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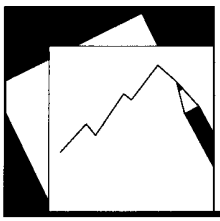

IMF Working Paper

Credit Growth and the Effectiveness of Reserve Requirements and Other Macroprudential Instruments in Latin America

Camilo E. Tovar, Mercedes Garcia-Escribano, and Mercedes Vera Martin

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Abstract

Over the past decade policy makers in Latin America have adopted a number of macroprudential instruments to manage the procyclicality of bank credit dynamics to the private sector and contain systemic risk. Reserve requirements, in particular, have been actively employed. Despite their widespread use, little is known about their effectiveness and how they interact with monetary policy. In this paper, we examine the role of reserve requirements and other macroprudential instruments and report new cross-country evidence on how they influence real private bank credit growth. Our results show that these instruments have a moderate and transitory effect and play a complementary role to monetary policy.

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Contents Page

I. Introduction 3

II. Reserve Requirements as a Macroprudential Tool 5

III. Literature Review....8
A. Some Theoretical Considerations 8
B. The Recent Latin American Experience 11
C. Recent Empirical Literature on the Latin America Experience 15

IV. Empirical Analysis....17
A. Event Analysis 19
B. Dynamic Panel Vector Autoregression 20

V. Conclusions....24

References....26

Table
1. Recent Macroprudential Measures 4

Figures
1. Reserve Requirements on Banks Liabilities 6
2. Effects of Reserve Requirements when Financial Intermediation Involves a Competitive Loan Market and Market Power in the Deposit Market 9
3. Effects of Reserve Requirements when Financial Intermediation Involves a Competitive Deposit Market and Market Power in the Loan Market 10
4. Credit Dynamics and Interest Rates 12
5. Reserve Requirements in Brazil 13
6. Reserve Requirements in Colombia 14
7. Reserve Requirements in Peru 15
8 Latin America: Average and Marginal Reserve Requirements 18
9. Impact of RRs and other Macroprudential Measures on Private Credit Growth 19
10. Impulse Response of Private Credit Growth to Macroprudential Policy Shocks 22
11. Complementary Role of Macroprudential Policies and Reserve Requirements 23

I. INTRODUCTION

Emerging market economies (EMEs), including those of Latin America, have actively been adopting prudential measures to curb credit growth and anchor the stability of their financial systems. These policies, now commonly referred to as "macroprudential," include market-wide measures such as loan-loss dynamic provisioning (e.g., Bolivia, Colombia, Chile, Peru, Uruguay) and reserve requirements.[1] In some instances, targeted sectoral measures have also been employed, such as the tightening of capital requirements to address the rapid loan growth in specific market segments (e.g., automobile consumer loans involving long maturities or high loan-to-value ratios in Brazil) and, more recently, reserve requirements on banks' short spot dollar positions (Brazil) to limit over borrowing.[2] A summary of the recent use of macroprudential measures in Latin America is reported in Table 1.

Despite their increasing use, the effectiveness of macroprudential policies in leaning against credit growth and in protecting financial stability remains an open question. Empirical analyses have been limited thus far,[3] to a large extent reflecting the complexity of the question at hand, including the many dimensions over which these policies operate and their sectoral and market-specific targeted nature. Moreover, given that systemic risk is not directly observable, assessing the effectiveness of these measures against credit growth may only provide us with a partial answer. For example, even if macroprudential measures were to have a muted effect on credit growth, systemic risks could still be reduced by these policies, including through changes in the composition of credit and/or improvements in the quality of bank funding.

This paper examines the role of reserve requirements (RRs) as a macroprudential tool in Latin America.[4] In particular, it assesses their effectiveness in containing bank credit to the private sector, and its interactions with other policies. For this purpose, we examine the experience of large Latin American economies over the period 2003–11. Understanding the role of RRs and its effectiveness is fundamental given its flexibility as a countercyclical tool, its widespread use, and its scope. Certainly, the analysis of *other* macroprudential instruments—e.g., dynamic provisioning, countercyclical capital requirements—are no less important, but their role is examined here only tangentially. This

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[1] For a detailed overview of recent experiences with prudential policies see September 2011*Global Financial Stability Report* (2011b), IMF (2011c, 2011d), and Terrier and others (2011).

[2] Compared with Asia, measures aimed at real-estate related lending have been less common in Latin America (see IMF and Bank of Korea, 2011).

[3] See IMF (2011c) for a comprehensive cross-country analysis on the effectiveness of macroprudential policies. For recent studies investigating the effect of countercyclical capital requirements on credit growth see Drehmann, and others (2010) and Peydró-Alcalde and other (2011). For a study on dynamic provisions see Chan-Lau (2011).

[4] See Gray (2011) for a complementary and recent discussion of the motives and use of RRs across the world.

partly reflects the sectoral and targeted nature of many of these *other* macroprudential instruments and also their less active use over the cycle. It is for this reason that this study delves deeper into understanding the role of RRs, and leave for future research a more comprehensive analysis of the other individual macroprudential tools.

Table 1. Recent Macroprudential Measures

Policy tool	Country and measure	Motivation—objective
Capital requirements	Brazil (long-term consumer loan market-2010)	Slow down credit growth.
Dynamic provisioning	Bolivia (2008), Colombia (2007), Peru (2008), Uruguay (2001)	Countercyclical tool that builds up a cushion against expected losses in good times so that they can be released in bad times.
Liquidity requirements	Colombia (2008) Peru (1997)	Tools to manage liquidity risk.
Reserve requirements on bank deposits	Peru (2011), Brazil (2010), Uruguay (2009, 2010, 2011)	Limit credit growth, manage liquidity, and complement monetary policy to achieve macroprudential goals.
Reserve requirements on short–term external liabilities of banking institutions	Peru (2010, 2011)	Increase the cost of bank financing with the aim of shifting the funding structure towards the longer term
Tools to manage foreign exchange credit risk	Peru (2010), Uruguay (2010)	Help financial institutions internalize foreign exchange credit risks associated with lending to un-hedged borrowers.
Limits on foreign exchange positions	Brazil (reserve requirement on short spot dollar positions, 2011), Peru (2010, on net FX derivative position (2011))	Quantitative measures to manage foreign exchange risk in on- and off-balance sheet foreign-exchange-denominated assets and liabilities.
Other	Peru (limits to foreign investment by domestic pension funds, 2010)	Measure to facilitate capital outflows and ease pressure on the currency, domestic demand, and consumer prices.

Source: IMF Staff based on national sources.

Notes: **Brazil:** Starting in 2010, Brazil has taken steps toward RR re-composition (to the pre-crisis levels of 2008). In December 2010, capital requirements on new consumer credit operations (in particular, personal credits, payroll-deducted loans, and vehicle financing, involving longer maturities or high loan-to-value ratios) were increased. In November 2011, a recalibration lowered the capital requirements for consumer loans according to their maturity, removing the loan-to-value ratio criteria. Since December 2011, it incorporated with no expiration date the measure that large banks may acquire small bank assets using resources locked in reserve requirements on time deposits—a temporary measure initially taken in October 2008. The December 2011 measure allows large banks to use the non-remunerated part of the RRs on time deposits to acquire small bank assets; **Peru:** The RR on short-term bank liabilities were raised from zero to 75 percent in 2010 and reduced to 60 percent in 2011.

Our analysis suggests that RRs have a moderate and transitory impact in slowing the pace of credit growth in Latin America. The study uses two complementary methodologies: (i) event analysis, whereby the effects of measures are tracked around the

time of a policy change, and (ii) dynamic *panel* vector autoregressions, whereby simultaneous and feedback effects between credit growth, RRs and policy rates are considered. Our results also show that average RRs might be more effective than marginal RRs, as they may be more strenuous for financial institutions. Finally, monetary and macroprudential instruments, including RRs, appear to have complemented each other in recent episodes.

The paper is structured as follows. Section II briefly discusses reasons why RRs might play a macroprudential role, along with its benefits and drawbacks. Section III then discusses a simple basic framework to think about the mechanics through which RRs may affect credit dynamics and briefly reviews the empirical literature. Section IV describes and documents the recent Latin American experience with RRs, while Section V reports the empirical analysis. Finally, Section VI concludes.

