credit growth and inflation could be associated with even higher capital inflows if banks increase deposit rates, while (ii) tightened reserve requirements would not, if banks decrease deposit rates or keep them unchanged.

The model is therefore further enriched by including interactions between the two monetary policy indicators and the variables on reserve constraints and capital flows. In particular we estimate the following model:

$$i_{kct} = \alpha_0 + \alpha_1 i_{kct-1} + (\beta + \beta^* D_{kct} + \beta^{**} CF_{ct}) \cdot CB_{ct} + (\gamma + \gamma^* D_{kct} + \gamma^{**} CF_{ct}) \cdot \overline{\tau^*_{kct}} + \Phi C_{ct} + \Psi X_{kct-1} + \vartheta_k + \varepsilon_{kct}$$

where D is a bank-specific dummy variable for reserve-constrained banks and CF is a country-specific indicator for periods of large capital inflows. The coefficient γ^* indicates whether the response to changes in reserve requirements is different for reserve-constrained banks compared to the other banks, whereas γ^{**} indicates whether the responsiveness of loan and deposit rates is different during periods of large capital inflows.

Reserve-constrained banks are identified using the distribution of the difference of the BankScope items "cash and due from banks" and "loans and advances to banks" with respect to required reserves (the required reserve ratio multiplied by total deposits) as a percentage of total assets. If this ratio is below the 10th percentile of the distribution in a given country and year, a bank is considered as reserve-constrained and otherwise as unconstrained.[28] Periods of large capital inflows are identified as those years in which the ratio of net private capital inflows (excluding foreign direct investment) to GDP is above the 90th percentile of its distribution (or 4.4 percent of GDP).

Results

We now report the main findings. Table 4 provides the variable definitions and Table 5 the summary statistics of the regression variables. Table 6 reports the regression results for the deposit and loan rates. In the various columns of this table, the regressions are gradually augmented by including the interaction terms between the monetary policy indicators and the variables for reserve-constrained banks and periods of large capital inflows.

The results confirm the dynamic specification. Banks' lending and deposit rates are correlated over time. The autoregressive coefficient is larger for deposit rates in line with the view that banks change deposit rates less frequently than loan rates (Driscoll and Judson, 2013). Further, the Hansen test validates the instruments used in all model specifications (the null hypothesis of exogenous instruments cannot be rejected). The ensuing discussion will focus on the estimated results for the full model specification, shown in columns (III) and (VI) for the deposit rate and loan rate, respectively.

[28] Bank reserves held at the central bank are included in the two items, i.e. there is no distinction between required reserves, voluntary reserves and interbank positions. The identification thus relies on the assumption that interbank positions have been similar across banks.

Across all specifications, the two monetary policy instruments are major determinants of bank loan and deposit rates, and thus net interest margins. Banks tend to increase their loan and deposit rates with higher policy rates, but loan rates rise by more so net interest margins rise. This result is in line with the findings of Hannan and Berger (1991), Neumark and Sharpe (1992) and Gambacorta and Iannotti (2007). Banks increase lending rates because higher policy rates are associated with higher funding costs and increased credit risk (Borio and Fritz, 1995; Kashyap and Stein, 1995; Gambacorta and Mistrulli, 2014). On the other side, the upward pressure on deposit rates can be explained by the associated increase in money market rates which makes risk-free securities more attractive than deposits and results in a reduction of deposit supply.

Increases in the required reserve ratio do not significantly affect deposit rates during normal conditions, however, once facing large capital inflows banks appear to lower deposit rates (γ^{**} is significantly negative). This could be because banks prefer to keep deposit rates unchanged when business conditions are normal, as lowering them could lead to deposit withdrawals and lower profitability. In contrast, when external capital flows surge and bank funding is abundant, banks take advantage and lower deposit rates. The response of loan rates, on the other hand, does not depend on the external financial environment, as banks increase loan rates during normal times and periods of large capital inflows (γ is significantly positive, whereas γ^{**} is not significant). This finding could indicate that banks enjoy some market power in the loan market, because bond markets are underdeveloped and banks are the main providers of funds. Taken together, the results imply that banks widen net interest margins in response to higher reserve requirements.

The cost channel of increased reserve requirements appears to dominate the liquidity and interest rate risk channels, since banks do not increase deposit rates in response (Vargas et al., 2010; Alper et al., 2016). The transmission mechanism works, because the remuneration of reserves is lower than what a bank would have earned otherwise, i.e. $\overline{\tau^{*}_{kct}} > 0$. By absorbing liquidity from the banking sector, higher reserve requirements increase banks' marginal funding cost, act as a tax on bank intermediation, and thus drive a wedge between banks' loan and deposit rates. The higher lending rates suggest that banks cannot accommodate in full the higher cost by sourcing other funds such as central bank credit or short-term borrowing.

The results are economically relevant as well as statistically significant. A 100-basis point increase in policy rates is associated with a 30-basis point increase in bank deposit rates in the same year (i.e. $\beta = 0.302$). The instantaneous pass through to loan rates is stronger, i.e. banks increase loan rates by 58-basis points in response to a similar increase in the policy rate ($\beta = 0.581$). As noted before, the responses to policy rates do not differ across normal times and periods of large capital inflows (β^{**} is not significant). This stands in contrast to the response of bank deposit rates which is insignificant during normal times and significantly negative during periods of large capital inflows. To be more precise, in response to a 100-basis point increase in the required reserve ratio, banks reduce deposit rates by 19-basis points during periods of large capital inflows ($\gamma^{**} = -0.186$). And lastly, banks increase loan rates by 11-basis points in response during both normal times and periods of large capital inflows ($\gamma = 0.114$).

Apart from the monetary policy indicators, currency depreciation is another important factor of banks' pricing decisions. Higher currency depreciation is associated with both higher deposit and lending rates but the deposit rate rises by more, so the net interest margin falls. The positive relationship with the lending rate

could be related to higher expected credit risk associated with currency depreciation, particularly for borrowers from the import sector or local income earners that have borrowed in foreign currency. As for deposits, one might argue that banks increase their compensation to reduce withdrawals from the banking system.

Higher operating costs also raise net interest margins by lowering deposit rates and raising loan rates. The result confirms our a priori expectation that banks with high operating costs tend to charge higher loan markups and pay out lower rates to depositors than banks that are more cost efficient. Similar findings are reported in Brock and Rojas Suarez (2000) and Martinez Peria and Mody (2004) for a number of banking systems in Latin America.

There are other factors that influence banks' lending and deposit rates. While higher GDP growth is associated with significantly lower loan rates, banks do not seem to adjust deposit rates over the cycle. The first result could be explained by reduced credit risks and higher loan demand during booms. Increases in foreign currency cross-border liabilities vis-à-vis BIS reporting countries are associated with higher deposit rates, while loan rates do not react. This could be due to banks' increased demand for domestic currency deposits in response to the higher foreign currency exposure.

Results for different types of banks

Next, we consider the possibility that the monetary policy transmission differs across bank types and distinguish between (i) foreign-owned banks, (ii) savings and cooperative banks, (iii) government-owned banks, and (iv) banks with market power.[29] This means that we replace the variable on reserve-constrained banks with the different bank type indicators, which all take the value of 1 if a bank is of a specific type and 0 otherwise. Foreign and government-owned banks are identified using BankScope data on the global ultimate owner and information obtained from Claessens and van Horen (2013) and Brei and Schclarek (2013). For savings and cooperative banks, we use BankScope information on bank specialization, and banks with market power are those with a Lerner index above the 90th percentile of the distribution in a given country.[30] Table 7 shows the regression results of the full specification (i.e. comparable to columns (III) and (VI) of Table 6) for each bank type indicator.

