Bank capital buffers, lending growth and economic cycle: empirical evidence for Brazil

Abstract

This paper analyzes the relationship between economic cycle and capital buffers held by banks in Brazil; the monetary policy impact on the capital buffers; the effects of such capitalization on the bank lending growth; and how these effects vary among banks with different ownership structure. We use an unbalanced panel data of Brazilian institutions from 2001 to 2009 to estimate an equation for the behaviour of capital buffers. Our results, robust and significant, reveal that the economic cycle and monetary policy affect the surplus capital and that capitalization is positively related to loan growth.

Key words: capital buffers, economic cycle, pro-cyclicality, Basel II

JEL: G18, G21, E58

Resumo

Este artigo analisa a relação entre as reservas de capital (buffers de capital) mantidas pelos bancos no Brasil entre 2001 e 2009 e o ciclo econômico; o impacto da política monetária nestas reservas; os efeitos desta capitalização no crescimento dos empréstimos bancários; e como esses efeitos variam entre bancos com diferente controle acionário. Estimando uma equação para o comportamento dos buffers de capital, conluímos que tanto o ciclo econômico como a política monetária afetam o excesso de capital e que esta capitalização está relacionada com o crescimento dos empréstimos.

Palavras-chave: buffers de capital, ciclo econômico, pró-ciclicidade, Basiléia II

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1 Introduction

Banking is certainly one of the most regulated industries in the world, and the rules on bank capital are one of the most relevant aspects of such regulation. In general, bank regulation is justified on the basis of the preservation of financial stability, the presence of market failures and the inability of depositors to monitor banks (Santos, 2000).

Both the 1988 Basel Accord and the proposal for a new capital adequacy (the Basel II Accord), in particular the issue of "pro-cyclicality," has been subject of much investigation (see, among others, Kashyap and Stein (2004), Heid (2007), Jackson (1999), Santos (2000), Borio et al. (2001)). As is well known, by linking capital requirements more closely to risks, hence more closely to economic conditions, the Basel II rules increase the pro-cyclical nature of banks' lending behaviour. These studies have focused primarily on the effects of the Basel II framework on the cyclicality of the capital charges and making proposals to dampen this pattern (Gordy and Howels, 2004; Estrella, 2004; Pederzoli and Torricelli, 2005).

Another important branch of the literature on bank regulation focuses on how bank capital ratios affect the response of lending activity to monetary policy and GDP shocks (Gambacorta and Mistrulli, 2004; Furfine, 2001; Kishan and Opiela, 2000; Hancock and Wilcox, 1994; den Heuvel, 2001; Altunbas et al., 2002; Ehrmann et al., 2003). These studies, for instance, show that regulatory tightening of capital ratios can generate aggregate shocks and, therefore, that prudential capital requirements can influence macroeconomic outcomes.

In order to assess the effects of bank regulation on the economy, more broadly speaking, we analyze (1) the relationship between economic cycle and capital buffers held by banks in Brazil; (2) the monetary policy impact on the capital buffers; and (3) the effects of such capitalization on the bank lending growth. In addition, we test whether these effects and the amount of capital buffers vary among banks with different ownership structure.

We use an unbalanced quarterly panel data of Brazilian institutions from 2001:1 to 2009:3 and we estimate an equation for capital buffer controlling for other determinants, besides an economic cycle variable. We find a robust and significant negative relationship between capital and the economy. This result raises some concerns about the pro-cyclicality problem, especially in the debate about the implementation of Basel II accord in Brazil.

Another important finding is with respect to the monetary policy effects on capital buffers and the consequent impact on bank lending. We find a robust relationship between capital buffers and changes in monetary policy, which in turn affects loan variation. Since capital buffers has a positive impact in lending activity, one may conclude that our results suggest the existence of a "bank capital channel" in the transmission of the monetary policy effects.

It is important to highlight that most of the banks, according to their balance sheets, hold capital ratio above the required minimum. In this context, the recent research in this area has focused on analyzing the cyclical behavior of capital buffers. Ayuso et al. (2004) examine the Spanish banks, Lindquist (2004) Norwegian banks, and Stolz and Wedow (2005) German banks, finding evidence of a negative relation between the cycle and the buffer. Using an international bank database, Jokipii and Milne (2008) find a similar negative relation for the 15 countries of the European Union in 2004, but an opposite relation for the 10 countries that joined European Union in 2004.

Therefore, our paper contributes to the literature on bank pro-cyclicality providing recent empirical evidence about the cyclical behaviour of capital buffers in Brazil and how they vary among banks with different ownership structure. Furthermore, our finding about the effects of monetary policy on capital buffers, on lending growth and the relationship between these variables show that in fact bank capitalization has an important role in the mechanism through which a monetary tightening affects credit activity. To the best of our knowledge this is the first paper in this literature that takes into account explicitly the impact of monetary policy on the capital buffers held by banks as well as that studies exclusively an emerging market case.

The banking system in Brazil is basically composed of domestic institutions (55.7%) and domestic with foreign ownership (34.2%). Public banks account for less than 8% of total assets[1]. In addition, it is worth noting that Brazil does not have a well developed corporate bond market and the stock market has been growing fast in the last decade. Due to this fact most firms rely on bank financing and internal sources of funding. Therefore, evaluating the banking system and the capital movement along the economic cycle is crucial.

The rest of the paper is organized as follows. Section 2 summarizes the motivations for this study: the reasons why banks hold an excess of capital; a brief review about the link between capital and lending activity; and the general ideas behind the pro-cyclicality of capital buffers. The theoretical framework and methodology about capital buffers are described in section 4, as well as the dataset used in equations. The model for lending growth is explained in section 5. Section 6 shows the econometric results. Finally, section 7 presents our conclusion.

[1] Financial Stability Report of Central Bank of Brazil - May, 2010

2 Motivation

2.1 Reasons why banks hold excess capital

Banks maintain excess of capital primarily because of market discipline, supervisory intervention, and adverse shocks.