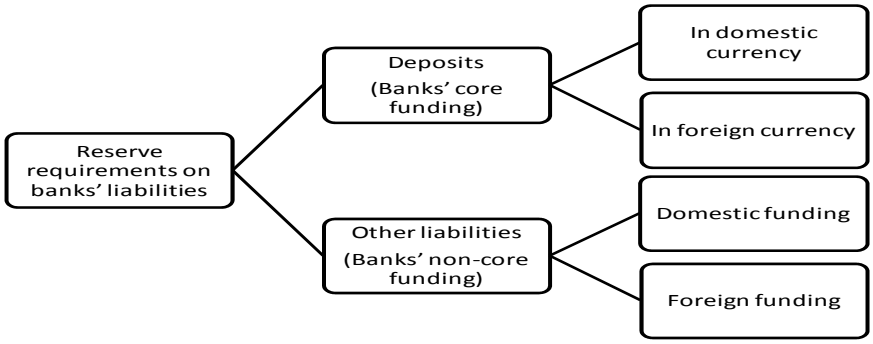
II. Reserve Requirements as a Macroprudential Tool

In recent years, central banks in Latin America—as in other EMEs—have actively used RRs on bank deposits and other bank liabilities in a countercyclical manner to address systemic risk. Although similar in spirit to the original conception of RRs as a liquidity and credit policy tool, their use with a macroprudential perspective is relatively new.[5] This contrasts with the long-held view that considered RRs (on deposits) a supplemental monetary policy tool for macroeconomic purposes (Goodfriend and Hargraves, 1983 or Feinman, 1993) or an integral component of a financially repressed economy (McKinnon, 1973). In that light, several countries dismantled RRs with the implementation of inflation-targeting frameworks once short-term interest rates became the main monetary policy instrument. Nonetheless, RRs have remained part of central banks' policy toolkit in most EMEs and its role re-examined.

RRs are a regulatory tool that requires banking institutions to hold a fraction of their deposits/liabilities as liquid reserves. These are normally held at the central bank in the form of cash or highly liquid sovereign paper. When applied to deposits, the regulation usually specifies the *size* of the requirement according to deposit type (e.g., demand or time deposit) and its *currency denomination* (domestic or foreign currency). The regulation also sets the *holding period* relative to the reserve statement period for which the RR is computed, and whether they are *remunerated* or *unremunerated*. When they apply to new deposits from a reference period only they are referred to as *marginal* RRs. In addition, RRs can apply to *domestic* or *foreign (non-deposit) liabilities* of bank's balance sheets (Figure 1). Finally, RRs could be applied on assets rather than on liabilities (Palley, 2004). The experience so far shows a preference for RRs on liabilities.

[5] There are historical episodes in which RRs were used countercyclically to provide liquidity and support financial stability. For example, in 1995 Argentinean authorities lowered RRs to pump liquidity to the economy. In 2004, Brazil used RRs to provide liquidity to smaller banks after the confidence crisis that took place with the bankruptcy of a medium-size bank (Banco Santos).

Figure 1. Reserve Requirements on Banks Liabilities



The active management of banks' RRs can serve different macroprudential purposes.[6]

- First, they can serve a c*ountercyclical role for managing the credit cycle in a broad context.* In the upswing, hikes in RRs may increase lending rates, slowdown credit, and limit excess *leverage* of borrowers in the economy, thus acting as a *speed limit* (see discussion below). In the downswing, they can ease liquidity constraints in the financial system, thus operating as a *liquidity buffer*.[7] In this regard, RRs can serve as a *flexible substitute for other macroprudential tools* aiming at reducing credit dynamics. For example, they are an alternative to more distortive quantitative restrictions such as credit ceilings.[8]

- Second, RRs on foreign or domestic banks' borrowing can help *contain systemic risks by improving the funding structure of the banking system* in a manner similar to what is pursued by some of the liquidity requirements proposed under Basel III (see Terrier and others, 2011). They can also reduce dependence on (short-term) external financing or wholesale domestic funding, mitigating the vulnerability of the banking sector to a rapid tightening in liquidity conditions. Peru's active management of RRs on foreign liabilities with maturity lower than 2 years provides evidence on how RRs on banks foreign credit lines can change the composition of banks' foreign borrowing in a juncture of large capital inflows.

- Third, they can serve as a *tool for credit allocation to ease liquidity pressures.* At times of stress, an asymmetric use of RRs across instruments, sectors and financial

[6] Benefits are not necessarily cumulative and may mutually exclude each other. For a general overview of the macroprudential policy discussion see IMF (2011d and 2010b).

[7] Liquidity proposals under Basel III assume that assets are liquid in times of stress. To some extent, RRs may fill this gap if assets are illiquid, an issue that can be magnified due to financial underdevelopment.

[8] Targeted macroprudential measures such as loan-to-values and debt-to-income ratios may be preferable to manage sectoral credit dynamics, for example, in the real estate market (IMF 2010).

institutions can help direct credit to ease liquidity constrains in specific sectors of the economy that threaten to have systemic implications (e.g., in Brazil the authorities have directed liquidity to smaller banks by granting to large banks reductions on their requirements if they extended liquidity to small and medium-sized banks). In other instances, if systemic risks are evident, marginal RRs can be applied to control the volume of bank credit stemming from the funding linked to the issuance of certain instruments (e.g., certificate deposits).

- Fourth, RRs can play a useful *complementary tool for capital requirements* in countries where the valuation of assets is highly uncertain—because of a lack of liquid secondary markets, for example—as the true measurement of capital also becomes less certain.

- Fifth, they have also been employed as a *bank capitalization tool.* In times of stress rather than lowering RRs, governments can increase their remuneration to help capitalize banks (e.g., Korea).

- Finally, they can *substitute some of the effects of monetary policy to achieve macroprudential goals.* For example, this is evident when large capital inflows foster rapid credit expansion and put the credit cycle at odds with monetary goals.[9,10] In such instances, RRs may substitute for increases in policy interest rates (e.g., Peru).[11]

However, RRs are no free lunch as they have associated costs and may introduce distortions in the financial system. RRs constrain banks' funding and also, if remunerated below market rates, act as a tax on banks. In response, banks may pass its cost to other agents by raising the spread between lending and deposit rates. This may stimulate bank disintermediation, increase nonbank financing, and lead to excessive risk taking in other less regulated sectors. RRs can also reduce credit through the effect on bank's funding, especially if RRs are binding (for example, for banks that do not have sufficient reserves). Furthermore, RRs can also generate incentives for regulatory arbitrage. In some instances, such incentives materialize in the form of a proliferation of weakly regulated "bank-like" institutions, such as off-shore banks.[12] Finally, when implemented in an asymmetric manner across market agents,

[9] See a complementary discussion of alternative approaches for managing capital flows in Agénor and others (2012), IMF (2011), and Ostry and others (2011).

[10] Agénor and others (2012) show in a small open economy DSGE model how a moderate use of macroprudential policies (in their case modeled as a Basel-III type rule) can help authorities deal with policy tensions arising from large capital flows.

[11] RRs are also *a complementary tool for foreign exchange sterilization*. In periods of large capital inflows, RRs can substitute open market operations as a tool to sterilize central bank foreign exchange intervention, thus reducing their quasi-fiscal effort (especially if RRs are unremunerated).

[12] Peru extended the application of reserve requirements to liabilities of off-shore branches of domestic financial institutions (January 2011). Brazil also charges reserve requirements on leasing institutions to avoid the circumvention of reserve requirements on deposit-taking institutions.

RRs becomes a de facto cross-subsidy scheme that distorts bank behavior, pushing some banks to change its funding patterns towards more unstable funding sources (Robitaille, 2011).

Moreover, their design is complex. RRs are a *blunt* instrument whose calibration is not straightforward given the many variables that need to be considered, including a careful analysis of its goals. This may include deciding which banks' liabilities (deposits or non-deposits) to target, their holding period, the RR rate itself, whether to remunerated them or not, and how to calculate and constitute the base for the regulation (e.g., lagged or contemporaneous). Also, if RRs are calibrated along the economic cycle, consideration needs to be given to changes in the rate and changes in the reference period. For example, changes in the marginal rate could mainly have a signaling effect; while changes in the reference period or in the average RRs a higher effect on banks' liquidity.[13] Finally, but not least, their level has to balance monetary and financial stability goals. Moreover, it should be clear that the management of easy external conditions through this instrument should not be a substitute for using sound traditional fiscal and monetary policies along with exchange rate flexibility as the first line of defense (See Eyzaguirre et al, 2011 and IMF, 2010).