There are signs that the type of banks matters. The pass through of higher policy rates to deposit rates is significantly lower at foreign banks. While domestic banks increase deposit rates by 31 basis points in response to a 100-basis point increase in policy rates, foreign banks' deposit rates increase by 24 basis points ($\beta + \beta^* = 0.307 - 0.071 = 0.236$, see first column of Table 7). The pass through to loan rates also depends on the bank type. Savings and cooperative banks do not increase loan rates as much as the other banks in response to higher policy rates ($\beta + \beta^* = 0.678 - 0.316$, see column VI of Table 7), whereas loan rates of banks with market power react more strongly ($\beta + \beta^* = 0.583 + 0.218$, see last column of Table 7). The two findings seem intuitive as higher market power allows banks to pass on more easily the

[29] Several studies have found that the pass through of interest rate policy can differ across banks depending on their financial condition or market power (see amongst others, Peek and Rosengren, 1995; Kishan and Opiela, 2000; de Graeve et al., 2007; Gambacorta, 2008).

[30] The Lerner index is computed as the mark-up a bank charges over its marginal costs. It involves an auxiliary regression as described in Birchwood et al. (2017).

implied costs of higher policy rates to bank borrowers (de Graeve et al., 2007), while cooperative and savings banks may be more involved in relationship lending and thus be more reluctant to increase loan rates in response. The main results on the pass through of changes in reserve requirements to deposit rates and loan rates are robust across all specifications, since the interaction terms of reserve requirements and the bank type indicators are never significant. Across all bank types, banks increase loan rates and decrease deposit rates (the latter only during periods of large capital inflows) in response to higher reserve requirements.

Robustness tests

To test for robustness, we examine alternative specifications for the monetary policy indicators and also estimate the model excluding Chile and Mexico which do not use reserve requirements actively. As can be seen in the first and seventh column of Table 8, the main results are robust to the exclusion of Chile and Mexico: banks increase both deposit and loan rates in response to higher policy rates, while they increase loan rates and keep unchanged or decrease deposit rates.

In the next two sets of regressions, we experiment with different specifications for our measure of capital controls. First, we replace the annual change in the index of Cantú García (2017) with the annual change in the index compiled by Fernández et al. (2015). As can be seen in columns II and VIII, the main results on the asymmetric response of loan and deposit rates to policy rates and reserve requirements are not affected by the measurement of capital controls. Next, we interact the annual change in capital controls with our dummies for reserve-constrained banks and periods of large capital controls, as we did with the other two monetary policy variables. This allows us to examine, side-by-side, the relationship between bank interest rates, policy rates, reserve requirements and capital controls. The previous results are not affected. According to our regressions, changes in capital controls do not have a significant impact on loan and deposit rates, after controlling for the other monetary policy indicators.

In the next set of regressions, we consider instead of the level of the policy rate its annual change. The results shown in columns IV and X suggest that banks increase both deposit and lending rates in response to positive changes in policy rates. The pass through is somewhat lower than for the level, which is not surprising. With regard to increases in reserve requirements, we still find an asymmetric response: banks decrease deposit rates (during both normal times and periods of large capital inflows) and increase lending rates (the latter only during periods of large capital inflows).

In the final two sets of regressions, we replace the annual change in the required reserve ratio by (i) its cumulative change and (ii) its level. The first test allows us to see whether banks' adjustment is not only related to instantaneous changes in reserve requirements, but also to past changes. The second test checks whether regulations in place in some countries are binding, so there is no need for adjustment.

As shown in Table 8 (columns V and XI), there is evidence of a positive correlation between bank loan rates and the cumulative change in reserve requirements, particularly during periods of large capital inflows, but deposit rates do not react. This is in contrast to the evidence that deposit rates adjusted instantaneously during periods of large capital inflows (Tables 6 and 7). Bank lending rates also do not react as much to the level of reserve requirements, as shown in columns VI and XII, except during periods of large capital inflows. Deposit rates are not significantly related to the level of reserve requirements. Across all specifications, banks increase loan and

deposit rates in response to higher policy rates confirming our findings of an asymmetric response of bank interest rates to policy rates and reserve requirements.

Conclusion

Using disaggregated bank data, this paper has shed light on bank pricing (lending and deposit rate) behaviour in Latin America in response to interest rate and reserve requirement policies. It also describes how this response may vary depending on a number of factors, including the cycle of external capital flows, the behaviour of the exchange rate, or capital controls. Our econometric analysis is based on 128 major banks from seven Latin American countries over the period 2000-14.

An important finding is that there is an asymmetric response of loan and deposit rates to changes in reserve requirements: when facing higher reserve requirements, banks tend to increase loan rates, which contains credit growth, while they do not increase or even decrease deposit rates, which mitigates capital inflows and relieves pressure from the capital account. This is not the case with conventional interest rate policy, as banks increase both loan and deposit rates when facing higher policy rates.

These results suggest that in Latin America reserve requirements have been an effective tool to resolve policy dilemmas associated with capital inflows. While conventional interest rate policy may exacerbate the cycle in capital flows, the active use of reserve requirements can help in curbing domestic credit growth while mitigating capital inflows. In particular, adjustments in reserve requirements may have helped to stabilise domestic credit growth in a way that moderated capital flows. They may also have helped to smooth credit growth during the expansionary and contractionary phases of the economic and financial cycle.

That said, there are trade-offs in the use of reserve requirements, which can give rise to distortions in the financial system that increase the cost of credit and reduce financial intermediation. In our view, it is the adjustment in required reserve ratio during the capital flow cycle, not the level, that is effective in resolving the policy dilemma.

References

Agénor, R.P., K. Alper and L. Pereira da Silva (2015): "External Shocks, Financial Volatility and Reserve Requirements in an Open Economy," Working Papers Series 396, Central Bank of Brazil, Research Department.

Alper, K., M. Binici, S. Demiralp, H. Kara, and P. Özlü (2014): "Reserve Requirements, Liquidity Risk, and Credit Growth," Working Paper No. 14/24, Central Bank of Turkey.

Araujo, J.D., David, A.C., van Hombeeck, C. and C. Papageorgiou (2017): "Non-FDI Capital Inflows in Low-Income Countries: Catching the Wave?," *IMF Economic Review*, vol. 65(2)

Arellano, M. and O. Bover (1995): "Another look at the instrumental variable estimation of error-components models," *Journal of Econometrics*, 68(1), 29-51.

Armantier, O., E. Ghysels, A. Sarkar, and J. Shrader (2013): "Discount Window Stigma during the 2007-2008 Financial Crisis," Staff Report No. 483, Federal Reserve Bank of New York.

Armas, A., P. Catillo, and M. Vega (2014), "Inflation Targeting and Quantitative Tightening: Effects of Reserve Requirements in Peru," Working Paper No. 499, Inter-American Development Bank.

Banco de la República Argentina [BCRA] (2007): "Efectivo mínimo," Ultima comunicación incorporada A 4691, Banco Central de la República Argentina.

--- (2014a): "Prudential Regulations," Banco Central de la República Argentina.

--- (2014b): "Boletín Estadístico," Banco Central de la República Argentina.

--- (2016): "Boletín Estadístico – Notas metodológicas," Banco Central de la República Argentina.