Banks may hold capital buffers to avoid costs related to market discipline (for instance, the cost of deposits) (Lindquist, 2004). When bank liabilities are not totally insured, the depositors demand higher returns to compensate for higher bank risk. Therefore, banks may have incentives to reduce its risk and hence the cost of deposits by increasing its capital level (Fonseca and Gonzalez, 2009).

According to Nier and Baumman (2006), the effectiveness of market discipline depends on banks' support, funding and disclosure. That is, (1) the extent of the government safety net; (2) The degree to which the bank is financed by uninsured liabilities; (3) The observability of the banks' risk choice. Thus, the first one reduces capital buffer and the others factors encourage banks to limit their risk of insolvency (Nier and Baumman, 2006). And this may be achieved by increasing the amount of capital above the minimum required. Hence banks also may hold excess of capital to protect themselves against insolvency.

Banks may keep capital buffers to signal soundness to the market and to satisfy expectations of rating agencies (Jokipii and Milne, 2008; Nier and Baumman, 2006). Hence, excess of capital may serve as an instrument in the competition for unsecured deposits and money market funding (Lindquist, 2004). Therefore, banks care about their relative capital buffer.

Banks maintain a cushion of capital as an insurance against violating the minimum capital requirement (Stolz and Wedow, 2005; Jokipii and Milne, 2008; Lindquist, 2004; Fonseca and Gonzalez, 2009). When regulatory requirement changes, banks cannot adjust capital and risk instantaneously. This is because there are adjustment costs related to raise fresh external capital and the drop in banks' common stock values due to changes to equity capital. In addition, this violation results in costs arising from a supervisory intervention, which may be (partially) absorbed by excess of capital.

Capital buffers also act as an insurance for the banks against adverse shocks (Nier and Baumman, 2006). Capital reduces the likelihood of bankruptcy and financial distress costs (Fonseca and Gonzalez, 2009). In particular for poorly capitalized banks, this excess of capital reduces difficulties in raising new capital when capital ratio falls. On the other hand, banks may hold capital to be able to exploit unexpected investment opportunities. So banks can obtain wholesale funds quickly (Jokipii and Milne, 2008; Lindquist, 2004; Fonseca and Gonzalez, 2009).

2.2 Bank capitalization and lending behavior

There are several theories that explain how bank capital could influence the propagation of economic shocks to lending. All these theories suggest the existence of market imperfections that modify the standard results of the Modigliani and Miller (1958) propositions. Specifically, banks face increasing marginal adjustment costs as well as they avoid regulatory costs.

Bank capital can influence the impact of economic shocks on lending in two ways: the "bank lending channel" and the "bank capital channel," in which we are more interested. Both of them are based on adverse selection problems that affect banks' fund-raising: the first relies on imperfections in the market for bank debt (Kishan and Opiela, 2000; A. K. Kashyap, 1995; Bernanke and Blinder, 1988) and the second concentrates on an imperfect market for bank equity (den Heuvel, 2001).

The lending channel also relies on another two conditions. First, the banking sector as a whole must not be able to completely insulate its lending activities from shocks to reserves, either by switching from deposits to less reserve-intensive forms of finance or by paring its net holdings of bonds. Second, there must be some form of imperfect price adjustment that prevents any monetary policy shock from being neutral (A. K. Kashyap, 1995). Thus, a monetary tightening affects bank lending because the drop in reservable deposits cannot be completely offset by issuing non-reservable liabilities (or liquidating some assets). In this case, bank capital has an important role because it affects banks' external ratings and provides the investors with a signal about their creditworthiness (Kishan and Opiela, 2000).

Gambacorta and Mistrulli (2004) sum up the three hypotheses on which the bank capital channel is based: 1) an imperfect market for bank equity; 2) a maturity mismatching between assets and liabilities that exposes banks to interest rate risk; and 3) a direct influence of regulatory capital requirements on the supply of credit. The mechanism is the following. Since the interest rates on banks' assets are slower to adjust to changes in market interest rates than those on banks' liabilities, banks bear a loss due to the maturity mismatch between assets and liabilities that reduces profits and then capital. If equity is sufficiently low and it is too costly to issue new shares, banks reduce lending, or else they fail to meet regulatory capital requirements.

Bank capitalization may also influence the way the loan supply reacts to output shocks if banks' profits, and thus banks' capital accumulation, depend on the business cycle. In this case, output shocks affect banks capacity to lend if the market for equity is not frictionless and banks have to meet regulatory capital requirements. Other things being equal, well-capitalized banks are in a better position, with respect to low-capitalized banks, to absorb output shocks. Since they hold more capital in excess of the minimum required to meet prudential regulation standards, well-capitalized banksxc need to adjust lending less during economic downturns in order to avoid regulatory capital shortfalls. Thus, if for institutional reasons banks hold a different amount of capital in excess of regulatory requirements, this may in turn imply cross-sectional differences in lending responses to output shocks (Gambacorta and Mistrulli, 2004).

The bank capital channel and the way banks react to output shocks are closely related to the amount of capital held in excess of regulatory requirements. Gambacorta and Mistrulli (2004) point out that the traditional capital-to-asset ratio does not discriminate among banks with the same level of capital facing different regulatory constraints. By contrast, the capital buffer ratio takes regulatory requirements directly into account.

2.3 Capital buffers along the economic cycle

There is strong empirical evidence that bank capital buffers under Basel I exhibit significant cyclical patterns (Ayuso et al., 2004; Jokipii and Milne, 2008; Lindquist, 2004; Stolz and Wedow, 2005). They will increase during economic downturns and decrease during upturns. One reason for this is obvious: demand for loans is pro-cyclical (Stolz and Wedow, 2005; Gambacorta and Mistrulli, 2004).