III. Literature Review

A. Some Theoretical Considerations

The effects of RRs on the cost and availability of credit is determined by the banking system's market structure, the degree of financial development, and the design of RRs themselves.[14] The effects of RRs have traditionally been analyzed as a tax on bank intermediation (see the recent discussion in Walsh, 2012). As financial intermediaries, banks take deposits to extend loans, which in turn mean that banks have customers on both sides of their balance sheets. It is for this reason that the effect of RRs depends critically on the market structure of the banking system. In general, changes in RRs will pass-through wholly or in part to lending interest rates in those markets where banks have some monopoly power or where financial frictions are in place (see Glocker and Towbin, 2012).[15] The extent of

[13] However, the use of average reserve requirements as a prudential tool have a potential weakness as banks can comply with the requirements and run down reserves for a period, but then fail to have enough reserves once they are needed. See a complementary discussion in Gray (2011).

[14] In this section we do not emphasize the effect of RRs on the money multiplier. Conceptually, its impact is different and falls in the realm of monetary policy control, rather than on the macroprudential side that we stress in this paper.

[15] These authors develop a DSGE model in which financial structure of the model gives rise to three frictions: (i) market segmentation, due to the fact that household hold deposit in the banking sector and investors are forced to obtain credit from banks; (ii) real resource cost associated with deposit banking, which depends on banks holding excess reserves, (iii) an agency cost (optimal debt problem with costly state verification) arising from bank lending to entrepreneurs. See also Walsh (2012).

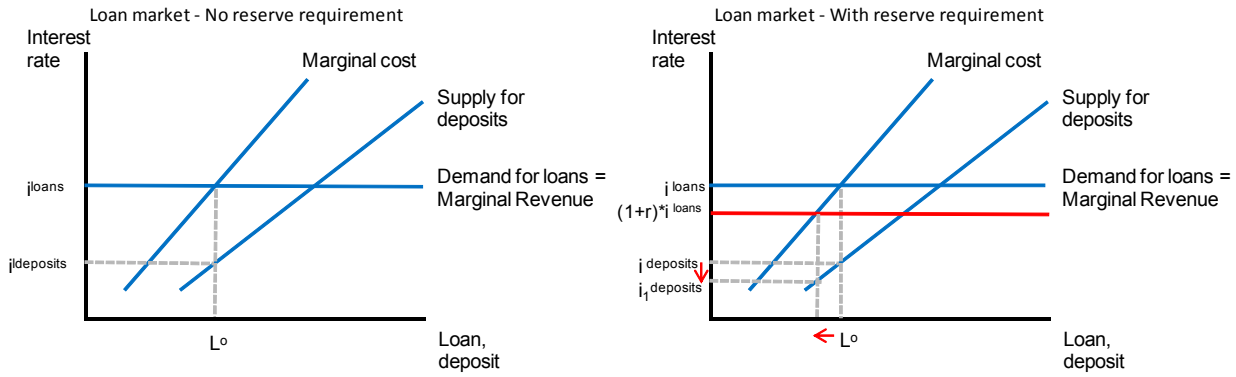
pass-through to lending interest rates, and hence, the supply of credit will also depend on the remuneration set for RRs.

The effect of RRs can be analyzed in a simple framework using two extreme scenarios that take into account banks' market power (See Reinhart and Reinhart, 1999). The first is one in which the loan market is competitive and the bank has market power setting deposit rates. In the second one, banks face a perfectly competitive deposit market, but have market power setting loan rates.

Competitive loan market, market power in the deposit market

In this scenario, the bank is a price-taker in the loan market (Figure 2, left-hand panel). The financial intermediary faces an upward sloping supply of funds and an upward marginal cost curve. Since it is a price taker in the loan market, the demand for loans and its marginal revenue are horizontal, at a price i^{loans}. In this setting, the bank exercises its market power on the deposit market; which implies that the rate paid for deposits is set at a rate $i^{deposits}$, which is below the loan rate. In the absence of market power, and if the supply of deposits was replicated as the aggregate behavior, loan supply would be higher and determined by the intersection of the supply of deposits and the lending demand curve. The rate paid on deposits would be higher.

Figure 2. Effects of Reserve Requirements when Financial Intermediation Involves a Competitive Loan Market and Market Power in the Deposit Market



In such market, RRs are analyzed as a tax, r. Thus, the marginal revenue on deposits declines by r, shifting the horizontal line down in Figure 2 (right-hand panel). Banks then reduce its intermediation, reduce profitability, and lower the rate on deposits. Ultimately, there is a complete pass-through of RRs to depositors in the form of lower interest rates.

Competitive deposit market, market power in the loan market

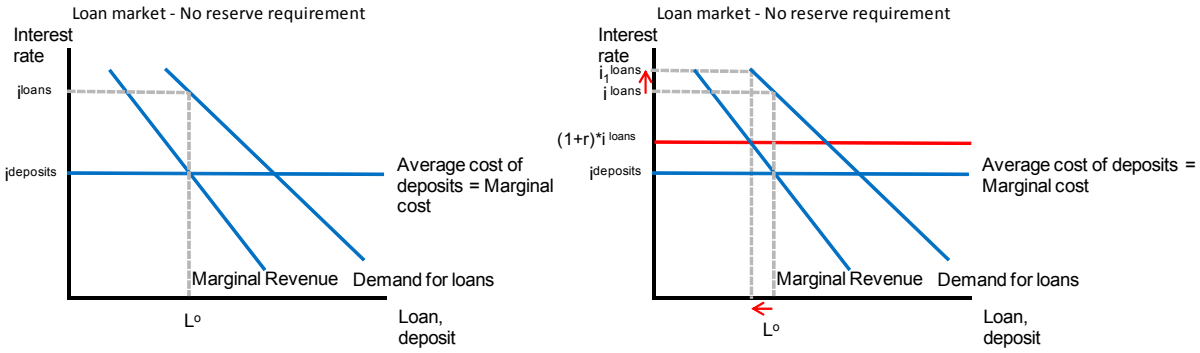
In this setting, bank intermediation now faces a funding supply (deposit market) that is competitive, but has market power in the loan market. The marginal cost of funding (deposits) is fixed at a rate $i^{deposits}$. However, the demand schedule for loans is downward

sloping as well as the marginal revenue (Figure 3, left-hand panel). Market clearance results in more available credit at a lower rate.

Interpreting RRs, again as a tax, r, the cost of funding increases thus shifting the marginal curve for funding (deposits) up (Figure 3, right-hand panel). The equilibrium now implies a higher interest rate on loans, and a decline in the level of credit available to the economy. Ultimately, the costs of RRs are borne by the borrowers.

Therefore, RRs will lower the amount of credit in the economy (*acting as a speed limit*), and depending on the market structure, they may lead to higher lending rates or lower deposit rates. In either case interest rate spreads between lending and deposit rates should widen.

Figure 3. Effects of Reserve Requirements when Financial Intermediation Involves a Competitive Deposit Market and Market Power in the Loan Market



It is worth highlighting that the effect of RRs on credit and interest rates also depend on the monetary regime or the presence of funding substitutes different than deposits. So far we have considered a simple partial equilibrium framework, however, in a general equilibrium setting it is important to consider endogenous feedbacks, some of which are amplified or mitigated by the monetary regime or the presence of funding substitutes in the market. For instance, in a quantitative monetary regime, RRs have a direct effect on the money multiplier and, therefore, on monetary aggregates and credit.[16] In an inflation targeting regime, by contrast, the effect is less evident as the central bank, in principle, stands ready to offer the liquidity necessary for the market to clear at its short-term policy rate. If central bank credit is a close bank funding substitute of deposits, higher RRs will lower deposit rates, keeping lending rates unchanged.[17] But if this condition is not met (because it

[16] With financial development, the role of a money multiplier and its relevance has changed. If banks are able to securitize loans, the total quantity of loans available to the banking system is not longer less than the total amount of money in deposits, as bank-originated lending can exceed the total amount of money on deposits.