Banco de México [Banxico] (2003, 2008): "Circular: Depósito de regulación monetaria," Circular 10/2003 and 36/2008. Banco de México.

--- (2010): "Depósito de regulación monetaria," Banco de México.

Banco Central de Reserva del Perú [BCRP] (2005): "Nota informativa – Evolución de la tasa de remuneración al encaje en moneda extranjera," Departamento de Prensa, Banco Central de Reserva del Perú

--- (2010, 2013): "Nota informativa – Tasa de remuneración de los fondos de encaje en el Banco Central de Reserva del Perú," Departamento de Prensa, Banco Central de Reserva del Perú.

Banco Central del Uruguay [BCU] (2011): "Resolución sobre aumento de encajes medios y creación de encajes marginales," Banco Central del Uruguay.

--- (2015): "Resolución por cambio en la normativa de encajes: Cronograma para la eliminación de encajes marginales y modificación de encajes medios," Banco Central del Uruguay.

Barth, J. R., G. Caprio, and R. Levine (2013): "Bank regulation and supervision in 180 countries from 1999 to 2011," *Journal of Financial Economic Policy*, vol. 5(2).

Betancourt, Y. R. and H. Vargas (2008): "Encajes bancarios y la estrategia de Inflación Objetivo," Borradores de Economía, no 533, Banco de la República. Ensayos sobre política económica, vol 27, no 59, June 2009.

Bianchi, J. (2011): "Overborrowing and Systemic Externalities in the Business Cycle," *American Economic Review*, vol. 101, 3400-26.

Birchwood, A., M. Brei and D. Noel (2017): "Bank Margins and Regulation in Central America and the Caribbean," *Journal of Banking and Finance*, vol. 85, 56-68.

BIS Market Committee (2013): "Central bank operating frameworks and collateral markets," CGFS Paper 53.

Borio, C. and W. Fritz (1995): "The response of short-term bank lending rates to policy rates: a cross-country perspective," BIS Working Papers 27, Bank for International Settlements.

Borio, C., L. Gambacorta and B. Hofmann (2017): "The influence of monetary policy on bank profitability," *International Finance*, vol. 20, 48-63.

Brei, M. and A. Schclareck (2013): "Public bank lending in times of crisis," *Journal of Financial Stability*, vol. 9, 820-830.

Brock, P. and S. Rojas Suarez (2000): "Understanding the behavior of bank spreads in Latin America," *Journal of Development Economics*. vol. 63, 113-134.

Bruno, V. and H.S. Shin (2015): "Capital flows and the risk-taking channel of monetary policy," *Journal of Monetary Economics*, vol. 71(C), 119-132.

Camors, C. D. and J.-L. Peydro (2013): "Macroprudential and Monetary Policy: Loan-Level Evidence from Reserve Requirements," unpublished manuscript.

Cantú García, C. (2017): "Effects of capital controls on foreign exchange liquidity," BIS Working Papers 659, Bank for International Settlements.

Castillo, P., H. Vega, E. Serrano and C. Burga (2016): "De-dollarization of credit in Peru: the role of unconventional monetary policy tools," Banco Central de Reserva del Perú, DT. N° 2016-002

Cayazzo, J., A. Garcia Pascual, E. Gutierrez, and S. Heysen (2006): "Toward an Effective Supervision of Partially Dollarized Banking Systems," IMF Working Paper 06/32.

Chinn, M.D. and M.P Dooley (1997): "Financial repression and capital mobility: why capital flows and covered interest rate differentials fail to measure capital market integration," Monetary and Economic Studies, Dec. 1997.

Claessens, S. and N. Van Horen (2015): "The impact of the global financial crisis on banking globalization," *IMF Economic Review*. Vol. 63(4): 868-918.

Cordella, T., P. Federico, C. Végh, and G. Vuletin (2014): "Reserve Requirements in the Brave New Macroprudential World," Policy Research Working 6793, World Bank.

Dancourt, O. (2012): "Crédito bancario, tasa de interés de política y tasa de encaje en el Perú," Ensayos Económicos 65/66, September 2012, Banco Central de la República Argentina.

De Graeve, F., O. De Jonghe, and R. V. Vennet (2007): Competition, transmission and bank pricing policies: Evidence from Belgian loan and deposit markets. *Journal of Banking and Finance*, vol 31(1), 259–278.

Driscoll, J.C. and R.A. Judson (2013): "Sticky deposit rates," Finance and Economic Discussion Series. Federal Reserve Board.

Edwards, S. and C. Végh (1997): "Banks and macroeconomic disturbances under predetermined exchange rates," *Journal of Monetary Economics*, Elsevier, vol. 40(2), pages 239-278, October.

Federico, P., C. A. Végh, and G. Vuletin (2014): "Reserve Requirement Policy over the Business Cycle," Working Paper No. 20612, National Bureau of Economic Research.

Fernández, A., M.W. Klein, A. Rebucci, M. Schindler, and M. Uribe (2015) "Capital Control Measures: A New Dataset," IMF Working Paper 15/80.

Fransson, L. and O. Tysklind (2016): "The effects of monetary policy on interest rates," Sveriges Riksbank Economic Review, 2016:1.

Gambacorta, L. and S. Iannotti (2007): "Are there asymmetries in the response of bank interest rates to monetary shocks?," *Applied Economics*, vol. 39(19), p. 2503-17.

Gambacorta, L. (2008): "How do banks set interest rates?," *European Economic Review*, vol. 52(5), 792-819.

Gambacorta, L. and P. E. Mistrulli (2014): "Bank Heterogeneity and Interest Rate Setting: What Lessons Have We Learned since Lehman Brothers?," *Journal of Money, Credit and Banking*, vol. 46(4), 753-78.

Glocker, C., and P. Towbin (2012): "Reserve Requirements for Price and Financial Stability: When are they Effective?," *International Journal of Central Banking*, vol. 8, 65-114.

--- (2015): "Reserve Requirements as a Macroprudential Instrument: Empirical Evidence from Brazil," *Journal of Macroeconomics*, 44, 158-76.

González-Rozada, M., and M. Sola (2014): "Towards a 'New' Inflation Targeting Framework: The Case of Uruguay," IDB Working Paper No. IDB-WP-486.

Gray, S. (2011): "Central Bank Balances and Reserve Requirements," Working Paper No. 11/36, International Monetary Fund.

Hannan, T. and A. Berger (1991): "The Rigidity of Prices: Evidence from the Banking Industry," *American Economic Review*, vol. 81 (4), 938-45.

Hoffmann, A. and A. Löffler (2014): "Low Interest Rate Policy and the Use of Reserve Requirements in Emerging Markets," *Quarterly Review of Economics and Finance*, vol. 54, 307-14.

Izquierdo, A., R. Loo-Kung, and L. Rojas-Suarez (2013): "Macroprudential Regulations in Central America," Working Paper No. 318, Center for Global Development.

Kashyap, A.K. and J.C. Stein (1995): "The impact of monetary policy on bank balance sheets," Carnegie-Rochester Conference Series on Public Policy. Vol. 42: 151-95.

--- (2012), "The Optimal Conduct of Monetary Policy with Interest on Reserves," *American Economic Journal: Macroeconomics*, vol. 4, 266-82.

Kishan, R. P. and T. Opiela (2000): "Bank Size, Bank Capital, and the Bank Lending Channel", *Journal of Money, Credit and Banking*, vol. 32, issue 1, p. 121-41.