Since loan losses tend to lag a bussines cycle, this negative movement of capital buffers may also be evidence for a myopic bank behaviour (Jokipii and Milne, 2008; Stolz and Wedow, 2005; Ayuso et al., 2004; Borio et al., 2001; Berger and Udell, 2004). Banks expand their loan portfolio in a boom without building up their capital buffers accordingly. During the following cyclical downturn, the capital accumulation may also be too slow. Hence, banks' capital buffers cannot absorb the materializing credit risks. The banks are forced to increase their capital buffers through a reduction in lending (Koopman et al., 2005; Stolz and Wedow, 2005; Jokipii and Milne, 2008).

It is also argued that portfolio risks actually increase during an economic upturn (Borio et al., 2001). During booms, borrowers are less likely to default than during economic downturn. However, banks are likely to take credit risks during booms when banks expand their loan portfolios. Hence, forward-looking banks build up their capital buffers during booms to be able to accommodate materializing credit risk during recession (i.e. positive movement) (Jokipii and Milne, 2008; Stolz and Wedow, 2005).

Considering the cyclicality of lending, the capital buffers are likely to reduce the impact of changes in capital charges, even partially (Heid, 2007). In this context, some authors point out that capital buffers will reduce the cyclical effects of Basel II (Nier and Zicchino, 2005).

Under Basel I, Heid (2007) predicts an increase in the capital buffer during an economic downturn due to a reduction in lending. Under Basel II, however, the capital buffer will actually decrease, because the rise in the average risk weights will usually overcompensate the reduction in lending (Heid, 2007). Nevertheless, it is still an open question whether the new accord has necessarily to change the behaviour of banks regarding the buffers they maintain over requirements (Ayuso et al., 2004).

Parallel to this approach of bank pro-cyclicality, there is also strong evidence that well-capitalized banks are less constrained in their responses to monetary policy and to other macroeconomic shocks compared with banks with relatively lower levels of capitalization (Kishan and Opiela, 2000; Gambacorta and Mistrulli, 2004; Nier and Zicchino, 2005; Peek and Rosegren, 1995). In particular, credit supply of these banks with higher capital ratio are less pro-cyclical.

3 An empirical model for capital buffers

3.1 Determinants of the surplus capital

Following Ayuso et al. (2004), Lindquist (2004), Fonseca and Gonzalez (2009) we consider three different types of bank capital costs to model capital buffers: costs of funding, costs of failure (financial distress) and adjustment costs.

Holding capital implies direct costs of remunerating the excess of capital, that is the opportunity cost of the capital. Therefore, banks' incentives to hold capital buffers depend on the cost of capital compared to the cost of deposits (Fonseca and Gonzalez, 2009). Ayuso et al. (2004), Jokipii and Milne (2008) use each institutions' return on equity (ROE) to proxy these costs. The expected sign for this variable is negative (Ayuso et al., 2004; Jokipii and Milne, 2008). As noted by Jokipii and Milne (2008), ROE may well exceed the remuneration demanded by shareholders and to this extent is a measure of revenue rather than cost. A high level of earnings substitutes for capital as a buffer against unexpected shocks. Thus, as raising capital through the capital markets is costly, retained earnings are frequently used to increase capital buffers. So the expected sign for ROE may be negative (Jokipii and Milne, 2008; Stolz and Wedow, 2005), but it also may be positive (Nier and Baumman, 2006; Stolz and Wedow, 2005; Rime, 2001).

The bank risk profile also determines the capital buffer, since it is related to the likelihood of costs of failure. Ayuso et al. (2004), Jokipii and Milne (2008), Fonseca and Gonzalez (2009) use the non-performing loan ratio to total loans and credits (NPL) to proxy the bank risk. It is predicted a negative relationship between capital buffers and risk.

Banks may face adjustment costs in moving toward their optimal capital ratios. These costs arise both when the bank is raising new external capital and when it is shedding external capital (Estrella, 2004). The main entry costs include those related to the problem of asymmetric information in capital markets. Equity is a form of capital for which monitoring costs are high, and the bank has an informational advantage over public investors as to the value of its own equity (Myers and Majluf, 1984). Accordingly, the issuance of equity could be seen by the potential buyers as a negative signal with regard to the banks' value. On the other hand, an important cost of shedding equity comes from pressure from regulators, supervisors and market participans to maintain clearly sound levels of capital (Estrella, 2004).

There are several reasons to expect a negative relationship between the banks' size and its capital level. The main reasons are: diversification effect, too-big-to-fail hypothesis, advantages in the access to capital (Brown and Davis, 2008; Berger and Udell, 2004), and if there are economies of scale in screening and monitoring borrowers, then large banks may substitute excess of capital with these activities (Jokipii and Milne, 2008; Lindquist, 2004; Stolz and Wedow, 2005; Nier and Baumman, 2006).

Finally, it is important to consider the ownership stucture in the modelling of the buffer. There are some factors to believe that foreign banks hold less capital buffer than domestic banks, and within these type of banks, public banks hold less surplus than private institutions. It is because public and private banks decide in a different manner loan supply. The reason for this is that public banks are often funding politics executers and also because it is easier for them to raise new capital. In addition, one may take into account the political influence factor that encourages such a banks to sustain credit levels which are not compatible to the economic rationality and the efficient management. Hence this negatively affects the amount of excess of capital held by the bank.

3.2 Methodology

We use an unbalanced panel data of 169 banks in 35 quarter periods from 2003:1 to 2009:3. We define provision as the difference between economic capital and regulatory capital and capital buffer is this difference divided by the regulatory capital (in percentage).

3.2.1 Empirical equation for capital buffer

Following previous literature (Ayuso et al., 2004; Stolz and Wedow, 2005; Jokipii and Milne, 2008; Fonseca and Gonzalez, 2009; Brown and Davis, 2008), we apply the generalized method of moments (GMM) estimator developed by Arellano and Bond (1991). This methodology is specially designed to obtain unbiased and efficient estimates in dynamic models with lagged dependent variables as regressors.