[17] This is precisely the case in a fully-optimizing small open economy model by Edwards and Vegh (1997) in which they examine the countercyclical role of RRs. In their setting, banks can always borrow from the rest of the world (by selling bonds), thus generating a deposit-spread gain if they borrow domestically at lower cost. However, their set-up is one of fixed exchange rate regimes.

exacerbates banks' maturity mismatches or because of uncertainty on the future path of short-term policy rates), then RRs would lower the volume of credit and drive lending interest rates up (Betancourt and Vargas, 2008). This stresses the role of imperfect substitutability across instruments and markets as a necessary condition for RRs to be effective.

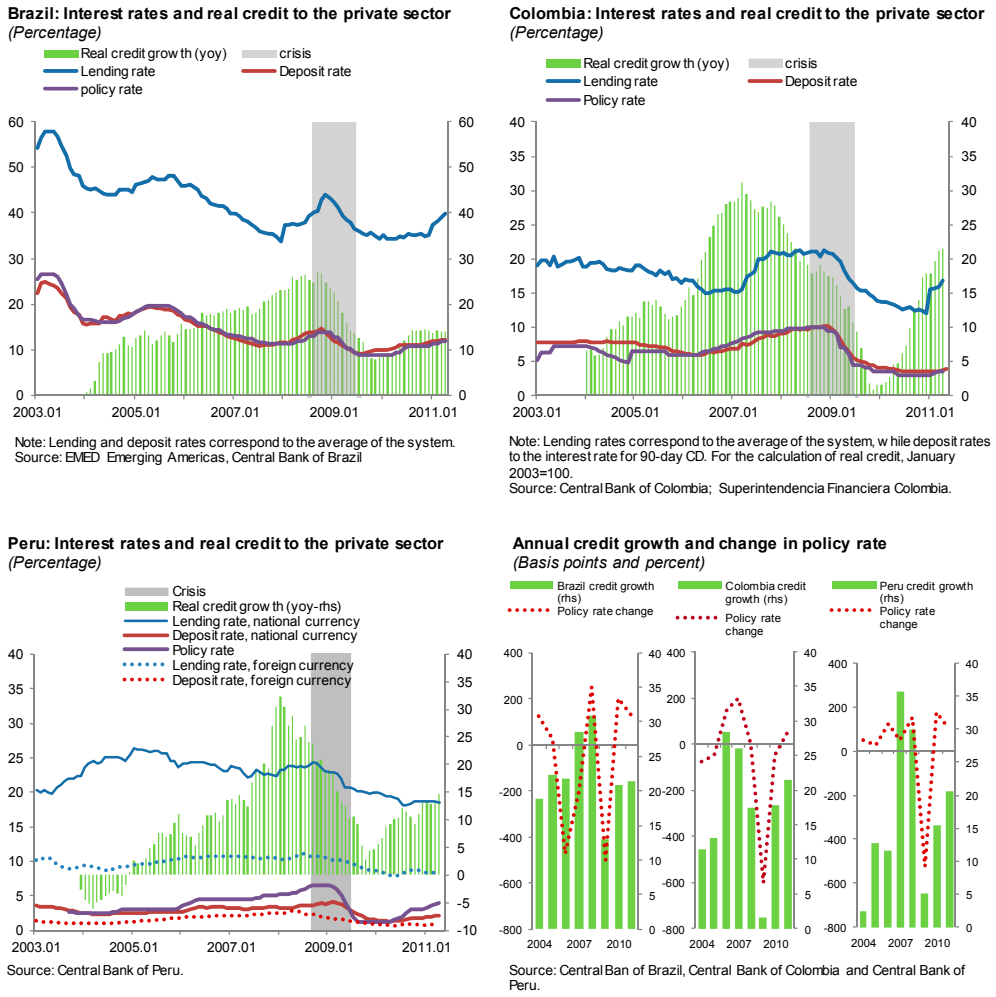
More generally, the presence of financial frictions determines to a large extent the role of RRs and its interaction with monetary policy. For example, Glocker and Towbin (2012) show that in a policy regime in which the policy rate adjusts to inflation and output and RR adjust to the quantity of loans, the later can achieve financial stability goals, while the former achieves the output inflation trade-off.

B. The Recent Latin American Experience

Latin American central banks have proactively used RRs in a countercyclical manner to manage the credit and liquidity cycle and anchor the stability of the financial system. Examples of such behavior are illustrated by the recent experience of Brazil, Colombia, or Peru. Central banks in these countries have managed RRs countercyclically to contain credit growth and manage liquidity conditions in the economy, while managing in tandem policy interest rates. These dynamics are evident prior, during, and following the 2008–2009 financial crisis:

- *The surge in credit growth and overheating pressures driven by large capital inflows during 2006–08*—ahead of the global financial crisis— forced the central banks of Colombia and Peru to gradually tighten policy rates. However, this tightening was unable to contain what appeared to be an unsustainable capital flow-driven credit boom (annual real credit growth rates exceeded in some instances 30 percent—Figure 4) that was starting to erode the health of the banking system, as reflected by an increasing trend in non-performing loans. It was in this context that average and marginal RRs where introduced to contain the risks associated with such credit expansion (Figures 6 and 7). In Brazil private bank credit also expanded rapidly during this period, reaching annual growth rates of 35 percent. However, the central bank's policy response was less aggressive. Interest rate tightening was smoother and RRs, which were already at high levels, were not adjusted (Figure 4).

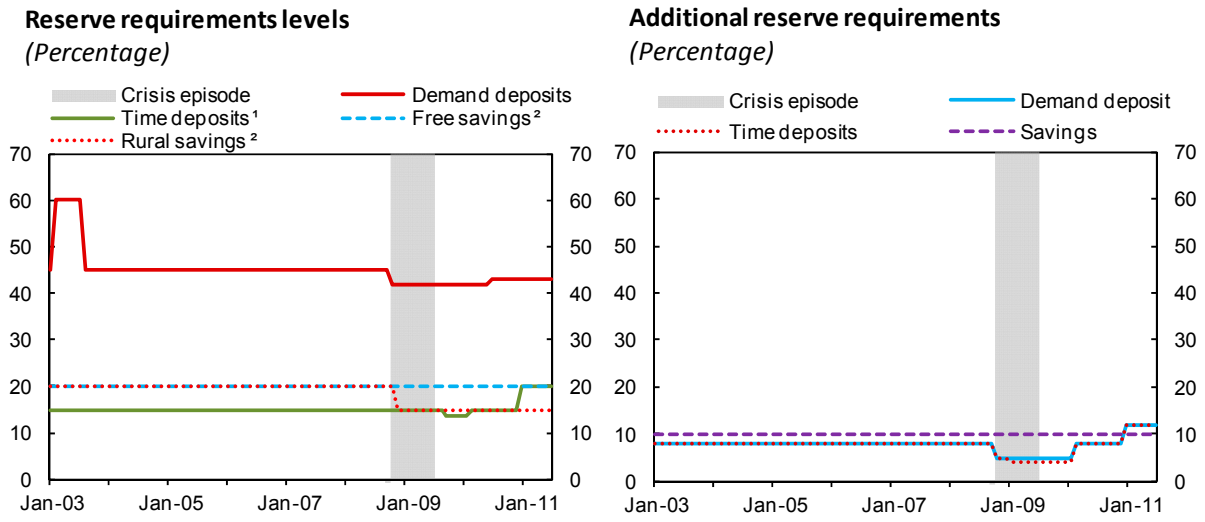
Figure 4. Credit Dynamics and Interest Rates



- *Liquidity provision became the main policy concern during the global financial crisis that followed Lehman Brothers' bankruptcy episode in September 2008*. Specifically, the goal was to maintain the flow of credit and avert a credit crunch that could lead to an economic collapse.[18] Thus central banks responded with aggressive policy rate cuts. In the aftermath of Lehman's episode, policy rate cuts —Colombia (600 bps), Peru (525 bps) and Brazil (500 bps) —helped mitigate the adverse effects on economic activity and contributed towards the reduction of bank lending rates. In addition, central banks lowered or eliminated RRs pumping additional liquidity to the economy (Figures 5–7). Despite these measures, all countries witnessed a credit slowdown (Figure 4).

[18] For a detailed account of policies implemented in Latin America during the global crisis see Jara and others (2010).