Lerner, A.P. (1934): "The Concept of Monopoly and the Measurement of Monopoly Power," *The Review of Economic Studies*, 1, 157-75.

Martinez Peria, M.S. and A. Mody (2004): "How foreign participation and market concentration impact bank spreads: Evidence from Latin America," *Journal of Money, Credit and Banking*, vol. 36(3), 511-37.

Medina, J. P., and J. Roldós (2014): "Monetary and Macroprudential Policies to Manage Capital Flows," Working Paper No. 14/30, International Monetary Fund.

Mesquita, M. and M. Toros (2010): "Brazil and the 2008 Panic", in "The global crisis and financial intermediation in emerging market economies", BIS Papers 54, December.

Montoro, C., and R. Moreno (2011): "The Use of Reserve Requirements as a Policy Instrument in Latin America," *BIS Quarterly Review* (March), 53-65.

Neumark, D. and S. Sharpe (1992): "Market Structure and the Nature of Price Rigidity: Evidence from the Market for Consumer Deposits," *The Quarterly Journal of Economics*, vol. 107(2), 657-680.

Peek, J. and E. Rosengren (2000): "Collateral damage: Effects of the Japanese bank crisis on real activity in the United States," *American Economic Review* vol. 90 (1), 30-45.

Reinhart, C. M., and V. R. Reinhart (1999): "On the Use of Reserve Requirements in Dealing with Capital Flow Problems," *International Journal of Finance and Economics*, 4 (January), 27-54.

Robitaille, P. (2011): "Liquidity and Reserve Requirements in Brazil," Working Paper No. 1021, International Finance Discussion Papers, Federal Reserve Board.

Quizpe, Z. and R. Rossini (2010): "Monetary policy during the global financial crisis of 2007–09: The case of Peru," BIS Papers, no 54, 299–316.

Tovar, C. E., M. Garcia-Escribano, and M. Vera Martin (2012): "Credit Growth and the Effectiveness of Reserve Requirements and other Macroprudential Instruments in Latin America," Working Paper No. 12/143, International Monetary Fund.

Uruguay (2014): "Sistema Financiero," Uruguay XXI, Promoción de Inversiones y Exportaciones, April.

Vargas, H., Y. Betancourt, N. Rodríguez and C. Varela (2010): "Effects of reserve requirements in an inflation targeting regime: the case of Colombia," BIS Papers, no 54, pp 133–70.

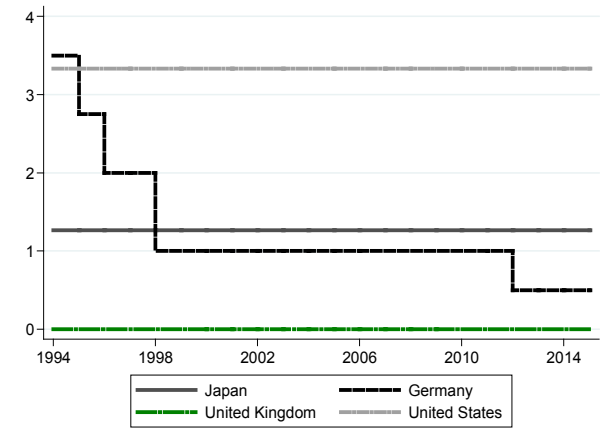
Yacaman, J. M. (2000): "The Implementation of Monetary Policy through the Zero-Average Reserve Requirement System: the Mexican Case," The Bank of Mexico.

Figures and tables

Figure 1: Reserve requirements for selected countries

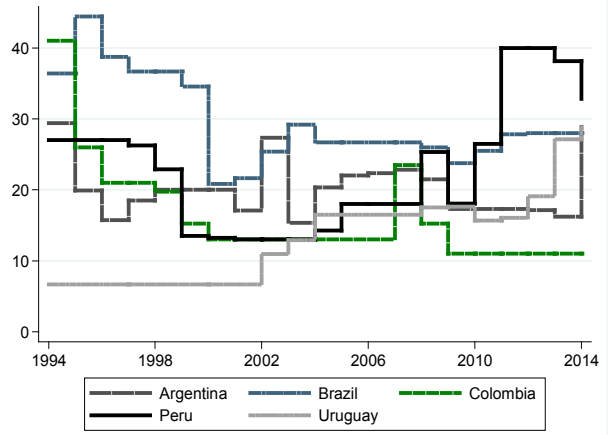
(I) Advanced economies

Percent



(II) Latin America

Percent



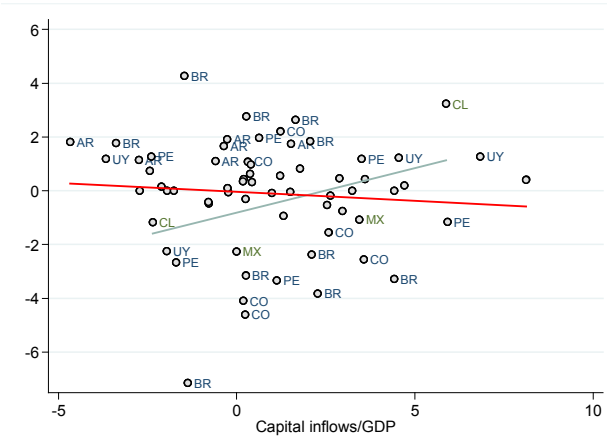
Note: The vertical axis shows the arithmetic average of the required reserve ratios for demand, saving and time deposits across domestic and foreign currency, where applicable, for selected countries over the period 1994-2015. For details on the Latin American countries, see Table 3.

Sources: Federico et al. (2014). Authors' calculations.