It also considers the likely endogeneity of the explanatory variables.

The model is

$$BUF_{i,t} = \beta_0 BUF_{i,t-1} + \beta_1 ROE_{i,t} + \beta_2 NPL_{i,t} + \beta_3 SIZE_{i,t} + \beta_4 OutputGap_{i,t} + \eta_i + \varepsilon_{i,t},\ i = 1,...,N\ t = 1,...,T \quad (1)$$

We define bank explanatory variables to capture the three types of costs related to capital buffers. We include the lagged dependent variable to test whether adjustment costs are relevant. Its expected sign is positive. Direct costs of remunerating the excess of capital are proxied by each institutions' *ROE* (return on equity). The expected sign for this variable is negative. Since the expected cost of failure of each institution depends on its risk profile, we use *NLP* (non-performing loans ratio) as a measure of *ex post* realized risk. It implies that its expected sign is negative. We include *SIZE* - the natural logarithm of banks' total assets - to capture the effect of the banks' size on buffer movements. Its predicted sign is negative.

In order to determine whether the business cycle has an additional effect on the bank capital buffer, we add $OutputGap$ - obtained after applying a standard Hodrick-Prescott filter. We also take into account explicitly the effect of monetary policy in the excess capital by adding in equation 1 the short-term interest rate, the overnight *selic* interest rate, set by the Monetary Policy Committee (Copom). Finally η_i is an unobserved bank-specific effect which we eliminate by taking first-differences of all variables. It captures heterogenous characteristics such as different risk preferences, governance structures, and managerial skills. The standard random shock is $\varepsilon_{i,t}$.

4 Estimating the effects of bank capitalization on lending behavior

In order to take into account the bank lending activity in the study of the procyclicality of the capital buffer, we consider the effect of each institutions' capitalization (e.g., the bank capital buffer) on the lending growth. In addition, we use this approach to analyze the mechanisms by which bank capital affects the effects of monetary policy in loan growth. As reported by Berrospide and Rochelle (2008), there are many possible values for the magnitude of this impact. Representing one extreme is the possibility that banks target a constant leverage ratio and are very limited in their ability to raise equity to offset declines in capital.

On the other hand, there is the possibility that a decline in the leverage ratio that results from a capital loss can be accommodated and that the capital loss can be offset by alternative sources of funding. In this case, capital losses result in no contraction of assets or of lending.

We estimate a regression of the growth rate in loans in which we include, besides the capital buffers, lags of the dependent variable, lags of the economic activity and lags of the Selic interest rate. Again, using difference GMM method, we estimate:

$$\Delta Loan_{i,t} = \sum_{s=1}^{4} \alpha_s \Delta Loan_{i,t-s} + \sum_{s=1}^{4} \gamma_s \Delta Selic_{i,t-s} + \sum_{s=1}^{4} \beta_s OutputGap_{i,t-s} + \phi Buf_{i,t} + \varepsilon_{i,t} \quad (2)$$

In order to analyze whether bank ownership structure and bank capitalization (capital buffers) affect the impact of monetary policy and of the business cycle on loan growth, we estimate extensions of equation 6 with the interactions of the dummy variables, Well(Low)-capitalized, Foreign, Private and Public with $\Delta Selic$ and $OutputGap$. Where Well(Low)-capitalized variables are defined in the following manner: if the bank holds a buffer higher (lower) than the average, that is equal to 9.282672, then Well(Low)-capitalized takes 1 and O otherwise. On the other hand, in order to verify whether the conditions of monetary policy and economic cycle affect the impact of bank capitalization on loan growth we add in equation 6 the interaction between the dummy variables Up(Down)-Selic, or Up(Down)-(output gap), and capital buffer. Where Up(Down)-Selic are defined in the following manner: if $\Delta Selic$ is increasing (decreasing) then Up(Down)-Selic takes 1 and 0 otherwise. The same for output gap.

5 Results

5.1 Estimation of the determinants of capital buffer

Tables 1-3 present the results of estimating equation 1 and its extensions. The results of the baseline model are displayed in columns 2 of tables 1 and 2. We apply Sargan test and Hansen test of over-identifying restrictions to confirm the absence of correlation between the instruments and the error term. The non-significance of the $m2$ test indicates no second-order serial correlation in the first-difference residuals. These are the conditions required for consistency of the GMM estimates.

The coefficient on the lagged dependent variable is positive, relevant and highly significant in all cases. This is predicted and reflects the fact that banks face short-term adjustment costs. It is also found that the opportunity cost of capital, measured by the return on equity (ROE), has a negative effect on the surplus capital.

Differently from expected, in some models the coefficient on NPL shows a positive relation between risk and capital buffer. In this case, it may indicate that higher capital in excess of capital requirements is linked to a higher risk appetite. In addition, there is evidence of a negative relationship between size and buffer. Actually, the coefficient is negative and highly significant when the dependent variable is Basel Index (see column 4 of table 3).

Considering the bank ownership structure, we test whether foreign, private domestic and public banks have a different portion of capital buffer. First we include the dummy variables $Foreign$ and $Private$. The sign and significance of these variables reveal that foreign banks have a smaller capital buffer than private domestic banks. This can be seen as evidence that geographically diversified banks are less likely to suffer a decline in their capital ratios. There is also evidence that private banks hold more surplus capital than public banks, although this difference is not so acute.

There is a negative and statistically significant relationship between the output gap and the capital buffers. We test the robustness of these results by trying different extensions of equation 1. In all cases, the results support a negative movement of capital buffers along the economic cycle.

First, we estimate a model in which all the bank-specific variables were omitted. We also experimented with varying lag lengths for the explanatory variables, and by dropping ROE and NPL variables at a time from the estimations. Because of their cyclical behavior, notably NPL, these variables could influence the sign and significance of $OutputGap$.