Figure 5. Reserve Requirements in Brazil



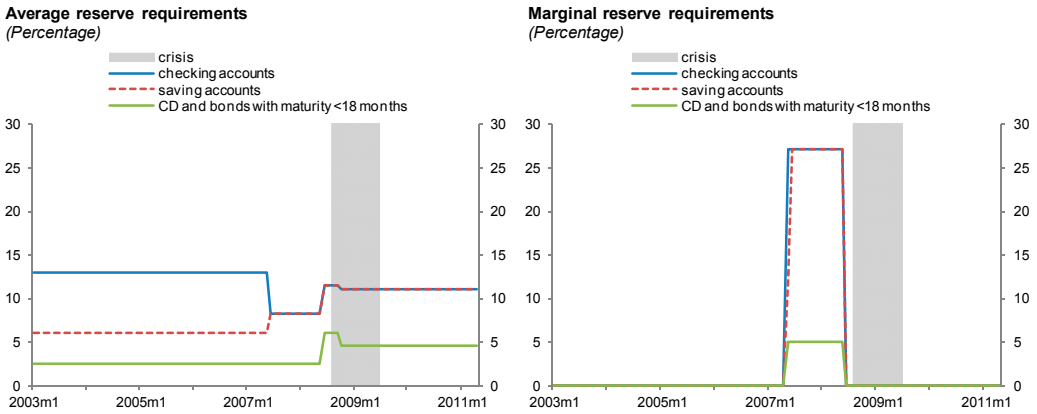
Source: Central Bank of Brazil
¹ Can be complied with public debt securities.
² Remunerated.

- *More recently, in the aftermath of the 2008–09 global crisis, RRs have helped manage excessive liquidity in the context of accommodative monetary conditions and strong capital inflows.* Economic activity and credit dynamics rebounded strongly, reaching new highs by mid-2011. Real bank credit to the private sector started to record annual growth rates in excess of 20 percent fueled by favorable international financing conditions, large capital flows, and historically high commodity prices (Figure 4). In this context, authorities in Brazil and Peru tightened policy rates and increased RRs more aggressively during 2010. However, Colombian authorities refrained from relying on RRs this time around (Figure 6). Despite the adoption of these measures, conditions were so favorable that credit dynamics remained robust, although at levels below those experienced prior to Lehman's bankruptcy episode in September 2008.

The countercyclical use of RRs by the Central Bank of Brazil (BCB) during the 2008–2009 global crisis was aggressive and innovative; supporting financial stability both through its effects on liquidity as well as through credit reallocation (Figure 5). Indeed, in addition to the traditional role for liquidity provision, the central bank used RRs as a mechanism to stimulate the distribution of liquidity from large financial institutions to smaller ones. In October 2008, large banks were partially exempted from RRs on term deposits if they purchased assets of smaller banks. Moreover, a new type of term deposits with special guarantees was introduced through the Deposit Insurance Institution (Fundo Garantidor de Créditos -FGC) so that institutions relying on this instrument could benefit from a reduction in RRs. Finally, it became mandatory for financial institutions to extend rural credit, which was financed through a reduction of RRs.

In 2010, the BCB tightened macroprudential policies to manage the credit boom. Specifically**,** average RRs were increased along with capital requirements on long term consumer loans and vehicle financing. Moreover, a new RR on the banks' dollar position in the FX spot market was introduced in January 2011 (Terrier and others, 2011).[19] This measure aimed at discouraging carry trade operations and moderate short-term appreciation pressures on the real. Starting in November 2011, as the European crisis unfolded, Brazilian authorities began to ease non-RR macroprudential instruments. In particular, in November 2011 capital requirements on auto-loans up to 60 months and personal credit up to 36 months were decreased. At the same time, the capital requirements on personal loans above 60 months were increased. In December 2011 large banks were authorized to acquire small bank assets using resources locked in RRs on time deposits, and to stimulate the acquisition of small bank assets the remuneration on time deposits was decreased.

Figure 6. Reserve Requirements in Colombia



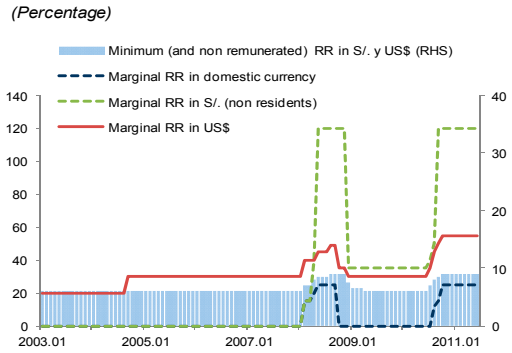
Source: EMED Emerging Americas, Central Bank of Colombia

In Colombia and Peru, the use of RRs came along hand-in-hand with other prudential and non-prudential measures. In Colombia (Figure 6), the use of RRs on domestic deposits prior to the crisis was complemented with the introduction of capital controls (e.g., RRs on foreign indebtedness and portfolio inflows, see Terrier and others, 2011), as well as with tighter macroprudential measures, such as the introduction of limits on the banks' positions in derivative products. In turn, RRs have been actively used to contain credit growth pressures in the context of large capital inflows— prior to Lehman and in 2010 and 2011 Figure 7). This was complemented with other macroprudential measures, including, among others, RRs on external liabilities with maturity less than 2 years; and limits to the net FX position (overall and derivative positions). The differentiated management of RRs for deposits in domestic and foreign currency has also allowed the Central Bank of Peru to

[19] In July 2011, the central bank reduced the exemption threshold to US$ 1 billion (from US$ 3 billion) or the tier I capital (whichever is lower), in which banks do not need to pay the 60 percent RR on bank's short dollar position in the FX spot market.

manage risks arising from the dollarization of the economy. For instance, in January 2011, the central bank included credit channeled through off-shore branches of domestic financial institutions into the computation of RRs.

Figure 7. Reserve Requirements in Peru



Source: BCRP

C. Recent Empirical Literature on the Latin America Experience

In general, there are only a handful of studies examining the recent experience effectiveness of RRs in the region.[20] The analysis is hindered by the heterogeneity in the application of RRs across countries, which makes cross-country empirical studies difficult, and by the fact that there is no consensus on their effectiveness and the optimal strategy to follow when applying them. Moreover, this literature tends to focus on country case studies.[21] The main exception is Lim and others (2011) who use 49 countries from 2000 to 2010 to examine the effectiveness of macroprudential instruments in reducing systemic risk. Their results—using event case and dynamic panel regressions—suggest that most of these instruments are effective in reducing the procyclicality of the financial system, but this depends on the type of shock facing the financial system. The study specifically finds RRs to be effective in reducing the procyclicality of credit growth, at least in the short run as they are unable to determine whether there are more persistent effects. Quite importantly, they find that RRs need to be recalibrated periodically to preserve their effectiveness.

Empirical studies tend to support the role of RRs as a policy tool for containing credit growth or in gaining degrees of freedom in the conduct of monetary policy. Vargas and others (2011) study the experience with RRs in Colombia and find that RRs have an

[20] An early contribution is Edwards and Vegh (1997). They use a VAR framework to confront the predictions of a fully-optimizing small open economy model that considers the countercyclical role of RRs. However, since their goal is to examine the amplification effects of the banking system to external shocks, their VAR system does not control for a specific measure of RRs.