Figure 2: The monetary policy dilemma

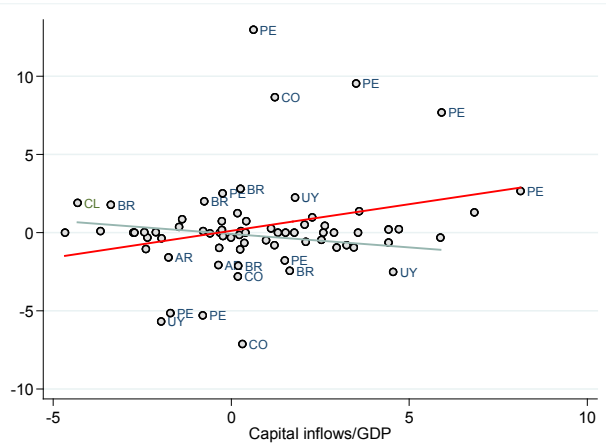
(I) Policy rate and capital flows

Percent



(II) Reserve requirements and capital flows

Percent



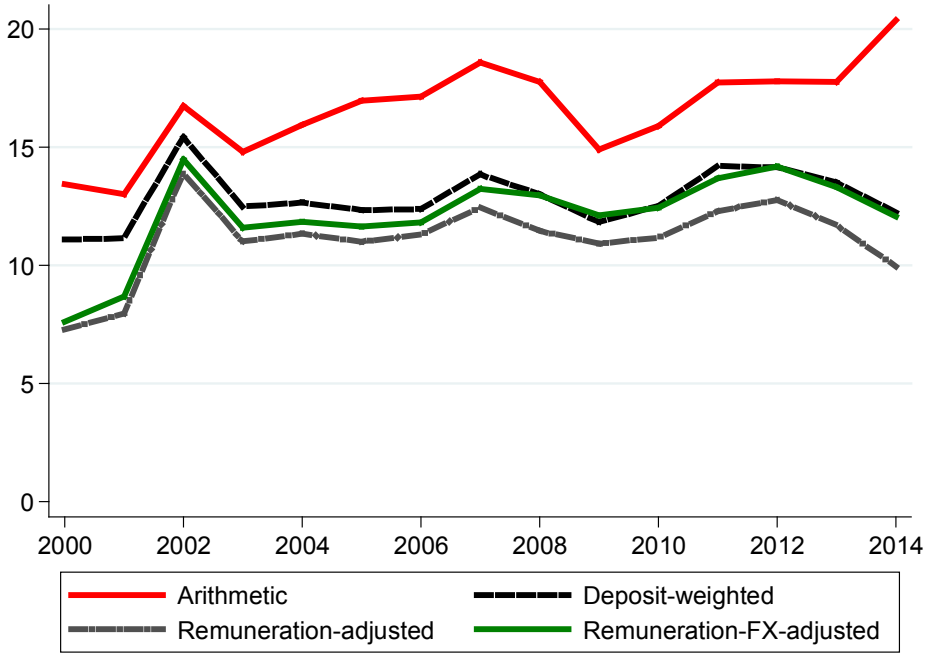
Note: The sample period is 2000-14. Each dot represents an observation per country and year. The vertical axis shows the annual change in the policy rate (left hand panel) and the annual change in the remuneration-adjusted required reserve ratios (right hand panel). The horizontal axis shows net private capital inflows (excluding FDI) as a percentage of GDP. The red line shows a linear trend for countries that use reserve requirements actively (Argentina, Brazil, Colombia, Peru, Uruguay), whereas the green line shows a linear trend for the other countries (Chile and Mexico).

Sources: Central bank reports; Araujo et al. (2014); Federico et al. (2014). Authors' calculations.

Figure 3: Weighted reserve requirements

Different measures of the required reserves ratio

Percent



Note: The sample period is 2000-14. Unweighted averages across banks are shown. "Arithmetic" indicates the arithmetic average of the required reserve ratios for demand, savings and term deposits across domestic and foreign currency, where applicable. "Deposit-weighted" is the average weighted by the share of demand, savings and term deposits in total deposits. "Remuneration-adjusted" is the deposit-weighted average adjusted for remuneration, and "Remuneration-FX-adjusted" is the remuneration-adjusted deposit-weighted ratio that takes in addition into account the currency composition of bank deposits. For details, see Table 3.

Sources: BankScope; Central bank reports; Federico et al. (2014). Authors' calculations.

Table 1: Intensity and frequency of changes in reserve requirements (2000-14)

Country	Change in required reserve ratio					No. of changes
	min	year	max	year	mean	
Argentina	-12.00	2003	12.66	2014	0.00	10
Brazil	-13.75	2000	3.75	2003	0.00	10
Chile	0.00		0.00		0.00	0
Colombia	-8.25	2008	10.50	2007	0.00	3
Mexico	-0.98	2007	2.17	2003	-0.31	9
Peru	-7.25	2009	13.50	2011	0.00	9
Uruguay	-1.96	2010	8.04	2013	0.37	10
Average	-6.13		7.23		0.01	7.29

Note: In percentage points. The required reserve ratio is measured as the arithmetic average of the required reserve ratios across deposits of different maturity and currency denomination. For Mexico, commercial bank monetary regulation deposits are reported as a fraction of total deposits. 'Min' indicates the minimum change in the required reserve ratio, 'year' the date at which the change took place, 'max' the maximum change, 'mean' the average change, and 'No. of changes' counts the number of times the required reserve ratio has changed at year-end.

Sources: Federico et al. (2014); Central bank reports. Authors' calculations.

Table 2: Characteristics of the database (2000–14)

Country	Total assets, end-2014		Loan rate	Deposit rate	Loan-deposit spread	Policy rate	Reserve requirements					No. of banks	No. foreign banks
	Billion USD	Percent of GDP					Type	Weighted[1]	Marginal	Remun-eration[2]	Use		
Argentina	130.7	23.9	14.1	6.3	7.8	7.7	CM	15.4	No	Yes	Active	30	9
Brazil	2047.6	98.6	21.0	16.9	4.1	13.9	M	14.4	No	Yes	Active	24	5
Chile	186.9	69.3	9.0	3.4	5.6	3.9	M	4.1	No	Yes	Inactive	12	4
Colombia	193.9	87.4	14.0	4.1	9.9	5.2	S	12.0	Yes	No	Active	20	8
Mexico	397.9	31.0	11.8	2.9	8.9	4.4	S	4.0	No	Yes	Inactive	19	8
Peru	119.8	61.4	14.3	2.9	11.4	3.7	C	20.6	Yes	Yes	Active	15	11
Uruguay	7.2	13.5	8.5	0.8	7.7	8.2	CM	8.7	Yes	Yes	Active	8	7
Average/sum*	3084*	55.0	13.2	5.3	7.9	6.7	n.a.	11.3	n.a.	n.a.	n.a.	128*	52*

Note: Unweighted averages across banks per country. "Average/sum*" indicates unweighted averages or sums (*) over countries. The loan rate is defined as interest income on loans divided by total loans, and the deposit rate is calculated as interest expenses on customer deposits divided by total deposits. The policy rate is the seven-day interbank lending rate for Argentina, Selic for Brazil, discount rate for Chile, minimum expansion rate for Colombia, overnight interbank rate for Mexico, reference rate for Peru, and T.P.M. for Uruguay. "Type" indicates whether reserve requirements are distinguished across currency (C), maturity (M), currency and maturity (CM), or whether there is a single requirement (S). Weighted reserve requirements are the average required reserve ratios weighted by banks' maturity and currency composition of deposits, and adjusted for remuneration. "Marginal" indicates whether marginal reserve requirements have been used during 2000-14. "Remuneration" indicates whether reserve requirements are remunerated. "Use" indicates whether central banks use reserve requirements as an active monetary policy tool. (1) For details, see Table 3. (2) Argentina: below market rate (only non-excess reserves); Brazil: demand deposits (no remuneration), savings deposits (above bank deposit certificate rate), other deposits (Selic); Chile: below CPI month rate; Colombia: 0% since 2009, below inflation target (2007-08), fixed rate on savings and time deposits (prior to 2007); Mexico: overnight interbank funding rate; Peru: only excess reserves, domestic currency deposits (below overnight deposit rate), foreign currency deposits (below LIBOR); Uruguay: domestic currency deposits (fixed rate), foreign currency deposits (below federal funds rate).

Sources: BankScope; Central bank reports; Montoro and Moreno (2011); Federico et al. (2014); Claessens and van Horen (2013). Authors' calculations.