In addition, three new regressors were added to equation 1, namely the ratio of capital tier 1 to total assets ($Tier1$), the equity ratio and the volume of deposits ($ln(Deposits)$) - the natural logarithm of total deposits. The estimated parameter of $OutputGap$ remains almost unchanged, supporting the robustness of the results. In particular, the significance of the estimated parater of $OutputGap$ increases. The new regressors are not significant and their signs are respectively positive, positive and negative - as it was expected.

We also investigate whether the pro-cyclicality of capital buffer could vary among banks with different ownership structure. First we interact $OutputGap$ with the dummy variables $Foreign$ and $Private$ and find that capital buffers in foreign banks are, if anything, less pro-cyclical than in private banks. On the other hand, the results reveal that capital buffer in public and private banks vary along the economic cycle in the same manner.

Table 3 shows the results of estimating equation 1 with $\Delta Selic_{i,t-1}$ as regressor. The negative sign on this variable can be seen as evidence that monetary tightening may lead to a reduction on bank profits, and then on capital. Since capital buffers are composed in some part by retained earnings, this drop in profits could reduce the amount of excess capital. In fact, when we estimate equation 1 using Basel Index as dependent variable, we find a positive sign on $\Delta Selic_{i,t-1}$, suggesting that monetary tightening and economic downturn have different impacts on capital buffers, although both of them are related with regulatory constraint (see column 4 of table 3). While the sign on the interactions $Foreign * Selic$ and $Private * Selic$ does not reveal any interesting result, the sign on $Public * Selic$ and $Private * Selic$ suggests that the effect of an increase in Selic on banks' capitalization is more moderate in public banks.

5.2 Estimation of the lending growth equation

Next, we show the results from estimating equation 2 in table 4. The coefficients on the three first lags of loan growth is negative and the sign of the fourth lag is positive and significant.

The coefficient on $\Delta Selic_{i,t-1}$ is negative, significant and robust. To test whether monetary policy effects are equal among banks with different capital ratios (e.g., capital buffers), we add the interaction between Selic and the dummy variables Well(Low)-capitalized. Inconsistent with the "bank lending channel" hypothesis, there is no clear evidence that the effects of monetary tightening are smaller for banks with higher capital ratios, although they have easier access to uninsured financing. We also test whether the bank ownership structure could influence the monetary policy effects. Hence we interact Selic with the dummy variables Foreign, Private and Public. Interestingly, the results reveal that the loan growth of foreign banks is more affected by changes in monetary policy than the lending of private banks. It is valid noting that these coefficients are not statistically significant.

As it was predicted, while the parameter of $OutputGap_{i,t}$ is negative and significant, the coefficient of $OutputGap_{i,t-1}$ is positive. In addition to the natural cyclicality of demand for loans, this can be seen as evidence of the cyclicality of capital requirements. The significant coefficient on the interaction between Low-capitalized and Output gap show that lending growth in low-capitalized banks is more susceptible than in well-capitalized ones to changes in economic conditions. It has also found significant evidence that the effect of GDP shocks is more pronounced for private banks than for foreign institutions.

The estimates show that capital buffers are positively related to growth in loans. Francis and Osborne (2009) explain that banks may choose to take this route in order to avoid the costs of regulatory intervention or adverse market reaction. The results also reveal that the capitalization impact on lending is weaker in economic downturn.

6 Conclusion

This paper analyzes the determinants of bank capital buffers, in particular the relationship between capital and the economic cycle, and its effects on lending activity using a panel data of 169 banks in Brazil between 2001 and 2009. We apply the GMM difference and system estimators to control for adjustment costs, unobservable heterogeneity and potential endogeneity of the explanatory variables. We focus primarily on whether the capital buffer depends on the business cycle and on whether the buffer depends on the banks' ownership structure. In addition, we test the effects of bank determinants of the cushion of capital.

Taken together, our results indicate that in economic downturn, banks raise the amount of capital buffers and lower growth in loans. One may argue that this raise in excess capital could imply in a higher lending growth, because the sign on capitalization is positive. In this case, considering the significance and robustness of the results regarding output gap in both equations for buffer and for loans, one may conclude the effect of the economic downturn overcompensates the impact of bank capitalization. However, we find that this effect is certainly stronger for low-capitalized banks, since they are more limited to assess external funding sources.

In economic downturn, banks have in our sample period increased capital buffers and, under the new accord Pillar 1, capital requirements will be increased as banks exposures are downgraded, whether by external rating agencies or in internal rating systems. This suggests that capital management will be especially challenging under the new accord because it will lead to higher capital requirements precisely at the time (the trough of the business cycle) when most of the banks are seeking to reduce their capital levels.

Another important conclusion is related to the impact of capitalization on lending behavior. According to our results, monetary tightening is related to a decrease in capital buffers and in loan growth. Since capitalization is positively related to lending variation, these findings can be seen as evidence of the "bank capital channel" in the transmission of monetary policy. Indeed, an increase in Selic interest rate would imply in a reduction on bank profits, and then on capital buffers. As the market for equity is imperfect, banks would opt to cut back on loans.

Finally, these results indicate that bank capital is a relevant balance-sheet item for the propagation of different kinds of shocks to lending, particularly owing to the existence of regulatory capital constraints. As highlighted by Gambacorta and Mistrulli (2004), this implies that when evaluating different schemes of regulation on bank capital, one has to consider not only microeconomic effects on banks' soundness but also the macroeconomic consequences of those same schemes.