[21] The main exception is the study by Montoro and Moreno (2010) who review the recent experiences of Brazil, Colombia and Peru. Based on static simulations, they argue that this instrument supports the conduct of monetary policy by helping resolve policy dilemmas of capital flows, restores the transmission mechanism of monetary policy, and helps contain credit growth.

important long-term role on business loan interest rates and on strengthening the pass-through from policy to deposit and lending interest rates. These findings, more generally support the use of RRs as a policy instrument in an inflation-targeting regime in terms of their effectiveness in reinforcing monetary policy transmission. However, these benefits need to be evaluated against their cost as taxes on financial intermediation and the difficulties in fine-tuning these tools to manage the adjustment on credit markets and aggregate demand. The study also highlights that the use of RRs is justified when policymakers perceive that standard, less costly policy instruments are deemed insufficient to maintain price or financial stability. Some theoretical studies have also been developed to gain perspective of RRs. For instance, attempts have been made to model deposit-specific RRs (following a Monti-Klein model) where banks have monopolistic power in the credit market, but has monopsonistic power in the deposit market (see Saade and Perez, 2009). In such setting, hikes in RRs are correlated with higher intermediation margins and a contraction in credit supply. Moreover, modifications to RRs in savings and checking accounts are shown to be the most effective in achieving these goals. The model is useful as it helps analyze the effectiveness of RR policies while taking into account that these policies are not indifferent to the balance sheet composition of banks.[22] Other studies have highlighted the role of RRs as a nonconventional monetary instrument, especially at time of stress and in the context of a dollarized economy (Leon and Quispe, 2010). Using data for Brazil, Evandro and Takeda (2011) and Glocker and Towbin (2012b) have analyzed the effect of RRs with a short- and long-term perspective. The first study concludes that RRs lead to a contraction in credit for households, especially from smaller banks. The second study uses a structural vector autoregression (SVAR) framework to identify interest and RR shocks, finding that the discretionary tightening of either instrument leads to a decline of domestic credit, but their effects on macroeconomic aggregates differ. They also find that the tightening of RRs induces a depreciation of the exchange rate and has inflationary effects. Overall, they conclude that RRs acting as a tool for financial stability constitutes a useful complement to monetary policy, a result that echoes their theoretical work (Glocker and Towbin, 2012).

However, there are criticisms to the countercyclical use of RRs. Based on the examination of the Brazilian experience Robitaille (2011) argues that policymakers may face obstacles in their efforts to limit banks' exposures to liquidity risk, in particular, if the instrument is used in an asymmetric manner across the system. The point made is that ahead of the global financial crisis, high RRs altered bank behavior, inducing banks to devise funding means that can give rise to financial fragilities. That is, while large banks were able to introduce a (stable and safe) time deposit substitute, smaller banks were forced to increase their reliance on (less stable and riskier) loan portfolio sales. As a result, in the aftermath of the global financial crisis, when RRs were relaxed, large banks hoarded liquidity while government entities ended up playing a lender of next-to-last resort role. The analysis implies

[22] In a different study, Bustamante (2011) relies in a general equilibrium model with heterogeneous agents and risk–adverse financial intermediaries to show that the countercyclical use of RRs contributes to marginally reduce consumption volatility. A key issue is that RRs become more effective the more risk-adverse banks are.

that RRs did not ensure adequate liquidity provision, in part because the smallest banks were exempted from them, while financial innovation were used by banks to circumvent the RRs. This study makes evident the complexities of designing and calibrating this instrument, at the same time it is unclear from it whether the overall banking system was in fact more prone to liquidity shocks and, therefore under greater systemic threat, in particular, because large banks—which are most likely to have a systemic effect—increased their liquidity holdings.

IV. EMPIRICAL ANALYSIS

To assess the impact of RRs and *other* macroprudential instruments on bank credit to the private sector, we use information from five Latin American countries (Brazil, Chile, Colombia, Mexico and Peru) over the period January 2003 to April 2011. In this manner, we combine countries that have actively used RRs and *other* macroprudential policies in a countercyclical manner (i.e., Brazil, Colombia, and Peru), along with countries where these policies have not been actively managed during this period (Chile and Mexico). Macro data is obtained from national central banks or from Haver Analytics, while the macroprudential information is constructed by the authors, relying on discussions with the corresponding country desks of the IMFs Western Hemisphere Department and cross-checked with the survey made by the IMF Monetary and Capital Markets Department and used by Lim and others (2011).

The analysis of the data is carried out using two complementary methodologies. The first one is an *event analysis*, whereby the effects of policy measures are tracked around the time of a policy change.[23] The second is a *dynamic panel data vector autoregression* (panel data VAR)*,* whereby feedback effects between credit, economic activity, monetary policy and prudential instruments are considered. It is important to highlight that the former involves an unconditional cross-country analysis, while the later is a conditional one. The panel VARs' analysis is able to isolate the effects of RRs and other macroprudential instruments from other shocks and take advantage of both the cross-country and time–series variation. For presentational purposes, two set of results are presented. The first is one where all instruments (average and marginal reserve requirements along with *other* macroprudential measures) are grouped into a single measure, which are referred to as "macroprudential shock". The second exercise splits the different measures to allow tracking the individual effects of average and marginal reserve requirements and other macroprudential policies individually.

RRs and *other* macroprudential measures are captured through a *cumulative dummy*.[24] In doing so, special attention is paid to the differentiated impact of average and marginal RRs

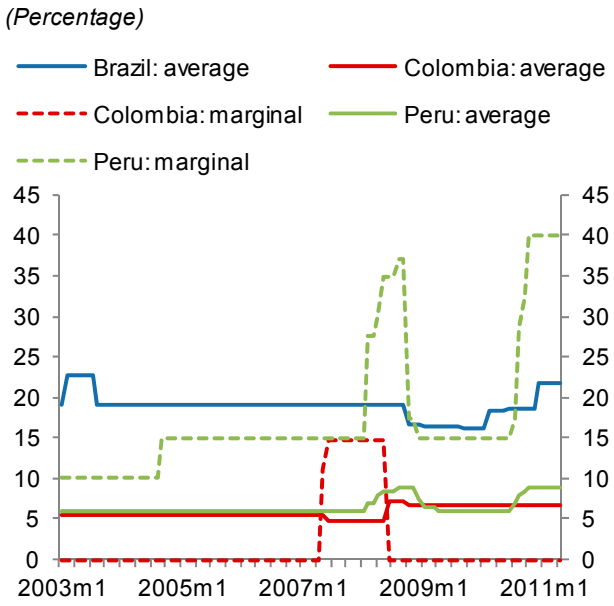
[23] By its nature the event analysis is limited to countries that have used RRs, i.e., Brazil, Colombia, and Peru.

[24] The cumulative dummy captures changes in the rates of the RRs and therefore, facilitates the comparison of changes to the RR regime across countries. However, the variable does not capture other important traits of the RRs such as changes to the remuneration, deductions or reference period. Future analytical work is needed to

(continued…)

on bank deposits. The use of a dichotomous variable is a non-trivial issue, as it bounds our analysis to the understanding of policy changes, limiting the possibility of examining the role of policies that are not adjusted over the cycle. For instance, in some countries regulations already in place may be tight enough that they do not demand an adjustment over the cycle. In such cases, it would be desirable to have a measure that controls for the level of regulations and not just its changes as is done in this section. At this point, it is worth clarifying that given the complex structure of reserve requirements in all countries, we rely exclusively on reserve requirement changes to identify the policy shock. Thus rather than using an effective rate our RR measure is based on a simple average of rates (in Brazil of demand and savings deposits; in Colombia of checking and saving accounts, CD and bonds, and in Peru the required rate as published by the central bank, see Figure 8). This simple approach has the advantage of focusing on the effects of policy changes; however, results could be improved by constructing a tax equivalent measure, as to capture also the size of the policy change. This is particularly relevant in the case of marginal RRs, an issue that we discuss further below.

Figure 8. Latin America: Average and Marginal Reserve Requirements



[1] Simple average. Brazil: reserve requirements on sight deposits and term deposits; Colombia: checking, savings, CDs and term deposits; Peru: domestic and foreign currency deposits.
Source: IMF staff estimates on teh basis of central bank data.

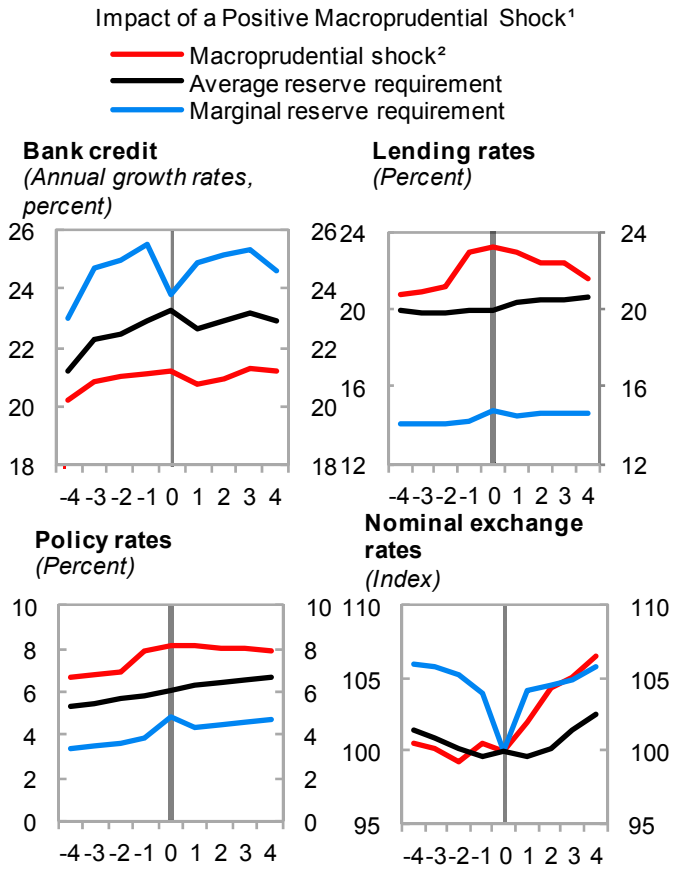
address this shortcoming. The other macroprudential measures index captures changes in measures, other than RRs, listed in Table 1.