Table 3: Required reserve ratios and composition of deposits (2000–14)

Country	Type	Required reserve ratio for deposits in local currency			Required reserve ratio for deposits in foreign currency			Fraction of total deposits				Overall required reserve ratio	
		Demand	Saving	Term	Demand	Saving	Term	Demand	Saving	Term	FX	Average	Weighted
Argentina	CM	18.7	18.7	12.4	25.6	25.6	21.3	20.9	28.0	51.1	7.7	20.4	15.4
Brazil	M	45.0	18.6	15.3	45.0	18.6	15.3	15.9	29.8	54.2	n.a.	26.3	14.3
Chile	M	9.0	3.6	3.6	9.0	3.6	3.6	25.5	2.9	71.6	n.a.	5.4	4.1
Colombia	S	12.4	12.4	12.4	12.4	12.4	12.4	18.8	37.6	43.6	n.a.	12.4	12.0
Mexico	S	6.4	6.4	6.4	6.4	6.4	6.4	28.4	17.6	54.1	n.a.	6.4	4.0
Peru	C	11.2	11.2	11.2	35.5	35.5	35.5	23.4	19.7	56.9	47.1	23.4	20.6
Uruguay	CM	18.0	9.0	4.0	29.5	29.5	22.3	51.1	32.8	16.2	81.6	18.7	8.7
Average		17.3	11.4	9.3	23.4	18.8	16.7	26.3	24.1	49.7	n.a.	16.2	11.3

Note: In percentages. Unweighted averages across banks per country. "Average" indicates unweighted averages across countries. "Type" indicates whether reserve requirements are distinguished across currency (C), maturity (M), currency and maturity (CM), or whether there is a single requirement (S). The columns on reserve requirements show the required reserve ratio for particular types of deposits (demand, saving and term) across domestic and foreign currency. The columns headed by "Fraction of total deposits" indicate the average ratio of demand, saving, term and foreign-currency (FX) deposits over total deposits. The columns "Overall required reserve ratio" show the arithmetic average of the required reserve ratios, and the weighted required reserve ratio takes into account banks' maturity and currency composition of deposits and remuneration (see equation (7) in section 2).

Sources: BankScope; Central bank reports; Federico et al. (2014). Authors' calculations.

Table 4: Variable definitions

Variable	***Definition***
Dependent variables	
Loan rate	Interest income on loans/Total loans
Deposit rate	Interest expense on customer deposits/Total deposits
Independent variables	
Policy rate	Central bank policy rate[1]
Reserve requirements	Annual change in the required reserve ratio[2]
Dummy, reserve constrained	=1, if excess reserve ratio below 10th percentile in a country and year[3]
Dummy, large capital inflow	=1, if net private capital inflows/GDP above 90th percentile[4]
Capital controls	Annual change in capital controls[5]
Dummy, marginal requirement	=1, if marginal reserve requirement in place
Real GDP growth	Annual real GDP growth
Inflation	Annual CPI inflation
Net private capital inflows	Net private capital inflows (excluding FDI)/GDP[6]
Depreciation	Annual growth in the exchange rate (>0: depreciation)
BIS liabilities, foreign currency	Annual change in foreign currency denominated cross-border liabilities[7]
IFRS dummy	=1, once a bank changed accounting standards from local GAAP to IFRS
Size (t-1)	Logarithm of total assets
Cost ratio (t-1)	Total operating costs/Total assets
NPL ratio (t-1)	Non-performing loans/Total loans

Note: [1]Seven-day interbank lending rate for Argentina, Selic for Brazil, discount rate for Chile, minimum expansion rate for Colombia, overnight interbank rate for Mexico, reference rate for Peru, and T.P.M for Uruguay. [2]Reserve requirement ratios, taken from Federico et al. (2014), are weighted by banks' maturity and currency composition of deposits and adjusted for remuneration. For Mexico, we used commercial bank monetary regulation deposits as a fraction of total deposits. [3]The excess reserve ratio is calculated as the sum of 'cash and due from banks' and 'loans and advances to banks' minus required reserves (reserve requirements multiplied by total deposits) divided by total assets. [4]Based on Araujo et al. (2014). [5]Capital controls are measured by the standardized index on capital transactions obtained from Cantú García (2017). For Argentina, we complemented the index by the standardized overall restriction index taken from Fernández et al. (2015). [6]The information was obtained from central bank reports. [7]Vis-à-vis BIS reporting countries on the locational basis.

Table 5: Summary statistics of the regression variables

Variable	Obs.	Mean	Std. Dev.	Min	Max
	Dependent variables				
Loan rate	904	15.35	8.93	1.29	76.24
Deposit rate	904	8.98	11.98	0.44	64.93
	Independent variables				
Policy rate	904	7.96	4.96	1.43	23.53
Reserve requirements	904	-0.10	3.57	-17.25	13.37
Dummy, reserve constrained	904	0.10	0.30	0.00	1.00
Dummy, large capital inflow	904	0.13	0.33	0.00	1.00
Capital controls	904	-0.03	0.57	-1.41	1.93
Dummy, marginal requirement	904	0.18	0.38	0.00	1.00
Real GDP growth	904	4.38	2.90	-4.70	9.20
Inflation	904	8.23	7.15	-2.58	30.74
Net private capital inflows	904	0.36	3.24	-9.56	8.12
Depreciation	904	4.21	14.77	-25.50	52.29
BIS liabilities, foreign currency	904	-0.50	1.95	-9.52	4.47
IFRS dummy	904	0.11	0.32	0.00	1.00
Size (t-1)	904	15.21	1.84	10.08	20.08
Cost ratio (t-1)	904	6.07	3.67	0.88	33.51
NPL ratio (t-1)	904	6.28	7.56	0.02	58.70

Note: The variable definitions are provided in Table 4.

Table 6: Results for the baseline model with reserve-constrained banks

Explanatory variables:	Dependent variables:					
	(I)	(II)	(III)	(IV)	(V)	(VI)
	Deposit rate			Loan rate		
Lagged dependent variable	**0.874*****	**0.871*****	**0.871*****	**0.227****	**0.234****	**0.232****
	(0.073)	**(0.074)**	**(0.074)**	**(0.104)**	**(0.103)**	**(0.107)**
Policy rate	**0.304*****	**0.312****	**0.302****	**0.586*****	**0.576*****	**0.581*****
	(0.116)	**(0.122)**	**(0.123)**	**(0.111)**	**(0.106)**	**(0.104)**
Reserve requirements	**-0.077***	-0.069	-0.062	**0.111****	**0.124****	**0.114****
	(0.041)	(0.043)	(0.043)	**(0.051)**	**(0.057)**	**(0.055)**
Policy rate * Reserve-constr.		-0.093	-0.091		0.018	0.011
		(0.099)	(0.103)		(0.116)	(0.113)
Reserve req. * Reserve-constr.		-0.050	-0.042		-0.115	-0.112
		(0.096)	(0.097)		(0.074)	(0.071)
Policy rate * Large inflow			0.028			-0.076
			(0.119)			(0.066)
Reserve req. * Large inflow			**-0.186****			0.109
			(0.073)			(0.084)
Capital controls	0.275	0.282	0.308	-0.066	-0.087	-0.105
	(0.199)	(0.198)	(0.200)	(0.152)	(0.140)	(0.144)
Marginal RR	0.000	-0.040	-0.015	0.816	0.774	0.838
	(0.385)	(0.433)	(0.457)	(0.843)	(0.851)	(0.840)
Real GDP growth	0.058	0.057	0.059	**-0.313*****	**-0.311*****	**-0.312*****
	(0.071)	(0.071)	(0.069)	**(0.080)**	**(0.077)**	**(0.078)**
Inflation	-0.007	-0.008	-0.009	-0.053	-0.054	-0.049
	(0.040)	(0.041)	(0.043)	(0.059)	(0.058)	(0.059)
Net private capital inflows	0.002	-0.001	-0.002	0.050	0.048	0.061
	(0.064)	(0.065)	(0.081)	(0.068)	(0.065)	(0.079)
Depreciation	**0.061*****	**0.062*****	**0.062*****	**0.048*****	**0.048*****	**0.045*****
	(0.020)	**(0.021)**	**(0.021)**	**(0.016)**	**(0.015)**	**(0.016)**
BIS liabilities, foreign currency	**0.235****	**0.243****	**0.267****	0.057	0.065	0.072
	(0.113)	**(0.112)**	**(0.113)**	(0.095)	(0.093)	(0.089)
IFRS dummy	-0.292	-0.365	-0.355	-0.634	-0.605	-0.588
	(0.545)	(0.583)	(0.600)	(0.895)	(0.854)	(0.852)
Size (t-1)	-0.074	-0.090	-0.091	-0.182	-0.153	-0.146
	(0.157)	(0.166)	(0.166)	(0.163)	(0.173)	(0.175)
Cost ratio (t-1)	**-0.213*****	**-0.217*****	**-0.213*****	**0.755*****	**0.754*****	**0.759*****
	(0.076)	**(0.078)**	**(0.080)**	**(0.192)**	**(0.202)**	**(0.207)**
NPL ratio (t-1)	-0.035	-0.032	-0.030	0.100	0.098	0.099
	(0.024)	(0.023)	(0.022)	(0.064)	(0.064)	(0.066)
Constant	1.011	1.313	1.366	**6.225****	**5.808***	**5.663***
	(2.609)	(2.783)	(2.811)	**(2.975)**	**(3.142)**	**(3.141)**
No. of banks/observations	128/904	128/904	128/904	128/904	128/904	128/904
Serial correlation test (1)	0.277	0.270	0.264	0.483	0.491	0.538
Hansen test (2)	0.121	0.131	0.133	0.376	0.613	0.630