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VARIABLES	(1) Provision	(2) Provision	(3) Provision	(4) Provision	(5) Provision	(6) Provision	(7) Provision	(8) Provision	(9) Provision
Lagged Provision		0.289***	-0.0305	-0.0329	0.0153	0.265***	0.0939	0.0225	0.100
		(0.0433)	(0.0825)	(0.0819)	(0.0946)	(0.0999)	(0.119)	(0.135)	(0.109)
ROE		-0.0103	0.00821	0.00880		-0.0414	-0.0590**	-0.0159	-0.0151
		(0.00941)	(0.0308)	(0.0304)		(0.0313)	(0.0288)	(0.0275)	(0.0301)
NPL		1.070	-3.802	-3.813	-4.483		1.455	-1.646	0.697
		(2.238)	(4.149)	(4.169)	(4.492)		(3.823)	(4.489)	(4.172)
Size		-2.018	-0.699	-0.683	-1.296	-3.928**	1.087	0.480	-2.886*
		(1.421)	(1.704)	(1.692)	(1.760)	(1.588)	(2.480)	(1.623)	(1.709)
Output gap	-28.47**	-12.12*	-20.34***	-22.76**	-21.61*	-17.36	-12.84	-19.16	-16.18
	(14.17)	(6.269)	(7.427)	(11.19)	(11.26)	(11.05)	(11.09)	(11.86)	(11.19)
Private				806.7**	826.6**	845.4**	769.4**	790.0**	722.7*
				(348.8)	(357.8)	(413.2)	(344.8)	(335.7)	(373.5)
Foreign			-782.2**						
			(348.1)						
Private*(Output gap)				-0.389	-1.261	1.126	-0.588	0.465	-4.797
				(9.604)	(9.625)	(10.17)	(9.851)	(9.946)	(10.08)
Foreign*(Output gap)				6.258	5.236	5.736	3.537	7.564	2.328
				(9.930)	(9.986)	(10.62)	(9.756)	(9.765)	(10.17)
Tier 1							13.03*		
							(7.540)		
Equity ratio								2.826	
								(6.056)	
ln(Deposits)								-21.71	
								(24.35)	
Loans									1.521
									(1.077)
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
m1	-6.64***	-8.34***	-3.7***	-3.72***	-3.68***	-4.69***	-3.30***	-2.68***	-3.58***
m2	-2.17***	1.49	-1.42	-1.43	-0.94	1	-0.38	-0.8	-0.28
Sargan test		145.21	154.15	153.73	105.67	159.91	134.88	108.95	132.27
p-value		0.142	0.017	0.018	0.110	0.00	0.152	0.590	0.191
Hansen test		129.97	121.55	118.77	96.28	103.72	111.13	109.57	119.79
p-value		0.435	0.418	0.489	0.281	0.19	0.684	0.574	0.463
Observations	3,884	3,718	3,718	3,718	3,718	3,718	3,718	3,718	3,718
Number of banks	166	165	165	165	165	165	165	165	165
Number of Instruments	34	165	157	159	128	131	160	155	160

Table 1: Results of estimating equation 1 and its extensions using Arellano and Bond (1991) difference GMM estimator. Banks operating in Brazil, 2001-2009. The dependent variable is *Provision*, the difference between economic capital and regulatory capital. In column 1 all the bank specific variables are omitted. Column 2 presents the results of the baseline model. In model 3 the dummy variable Foreign is added. In models 4-9, we include the interections $Private * (Outputgap)$ and $Foreign * (Outputgap)$. Model 5 excludes ROE and model 6 excludes NPL. Column 7 shows the results of the model with $Tier1$. In column 8, $EquityRatio$ and $ln(Deposits)$ are considered. Finally, in model 9 $Loans$ is added. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

VARIABLES	(1) BUF	(2) BUF	(3) BUF	(4) BUF	(5) BUF	(6) BUF	(7) BUF	(8) BUF	(9) BUF	(10) BUF
Lagged BUF		0.750***	0.574***	0.574***	0.571***	0.568***	0.558***	0.539***	0.552***	0.499***
		(0.0624)	(0.0891)	(0.0891)	(0.0892)	(0.0950)	(0.0867)	(0.0858)	(0.0799)	(0.0869)
ROE		-0.0346	0.0188	0.0188	0.0174		0.0318	0.0230	-0.00162	0.0221
		(0.0251)	(0.0260)	(0.0260)	(0.0260)		(0.0253)	(0.0237)	(0.0206)	(0.0214)
NPL		-2.403	-5.064*	-5.064*	-5.153*	1.758		1.969	-4.385**	1.086
		(2.192)	(2.782)	(2.782)	(2.811)	(3.071)		(2.777)	(2.193)	(2.396)
Size		0.0790	0.177*	0.177*	0.180*	0.113	0.0470	0.0789	0.242*	0.154
		(0.0912)	(0.100)	(0.100)	(0.101)	(0.162)	(0.133)	(0.128)	(0.144)	(0.148)
Output gap	-9.223	-3.184	-5.246	-5.246	-8.763	-6.353	-5.786	-2.248	-8.167	-5.403
	(6.870)	(4.978)	(4.339)	(4.339)	(5.743)	(6.357)	(5.932)	(4.885)	(5.271)	(5.530)
Foreign			-2.281		-11.42	-19.64	-11.92		-20.75	-16.58
			(30.33)		(36.10)	(39.85)	(41.48)		(36.42)	(41.26)
Private			33.41	35.69	25.96	10.01	5.800	20.78	27.13	13.24
			(30.30)	(21.59)	(36.48)	(48.06)	(45.89)	(27.39)	(37.58)	(43.04)
Public				2.281				10.58		
				(30.33)				(42.26)		
Foreign*(Output gap)					2.410	2.353	1.811		2.984	2.117
					(4.603)	(4.763)	(4.777)		(4.685)	(4.732)
Private*(Output gap)					2.171	1.437	1.493	-0.399	2.237	1.665
					(4.800)	(4.882)	(4.903)	(3.742)	(4.821)	(4.806)
Public*(Output gap)								-1.706		
								(4.766)		
Tier 1									0.390	
									(1.203)	
Equity ratio										0.847
										(1.560)
ln(Deposits)										7.592**
										(3.332)
Constant	243.4***	97.86*	11.08	8.798	31.64	54.88	43.48	9.453	18.18	-68.19
	(38.50)	(56.92)	(72.33)	(51.10)	(76.83)	(95.28)	(87.12)	(56.58)	(96.93)	(112.6)
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
m1	-5.46***	-5.67***	-5***	-5***	-4.78***	-5***	-4.99***	-5.13***	-5.02***	-5***
m2	-0.5	2.45	2.33	2.33	2.32	2.36	2.43	2.35	2.23	2.38
Sargan test		75.34	87.07	87.07	87.42	78.81	66.95	94.44	103.16	111.45
p-value		0.998	0.568	0.568	0.557	0.3	0.677	0.583	0.736	0.764
Hansen test		85.66	95.93	95.93	96.38	72.23	65.67	100.29	98.74	92.59
p-value		0.978	0.315	0.315	0.304	0.503	0.716	0.417	0.828	0.981
Observations	4,050	3,884	3,884	3,884	3,884	3,884	3,884	3,884	3,884	3,884
Number of banks	166	166	166	166	166	166	166	166	166	166
Number of Instruments	35	152	130	130	132	114	114	140	156	166