A. Event Analysis

The event analysis displays the behavior of annual bank credit growth to the private sector, lending rates, policy rates and exchange rates four months before and after the time of the implementation of three different policies: (i) average reserve requirements, (ii) marginal reserve requirements and (iii) other macroprudential policies. For presentational purposes, the effects of RRs are reported separately and also using a composite measure labeled macroprudential shock which encompasses in a single (cumulative dummy) measure the changes in RRs and in other macroprudential policies.

Our findings indicate that RRs and *other* macroprudential policies lead to a moderate and transitory slowdown in the growth of bank credit to the private sector (Figure 9).

Figure 9: Impact of RRs and other Macroprudential Measures on Private Credit Growth



Sources: Central bank data; and IMF staff calculations.
[1] Periods in the horizontal axis denote months. Time equal to *zero* denotes the time of the shock. Sample consists of Brazil, Colombia, and Peru, over the period 2003:M1—2011:M4.
[2] Includes reserve requirements.

In terms of bank credit (upper-left panel) results show, first, that countries introduce macroprudential policies and RRs when credit growth is booming (growing at rates exceeding 20 percent on annual terms) and accelerating. Second, the introduction of these policies is associated with an immediate but moderate decline in bank credit growth in the month following the shock. Third, the effects on credit growth are short-lived as growth rates return after four months to their pre-crisis levels. Fourth, although results seem to suggest that marginal RRs are associated with a sharp decline in bank credit, this may instead be due to the synchronization of tightening of RRs with hikes in policy rates (see bottom-left panel). Therefore, the event analysis does not permit to disentangle the effects of marginal RRs from monetary policy shocks. The complementary between RRs and policy rates is explored further in the next section. Fifth, our analysis also suggests that macroprudential instruments have a non-negligible weakening effect on the nominal exchange rate (bottom-right panel), a result that is in line with the empirical analysis of Glocker and Towbin (2012).

B. Dynamic Panel Vector Autoregression

The event case study is complemented with a conditional analysis using panel data vector autoregression (Panel data VAR). This methodology combines the traditional VAR approach, which treats all variables in the system as endogenous, with the panel data approach, which allows for unobserved individual heterogeneity. Specifically, the analysis considers a second order VAR model:

$$z_{it} = \Gamma_0 + \Gamma_1 z_{it-1} + \Gamma_2 z_{it-2} + f_i + e_t \qquad (1)$$

Where z_{it} is either a four variable vector

$$z_{it} \equiv \begin{bmatrix} \text{macroprudential policy dummy} \\ \text{policy interest rate} \\ \text{level of economic activity} \\ \text{private bank credit growth} \end{bmatrix}_{\text{it}}$$

or a six variable vector

$$z_{it} \equiv \begin{bmatrix} \text{marginal reserve requirements dummy} \\ \text{average reserve requirements dummy} \\ \text{other macroprudential policy dummy} \\ \text{policy interest rate} \\ \text{level of economic activity,} \\ \text{private bank credit growth} \end{bmatrix}_{\text{it}}$$

As mentioned earlier, the macroprudential policy variable is a cumulative dummy that includes RRs (marginal and average) and other macroprudential instruments; economic activity is measured by the industrial production index or economic activity index; and real private credit growth is measured on a monthly basis. Policy rates, economic activity and credit growth enter the system in differences. The other macroprudential instruments include

the array of macroprudential measures listed in Table 1, for example, such as capital requirements, liquidity requirements, and limits on foreign exchange positions. The system in (1) is estimated using system Generalized Method of Moments (see Holtz-Eakin, Newey, and Rosen, 1988) and its results are analyzed using impulse responses. In applying the VAR procedure to panel data, we impose the restriction that the underlying structure is the same for each cross-sectional unit. Since this constraint is likely to be violated in practice, fixed-effects (f_i) in the model were incorporated to allow for individual heterogeneity in the levels of the variables. Since the fixed effects are correlated with the regressors due to lags in the dependent variable, the mean differencing procedure used to eliminate fixed effects is inappropriate as it can lead to biased results. To overcome this, we use forward mean differencing (Helmert procedure), which allows us to remove the forward mean (i.e., the mean of all future observations available for each country-year). The transformation also preserves the orthogonality between transformed variables and lagged regressors, and allows using lagged regressors as instruments.

The identification of shocks is achieved through a Choleski decomposition in which macroprudential policy variables are assumed to be the most exogenous variables, followed by the level of economic activity, and finally, bank credit growth to the private sector. Results were also evaluated using an alternative ordering of variables, but were found to be robust so they are not reported separately. Specifically, our analysis relies on impulse response functions where the shock to the different dichotomous macroprudential measures (RRs and other macroprudential measures) are normalized to equal 1 (in this manner it matches the unitary discrete changes of the cumulative dummy). The standard errors for the confidence intervals are calculated using Monte Carlo Simulations.

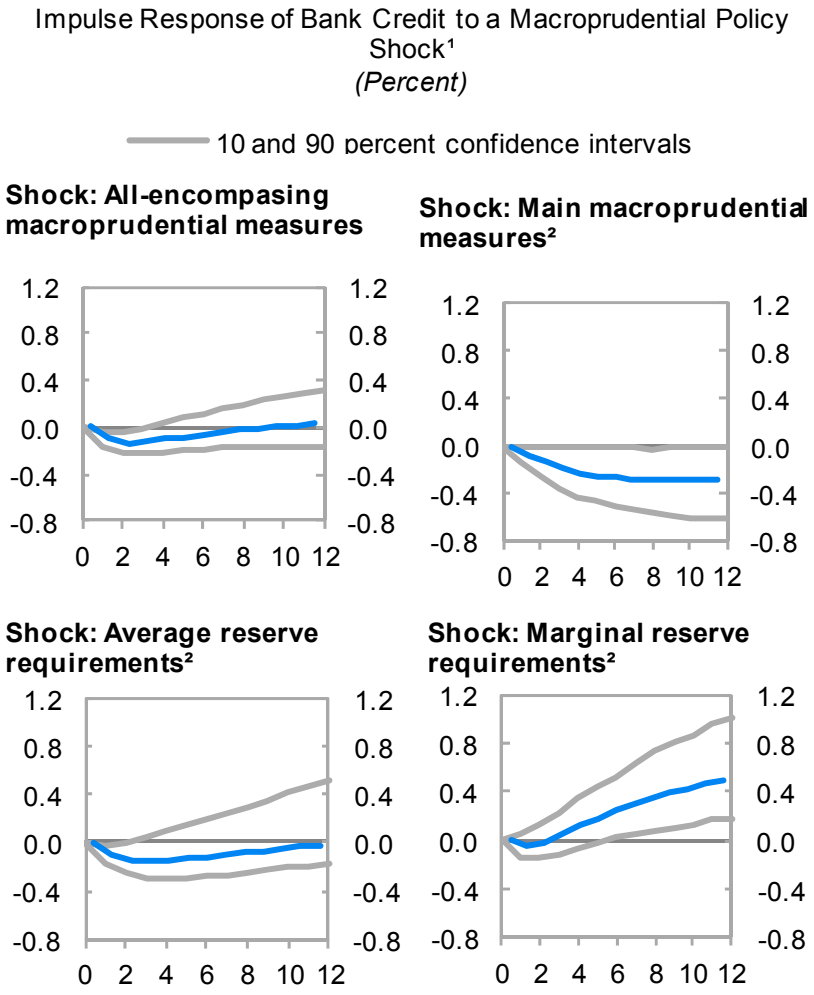
Our findings are in line with our event analysis and confirm that macroprudential measures lead to a modest and temporary reduction in private bank credit growth (Figure 10). The "strongest" impact is observed for the case of average RRs and other macroprudential policies (e.g., dynamic provisioning, countercyclical capital requirements). By contrast, we find that marginal RRs have negligible short-run effects.[25] This unveals that the findings of the event analysis for marginal RRs mainly reflect hikes in policy rates.[26] Moreover, from a policy perspective they also suggest that for these instruments to be effective it may be necessary to recalibrate with certain regularity. A finding that echoes the result found in Lim and others (2011).