Note: The sample goes from 2000 to 2014. All estimations are based on the Arellano and Bover (1995) system GMM estimator. Robust standard errors are reported in brackets. (***, **, *) indicate significance at the 1%, 5%, 10% level. (1) Reports p-values for the test of the null hypothesis that the errors in the first difference regression exhibit no second-order serial correlation. (2) Reports p-values for the test of the null hypothesis that the instruments used are valid.

Table 7: Results for different types of banks

Explanatory variables:	Types of banks and dependent variables:							
	Foreign banks	Savings & coop. banks	Public banks	Market power	Foreign banks	Savings & coop. banks	Public banks	Market power
	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
	Deposit rate				Loan rate			
Lagged dependent variable	**0.872*****	**0.860*****	**0.868*****	**0.871*****	**0.229****	**0.212***	**0.211***	**0.223****
	(0.074)	**(0.085)**	**(0.076)**	**(0.074)**	**(0.109)**	**(0.110)**	**(0.111)**	**(0.106)**
Policy rate	**0.307*****	**0.272****	**0.327****	**0.298****	**0.588*****	**0.678*****	**0.643*****	**0.583*****
	(0.117)	**(0.113)**	**(0.135)**	**(0.118)**	**(0.113)**	**(0.111)**	**(0.112)**	**(0.106)**
Reserve requirements	**-0.123***	-0.064	-0.053	-0.072	**0.123****	**0.114****	**0.103***	**0.094***
	(0.066)	(0.044)	(0.046)	(0.045)	**(0.054)**	**(0.054)**	**(0.053)**	**(0.050)**
Policy rate * Dummy type	**-0.071***	0.150	-0.080	-0.074	0.001	**-0.316*****	-0.129	**0.218****
	(0.037)	(0.096)	(0.053)	(0.063)	(0.068)	**(0.122)**	(0.098)	**(0.111)**
Reserve req. * Dummy type	0.093	-0.068	-0.139	0.036	-0.046	-0.050	-0.011	0.013
	(0.081)	(0.092)	(0.114)	(0.053)	(0.070)	(0.130)	(0.069)	(0.122)
Policy rate * Large inflow	0.027	0.037	0.021	0.026	-0.072	-0.096	-0.083	-0.076
	(0.118)	(0.122)	(0.117)	(0.118)	(0.065)	(0.066)	(0.065)	(0.069)
Reserve req. * Large inflow	**-0.206*****	**-0.174****	**-0.183****	**-0.190*****	0.139	0.121	0.131	0.125
	(0.073)	**(0.075)**	**(0.078)**	**(0.073)**	(0.090)	(0.087)	(0.086)	(0.081)
Capital controls	0.298	0.299	0.297	0.287	-0.075	-0.094	-0.067	-0.029
	(0.201)	(0.200)	(0.203)	(0.203)	(0.159)	(0.142)	(0.158)	(0.173)
Marginal RR	0.161	0.057	-0.049	-0.012	0.751	0.550	0.736	0.849
	(0.417)	(0.395)	(0.432)	(0.440)	(0.820)	(0.827)	(0.838)	(0.849)
Real GDP growth	0.055	0.059	0.056	0.059	**-0.303*****	**-0.308*****	**-0.310*****	**-0.309*****
	(0.067)	(0.068)	(0.071)	(0.067)	**(0.080)**	**(0.079)**	**(0.081)**	**(0.084)**
Inflation	-0.004	-0.005	-0.011	-0.009	-0.057	-0.069	-0.059	-0.057
	(0.041)	(0.041)	(0.042)	(0.040)	(0.057)	(0.061)	(0.058)	(0.062)
Net private capital inflows	-0.001	-0.008	0.008	0.003	0.062	0.0770	0.066	0.060
	(0.077)	(0.084)	(0.082)	(0.078)	(0.083)	(0.081)	(0.083)	(0.088)
Depreciation	**0.061*****	**0.063*****	**0.061*****	**0.060*****	**0.045*****	0.043***	**0.043*****	**0.049*****
	(0.021)	**(0.021)**	**(0.021)**	**(0.021)**	**(0.016)**	(0.016)	**(0.016)**	**(0.015)**
BIS liabilities, foreign curr.	**0.275****	**0.243****	**0.274****	**0.254****	0.043	0.065	0.068	0.066
	(0.120)	**(0.114)**	**(0.116)**	**(0.113)**	(0.099)	(0.097)	(0.104)	(0.103)
IFRS dummy	-0.241	-0.402	-0.130	-0.280	-0.587	-0.430	-0.279	-0.567
	(0.554)	(0.606)	(0.527)	(0.584)	(0.861)	(0.818)	(0.828)	(0.862)
Size (t-1)	-0.058	-0.040	-0.062	-0.045	-0.195	-0.234	-0.153	-0.240
	(0.166)	(0.146)	(0.149)	(0.165)	(0.167)	(0.161)	(0.180)	(0.175)
Cost ratio (t-1)	**-0.202****	**-0.206*****	**-0.201*****	**-0.203****	**0.750*****	**0.770*****	**0.787*****	**0.772*****
	(0.079)	**(0.075)**	**(0.077)**	**(0.079)**	**(0.204)**	**(0.219)**	**(0.215)**	**(0.206)**
NPL ratio (t-1)	-0.039	-0.043	-0.019	-0.035	0.096	**0.113***	0.122	0.097
	(0.024)	(0.029)	(0.028)	(0.026)	(0.067)	**(0.068)**	(0.076)	(0.066)
Constant	0.857	0.648	0.733	0.675	**6.453****	**7.047****	**5.595***	**6.944****
	(2.790)	(2.551)	(2.481)	(2.768)	**(2.973)**	**(2.947)**	**(3.198)**	**(3.117)**
No. of banks/observations	128/904	128/904	128/904	128/904	128/904	128/904	128/904	128/904
Serial correlation test (1)	0.271	0.271	0.271	0.277	0.581	0.581	0.523	0.563
Hansen test (2)	0.154	0.131	0.106	0.145	0.391	0.391	0.447	0.372

Note: The sample goes from 2000 to 2014. All estimations are based on the System GMM estimator. Robust standard errors are reported in brackets. (***, **, *) indicate significance at the 1%, 5%, 10% level. (1) Reports p-values for the test of the null hypothesis that the errors in the first difference regression exhibit no second-order serial correlation. (2) Reports p-values for the test of the null hypothesis that the instruments used are valid.