Table 2: Results of estimating equation 1 and its extensions using Arellano and Bond (1991) system GMM estimator. Banks operating in Brazil, 2001-2009. The dependent variable is capital buffer, the difference between economic capital and regulatory capital divided by regulatory capital (in porcentage). In column 1 all the bank specific variables are omitted. Column 2 presents the results of the baseline model. In model 3 the dummy variables Foreign and Private are added, and in model 4 the dummy variables Public and Private are added. In equations 5-7 and 9-10, the interections between output gap and the dummy variables Foreign and Private are included, while in equation 8 the interaction between output gap and the dummy variables Public and Private is considered. Model 6 excludes *ROE* and model 7 excludes *NPL*. Column 9 shows the results of the model with *Tier*1. In column 10, *Equityratio* and *Deposits* are considered. Robust standard errors in parentheses.*** p<0.01, ** p<0.05, * p<0.1

VARIABLES	(1) BUF	(2) BUF	(3) BUF	(4) Basel Index
Lagged BUF	-0.043	-0.171	-0.171	
	(0.105)	(0.106)	(0.106)	
Lagged Basel Index				0.337***
				(0.169)
ROE	-0.040	0.0204	0.0204	-0.0665
	(0.0802)	(0.0810)	(0.0810)	(0.0558)
NPL	0.045	0.0662	0.0662	-0.112*
	(0.133)	(0.133)	(0.133)	(0.0601)
Size	-0.301	0.408	0.408	-1.219***
	(0.217)	(0.194)	(0.138)	(0.456)
Output gap	0.499	-3.482	-3.482	-5.791
	(4.841)	(8.628)	(8.628)	(3.807)
$\Delta Selic_{i,t-1}$	-7.031	-4.513	-6.093	16.08
	(10.77)	(12.42)	(11.89)	(13.36)
Foreign		-30.17		
		(187.7)		
Private			30.17	
			(187.7)	
Foreign*$\Delta Selic_{i,t}$		-1.580		
		(5.910)		
Private*$\Delta Selic_{i,t}$		-0.883	0.697	
		(5.582)	(3.760)	
Public*$\Delta Selic_{i,t}$			1.580	
			(5.910)	
Time Dummies	Yes	Yes	Yes	Yes
m1	-4.68***	-3.04***	-3.04***	-4.35***
m2	-0.22	-1.23	-1.23	0.99
Sargan test	145.143	92.38	92.38	102.55
p-value	0.840	0.354	0.354	0.138
Hansen test	121.07	83.02	83.02	94.61
p-value	0.532	0.630	0.630	0.296
Observations	3,718	3,718	3,718	3,718
Number of bank	165	165	165	165
Number of Instruments	140	128	128	160

Table 3: Results of estimating equation 1 with the interest rate *Selic* as regressor. The methodology employed is the Arellano and Bond (1991) difference GMM estimator. Banks operating in Brazil, 2001-2009. The dependent variable is capital buffer, the difference between economic capital and regulatory capital divided by regulatory capital (in porcentage). Column 1 presents the results of the baseline model. In model 2 the interections between *Selic* and the dummy variables Foreign and Private are added, as well as in model 3 *Selic* is interected with dummy variables Public and Private. Column 4 shows the results when the dependent variable is Basel Index. Robust standard errors in parentheses.*** p<0.01, ** p<0.05, * p<0.1