Finally, our results suggest that there is a reinforcing role between policy rate hikes and macroprudential policy shocks and vice versa. That is, policy rates are set to increase following a tightening in macroprudential policies, and vice versa (Figure 11).

[25] Impulse responses in the long-run give the opposite sign.

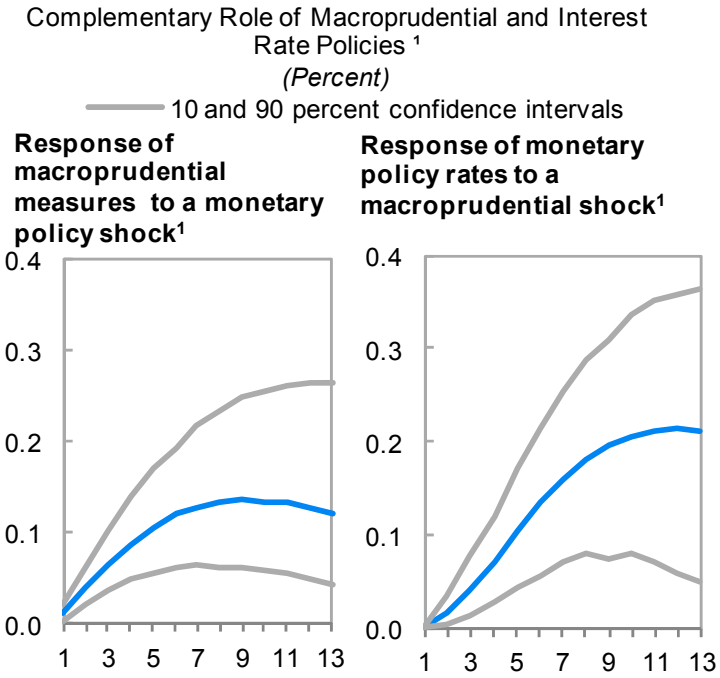
[26] Further analysis on the impact of marginal reserve requirements is left for future research, in particular, the need to control for the tightness of the RRs through a tax-equivalent measure.

Figure 10. Impulse Response of Private Credit Growth to Macroprudential Policy Shocks



Sources: Central bank data; and IMF staff calculations.
[1] Macroprudential shock includes an all-encompassing measure that includes reserve requirements and other macroprudential measures (e.g. dynamic provisioning, countercyclical capital requirements). Estimates based on system generalized method of moments panel vector autoregression with two lags using monthly data for the period 2004:M6—2011:M4. The system includes macroprudential measures, the policy interest rate, the level of economic activity, and bank credit to the private sector. Identification is achieved using Choleski decomposition with the ordering mentioned above. Impulse responses have been normalized to one. Sample includes Brazil, Chile, Colombia, Mexico and Peru.
[2] The all-encompasing macroprudential variable has been split into average and marginal reserve requirements and main macroprudential measures.

Figure 11: Complementary Role of Macroprudential Policies and Reserve Requirements



Sources: Central bank data; and IMF staff calculations.
¹ Estimates based on system generalized method of moments panel vector autoregression with two lags. The system includes macroprudential measures, policy interest rate, level of economic activity, and bank credit to the private sector. Identification is achieved using Choleski decomposition with the ordering mentioned above. Estimates are based on monthly data over the period 2004:M6—2011:M4 and include Brazil, Chile, Colombia, Mexico, and Peru. Macroprudential measure includes reserve requirements and other macroprudential measures (e.g., dynamic provisioning, countercyclical capital requirements) and is captured by a cumulative dummy. Simulation performed assuming 25-basis-point shock on policy interest rates. The impulse response has been normalized so that the corresponding macroprudential shock equals one.

V. CONCLUSIONS

This paper constitutes a first attempt at analyzing empirically the role and effectiveness of RRs and other macroprudential instruments in a cross-section of Latin American countries. Our review shows that authorities in Brazil, Colombia and Peru have actively relied on RRs as a tool to "lean against the wind": (i) raising RRs during the upswing phase of the cycle to contain excessive credit growth and the associated build up of vulnerabilities and (ii) lowering them during the downswing phase to ease liquidity pressures. The active management of RRs was evident both before and after the global financial crisis.

The paper argues that from a practical policy perspective RRs offer a number of benefits, but also have costs and drawbacks. On the positive side, RRs can help address the procyclicality of the credit cycle and build-in a buffer in good times that can be deployed in bad times, when liquidity is scarce. In addition, depending on the range of liabilities subject to RRs (e.g., when targeted at non-deposit liabilities), RRs can help improve the funding structure of the banking system, diminishing the exposure of banks—and therefore the extent of contagion via interconnectedness. For these reasons, in junctures of excess global liquidity and large capital inflows to emerging market economies, RRs appear to be a useful policy tool to "lean against the wind" and avoid the buildup of imbalances, in particular, those associated with excessive banks' reliance on cheap and volatile funding. Moreover, it was argued that RRs and other macroprudential tools allow for targeted intervention, avoiding distortion in market or segments not affected by exuberant conditions. And finally, that they can be a complement for monetary policy, even in IT regimes, in particular when monetary and financial stability goals are at odds with each other. On the negative side, we argued that RRs are difficult to calibrate given the many dimensions that need to be considered, and can induce disintermediation and hence, shift risks from regulated segments or sectors of the financial system to unregulated ones.

Our empirical analysis on the effectiveness of RRs and other macroprudential tools focused on one specific dimension of systemic risk: the procyclicality of private bank credit growth. Given the limited available data, we aimed at taking advantage not only of individual country experiences, but also relied on a methodology (Dynamic Panel VAR) that allowed to take advantage of the information contained in the individual times series of individual countries as well as in the cross-country differences of credit and business cycles in countries that have and have not relied on these policy measures. The empirical results suggest that the use of RRs as a countercyclical tool has modest and short-lived effects on credit growth. A practical implication of this is that RRs may need to be recalibrated with certain regularity to maintain their effectiveness. Moreover, our analysis also shows that there has been a reinforcing role between monetary policy and RRs and other macroprudential measures, with little evidence of substitution.

Future research is required in several areas. First of all, we have only examined the effectiveness of RRs and other macroprudential tools in one dimension: its effects on aggregate bank credit. However, a more comprehensive analysis should gauge the role of

these policies in other relevant dimensions, such as its impact on the funding structure of banks or by examining the sectoral effects of these policies.[27] Assessing their impact on aggregate domestic demand and financial deepening are also important. Second, although our results suggest that RRs and other macroprudential policies tend to work best when complemented with traditional macroeconomic policies (e.g., monetary policy), it is possible to envision circumstances that call for tighter prudential policies while monetary policy does not have room of maneuver (e.g., intensified capital inflows may limit the space to hike policy rate to contain rapid credit growth). Therefore, we need to understand better the interaction of monetary and macroprudential policies. With no doubt, general equilibrium analysis would prove of great value. Third, a priority is to construct more detailed measures of RRs that could provide a better guide towards the appropriate design and calibration of RRs. Doing so, for instance, should allow evaluating for possible non-linear effects that arise with the level and change of RRs, other macroprudential policies and/or policy interest rates. This would prove invaluable to improve the calibration and scope of these policy tools.

[27] It is worth pointing out that finding modest effects of RRs on aggregate credit does not imply that they are ineffective. For instance, they may be slowing down credit in a specific market segment or sector, with little impact on aggregate credit. In such instance, RRs would lower systemic risk by reducing sectoral vulnerabilities.

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