Table 8: Robustness checks

Explanatory variables:	Exclude CL+MX	CC, Fernández	CC, int.	Policy rate	RR, cum.	RR, level	Exclude CL+MX	CC, Fernández	CC, int.	Policy rate	RR, cum.	RR, level
	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)	(IX)	(X)	(XI)	(XII)
	Deposit rate						Loan rate					
Lagged dependent variable	**0.879*** **	**0.873*** **	**0.870*** **	**0.910*** **	**0.868*** **	**0.867*** **	**0.235** **	**0.235** **	**0.234** **	**0.398*** **	**0.242** **	**0.230** **
	(0.072)	**(0.074)**	**(0.074)**	**(0.061)**	**(0.073)**	**(0.073)**	**(0.110)**	**(0.108)**	**(0.105)**	**(0.093)**	**(0.109)**	**(0.106)**
Policy rate	**0.262** **	**0.294** **	**0.304** **	**0.160*** **	**0.292** **	**0.310** **	**0.600*** **	**0.552*** **	**0.575*** **	**0.164*** **	**0.554*** **	**0.580*** **
	(0.125)	**(0.132)**	**(0.126)**	**(0.052)**	**(0.118)**	**(0.123)**	**(0.116)**	**(0.112)**	**(0.104)**	**(0.046)**	**(0.102)**	**(0.102)**
Reserve requirements	-0.071	**-0.070***	-0.070	**-0.131** **	0.019	-0.000	**0.096***	**0.100***	**0.126** **	-0.034	**0.083** **	0.049
	(0.044)	**(0.041)**	(0.045)	**(0.051)**	(0.023)	(0.027)	**(0.055)**	**(0.056)**	**(0.056)**	(0.046)	**(0.039)**	(0.034)
Policy rate*Reserve-constr.	-0.110	-0.092	-0.090	-0.137	0.051	-0.100	0.023	0.004	0.018	**-0.100***	-0.014	0.042
	(0.107)	(0.107)	(0.104)	(0.143)	(0.099)	(0.094)	(0.127)	(0.113)	(0.115)	**(0.052)**	(0.110)	(0.158)
Reserve req.*Reserve-constr.	-0.062	-0.047	-0.053	0.019	-0.010	0.002	-0.102	-0.106	-0.113	-0.017	-0.057	-0.014
	(0.105)	(0.093)	(0.103)	(0.087)	(0.023)	(0.021)	(0.076)	(0.068)	(0.069)	(0.068)	(0.048)	(0.038)
Policy rate*Large inflow	0.010	0.028	0.077	-0.067	0.050	0.066	**-0.132***	-0.079	**-0.120***	0.249	**-0.130** **	**-0.156** **
	(0.129)	(0.119)	(0.166)	(0.333)	(0.123)	(0.141)	**(0.076)**	(0.065)	**(0.072)**	(0.178)	**(0.065)**	**(0.067)**
Reserve req.*Large inflow	**-0.121***	**-0.169** **	**-0.219*** **	-0.114	0.011	-0.005	**0.160** **	0.114	0.123	**0.171** **	**0.055** **	**0.034** **
	(0.063)	**(0.069)**	**(0.083)**	(0.087)	(0.016)	(0.024)	**(0.076)**	(0.083)	(0.085)	**(0.079)**	**(0.027)**	**(0.016)**
Capital controls	**0.352***	-0.009	0.331	**0.445** **	0.312	0.312	-0.033	**-0.036*** **	-0.078	-0.068	-0.073	-0.140
	(0.203)	(0.016)	(0.212)	**(0.194)**	(0.209)	(0.211)	(0.149)	**(0.012)**	(0.138)	(0.135)	(0.144)	(0.147)
Capital contr.*Reserve-constr.			3.696						-3.020			
			(4.685)						(2.377)			
Capital contr.*Large inflow			-0.415						-0.098			
			(0.492)						(0.668)			
Controls	yes	yes	yes	yes	Yes	yes	yes	yes	yes	yes	yes	yes
No. of banks/observations	97/757	128/904	128/904	128/902	128/904	128/904	97/757	128/904	128/904	128/902	128/904	128/904
Serial correlation test	0.262	0.269	0.258	0.310	0.268	0.265	0.435	0.463	0.653	0.796	0.775	0.744
Hansen test	0.826	0.139	0.100	0.098	0.103	0.146	0.781	0.655	0.509	0.328	0.679	0.766

Note: The sample is 2000-14. The table compares to the specification shown in Table 6, columns (III) and (VI). All control variables are included but not reported. Columns "Exclude CL+MX" only consider countries with active reserve requirement policy, "CC, Fernández" use as a measure for capital controls (CC) the overall restriction index of Fernández et al. (2015), "CC, int." include additional interactions with capital controls, "Policy rate" use the annual change of the policy rate, "RR, cum. (RR, level)" use the cumulative change (level) of the adjusted required reserve ratio. All estimations are based on the System GMM estimator. Robust standard errors are reported in brackets. (***, **, *) indicate significance at the 1%, 5%, 10% level.

Previous volumes in this series

740 August 2018	The macroeconomic effects of macroprudential policy	Björn Richter, Moritz Schularick and Ilhyock Shim
739 August 2018	The economics of revoking NAFTA	Raphael Auer, Barthélémy Bonadio and Andrei A. Levchenko
738 August 2018	Bank solvency risk and funding cost interactions in a small open economy: Evidence from Korea	Iñaki Aldasoro and Kyounghoon Park
737 August 2018	Transmission of monetary policy through global banks: whose policy matters?	Stefan Avdjiev, Cathérine Koch, Patrick McGuire and Goetz von Peter
736 July 2018	The role of household debt heterogeneity on consumption: Evidence from Japanese household data	Jouchi Nakajima
735 July 2018	Gauging procyclicality and financial vulnerability in Asia through the BIS banking and financial statistics	Stefan Avdjiev, Bat-el Berger and Hyun Song Shin
734 July 2018	Payments, credit and asset prices	Monika Piazzesi and Martin Schneider
733 July 2018	A risk-centric model of demand recessions and macroprudential policy	Ricardo J Caballero and Alp Simsek
732 July 2018	The global factor in neutral policy rates: some implications for exchange rates, monetary policy, and policy coordination	Richard Clarida
731 June 2018	The likelihood of effective lower bound events	Michal Franta
730 June 2018	U.S. monetary policy and fluctuations of international bank lending	Stefan Avdjiev and Galina Hale
729 June 2018	Has inflation targeting become less credible?	Nathan Sussman and Osnat Zohar
728 June 2018	Accumulation of foreign currency reserves and risk-taking	Rasmus Fatum and James Yetman
727 June 2018	Recent RMB policy and currency co-movements	Robert N McCauley and Chang Shu
726 June 2018	Residential investment and economic activity: evidence from the past five decades	Emanuel Kohlscheen, Aaron Mehrotra and Dubravko Mihaljek

All volumes are available on our website www.bis.org.