VARIABLES	(1) $\Delta loan$	(2) $\Delta loan$	(3) $\Delta loan$	(4) $\Delta loan$	(5) $\Delta loan$	(6) $\Delta loan$	(7) $\Delta loan$	(8) $\Delta loan$	(9) $\Delta loan$
$\Delta Loan_{i,t-1}$	-0.144	-0.122	-0.2166	-0.0159	-0.144	-0.142	-0.149*	-0.146	-0.145
	(0.0892)	(0.0899)	(0.1072)	(0.111)	(0.0892)	(0.0927)	(0.0893)	(0.0891)	(0.0890)
$\Delta Loan_{i,t-2}$	-0.0243	-0.0144	-0.1463	-0.0775	-0.0233	-0.0219	-0.0319	-0.0232	-0.0263
	(0.0967)	(0.0962)	(0.0972)	(0.0918)	(0.0966)	(0.0983)	(0.0973)	(0.0960)	(0.0973)
$\Delta Loan_{i,t-3}$	-0.0880	-0.0946	-0.2117*	0.00240	-0.090	-0.0833	-0.0843	-0.0873	-0.0875
	(0.115)	(0.111)	(0.1169)	(0.0857)	(0.115)	(0.114)	(0.115)	(0.115)	(0.115)
$\Delta Loan_{i,t-4}$	0.160*	0.169*	0.0113	0.215**	0.161*	0.164*	0.165*	0.164*	0.161*
	(0.0896)	(0.0882)	(0.1165)	(0.0972)	(0.0896)	(0.0891)	(0.0898)	(0.0886)	(0.0892)
$\Delta Selic_{i,t}$	1.365	-0.0156	-8.3744	1.350	3.351	2.184	1.140	1.414	2.184
	(4.542)	(4.871)	(5.2683)	(4.541)	(12.87)	(5.454)	(4.679)	(4.612)	(5.454)
$\Delta Selic_{i,t-1}$	-10.02**	-11.46**	-9.5164*	-18.38***	-10.02**	-9.996**	-10.18**	-10.11**	-10.00**
	(4.030)	(5.314)	(5.5689)	(4.861)	(4.037)	(4.055)	(4.051)	(4.040)	(4.035)
$\Delta Selic_{i,t-2}$	-7.496	-5.920	0.6196	-3.312	-7.492	-7.671	-7.506	-7.641	-7.570
	(5.767)	(4.619)	(6.1412)	(4.786)	(5.762)	(5.732)	(5.808)	(5.757)	(5.774)
$\Delta Selic_{i,t-3}$	13.60*	12.25*	4.7809	5.051	13.57*	13.37	13.70*	13.26	13.58
	(8.150)	(6.925)	(7.8765)	(5.114)	(8.141)	(8.219)	(8.229)	(8.377)	(8.211)
$\Delta Selic_{i,t-4}$	-4.921	-10.59**	-18.48***	-1.993	-4.958	-4.679	-5.059	-4.935	-4.816
	(6.077)	(5.293)	(6.974)	(5.134)	(6.093)	(6.131)	(6.104)	(6.195)	(6.076)
$OutputGap_{i,t}$	9.087*	8.926**	-14.3914*	24.22***	9.003*	9.152*	13.51	2.101	9.152*
	(4.924)	(3.669)	(8.7357)	(7.823)	(4.879)	(4.939)	(12.26)	(6.226)	(4.939)
$OutputGap_{i,t-1}$	-2.117	-7.418	14.57***	-13.88**	-2.118	-2.144	-1.927	-2.066	-2.096
	(3.845)	(9.980)	(4.9383)	(6.676)	(3.849)	(3.818)	(3.826)	(3.825)	(3.841)
$OutputGap_{i,t-2}$	-0.943	2.667	-4.3540	23.49***	-0.924	-0.900	-1.079	-0.842	-0.996
	(4.327)	(8.443)	(5.0087)	(6.022)	(4.335)	(4.384)	(4.336)	(4.369)	(4.344)
$OutputGap_{i,t-3}$	13.86**	10.93*	22.5017***	-6.841*	13.87**	13.68**	14.00**	13.67**	13.85**
	(5.598)	(6.519)	(7.6171)	(4.058)	(5.606)	(5.599)	(5.645)	(5.688)	(5.637)
$OutputGap_{i,t-4}$	-5.308	-6.176	-18.04***	4.996	-5.304	-5.131	-5.504	-5.150	-5.297
	(4.819)	(6.268)	(5.9471)	(3.758)	(4.816)	(5.104)	(4.871)	(5.044)	(4.854)
BUF	0.197	0.0385	0.0886	0.194	0.196	0.201	0.189	0.203	0.201
	(0.145)	(0.327)	(0.124)	(0.144)	(0.147)	(0.145)	(0.151)	(0.144)	(0.145)
Up-Selic		118.4							
		(143.7)							
Up-Selic*BUF		-0.0417							
		(0.314)							
Down-Selic*BUF		-0.0457							
		(0.326)							
Down-(Output gap)			-356.3175						
			(257.2243)						
Up-(Output gap)*BUF			0.069						
			(0.1745)						
Down-(Output gap)*BUF			-0.467**						
			(0.209)						
Low-capitalized				39.29	-18.33				
				(123.9)	(147.6)				
Low-cap*$\Delta Selic_{i,t}$				3.803					
				(5.631)					
Well-cap*$\Delta Selic_{i,t}$				4.337					
				(7.095)					
Low-cap*(Output gap)					9.211*				
					(4.869)				
Well-cap*(Output gap)					8.496				
					(7.080				
Private						271.1		165.5	
						(2,786)		(2,778)	
Foreign							-93.67		-147.7
							(288.8)		(300.1)
Public*$\Delta Selic_{i,t}$						-1.178			
						(13.14)			
Private*$\Delta Selic_{i,t}$						-3.679	1.374		
						(21.74)	(4.517)		
Foreign*$\Delta Selic_{i,t}$							-4.032		
							(5.363)		
Public*(Output gap)								-11.37	
								(12.47)	
Private*(Output gap)								-5.924	9.367*
								(18.19)	(5.213)
Foreign*(Output gap)									5.683
									(6.105)
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
m1	-3.94***	-3.92***	-3.91***	-3.74***	-3.93***	-3.89***	-3.92***	-3.95***	-3.96***
m2	-1.32	-1.34	-1.07	0.31	-1.33	-1.29	-1.24	-1.35	-1.29
Sargan test	109.84	112.76	118.57	128.44	109.84	109.69	110.76	109.53	109.96
p-value	0.354	0.285	0.313	0.185	0.354	0.308	0.331	0.331	0.351
Hansen test	111.94	113.04	113.43	104.24	111.43	110.21	112.71	109.76	112.32
p-value	0.304	0.279	0.293	0.754	0.315	0.296	0.286	0.306	0.295
Observations	3,242	3,242	3,242	3,396	3,242	3,242	3,242	3,242	3,242
Number of bank	149	149	149	154	149	149	149	149	149
Number of Instruments	140	142	142	153	142	141	143	141	143

Table 4: Growth in loans. Results of estimating equation 2 using Arellano and Bond (1991) difference GMM estimator. Banks operating in Brazil, 2001-2009. The dependent variable is the variation in loans. The measure of bank capitalization is capital buffer. Robust standard errors in parentheses.*** $p<0.01$, ** $p<0.05$, * $p<0.1$