ISSN 1518-3548

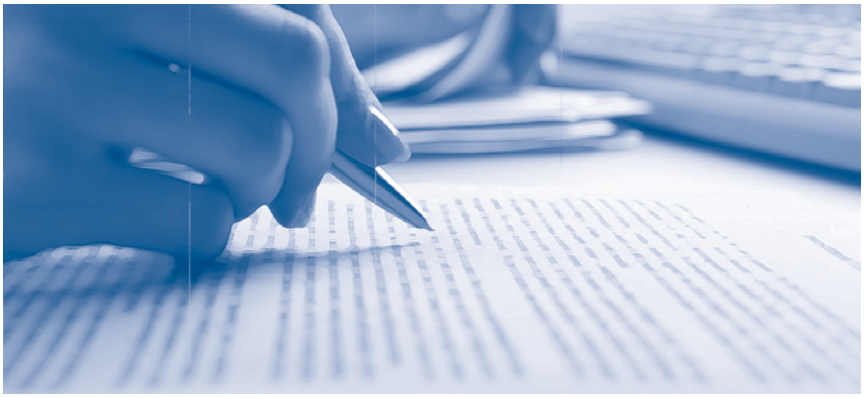
BANCO CENTRAL DO BRASIL

Loan Pricing Following a Macro Prudential Within-Sector Capital Measure

Bruno Martins and Ricardo Schechtman

August, 2013

Working Papers



323

ISSN 1518-3548
CNPJ 00.038.166/0001-05

Working Paper Series	Brasília	n. 323	August	2013	p. 1-36

Working Paper Series

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

Editor: Benjamin Miranda Tabak – E-mail: benjamin.tabak@bcb.gov.br
Editorial Assistant: Jane Sofia Moita – E-mail: jane.sofia@bcb.gov.br
Head of Research Department: Eduardo José Araújo Lima – E-mail: eduardo.lima@bcb.gov.br

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

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

General Control of Publications

Banco Central do Brasil

Comun/Dipiv/Coivi

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

Caixa Postal 8.670

70074-900 Brasília – DF – Brazil

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

Fax: +55 (61) 3414-1898

E-mail: editor@bcb.gov.br

Citizen Service Division

Banco Central do Brasil

Deati/Diate

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

70074-900 Brasília – DF – Brazil

Toll Free: 0800 9792345

Fax: +55 (61) 3414-2553

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

Loan Pricing Following a Macro Prudential Within-Sector Capital Measure[*]

Bruno Martins[**]

Ricardo Schechtman[***]

Abstract:

This paper investigates the consequences on loan spreads of a within-sector macro prudential capital measure in Brazil. Due to concerns related to a possibly too fast and unbalanced expansion of the auto-loan sector, regulatory capital was raised for auto-loans with specific long maturities and high LTVs. Our results show that Brazilian banks, after the regulatory measure, increased spreads charged on the same borrower for similar auto loans whose regulatory risk weights have increased. In comparison to the set of untargeted loans, the increase was at least of 13%. On the other hand, evidence on increase of spreads also for loans whose risk weights have not been altered is not robust. Finally, this paper shows that the later withdrawal of the regulatory capital measure was associated, similarly, to lower spreads charged on auto loans whose risk weights have decreased. Nevertheless, when measured relatively, this reduction in spreads was smaller than the original increase.

Keywords: bank capital requirement; macro prudential measure; auto loans; loan spreads
JEL Classification: G21; G28

[*] The authors would like to thank Henri Fraisse, Eduardo Lima, Walter Novaes, Tony Takeda, participants of the Basel Committee workshop on "Bank regulation and liquidity risk in a global financial system: a workshop on applied banking research" and of the BCB research department seminars for all comments and suggestions. We are also grateful to Jaime Gregorio and Simone Hirakawa (off-site supervision department) for helpful assistance with data extraction and analysis.
[**] Research Department, Central Bank of Brazil. E-mail: bruno.martins@bcb.gov.br
[***] Research Department, Central Bank of Brazil. E-mail: ricardo.schechtman@bcb.gov.br

1. Introduction

After the international financial crisis of 2007/2008, policy makers started to conceive financial regulation with a new macro prudential dimension. An important macro prudential tool brought to the forefront of the debate refers to countercyclical capital requirements, that boost capital requirements in booms, providing additional buffers to be consumed in downturns. Its objectives are to increase the banking sector resilience to future downturns and to lean against the credit cycle. The countercyclical capital buffer of Basel III is an example of such a tool (BCBS, 2010b). More recently, the policy of varying capital requirements only on lending to sectors that may be exhibiting particular exuberance has also been discussed and used in some countries (CGFS, 2012). Such sectoral capital requirements focus on the relative risks stemming from such apparent exuberance and, therefore, try to lean against that specific lending.

The experience of the Brazilian auto loan credit market during the years of 2009 and 2010 is an example of a sector evolution that generated concerns of prudential nature. The rapid expansion of new auto loan credit, accompanied by extension of loan maturities, greater loan to value (LTV) and, at the same time, decreasing spreads (see figures 3, 4, 5 and 6 of the appendix) naturally raised preoccupation. The underlying origin of those movements could perhaps be tracked to the higher risk-taking incentives prompted by the abundant liquidity transmitted into Brazilian credit markets by international capital flows (Silva and Harris, 2012). On its turn, the particular manifestation in the auto-loan sector might be related to an environment of fierce competition allied to a perception of opportunities for regulatory arbitrage. To cope with concerns with the formation of unbalances, a new Brazilian bank capital regulation was established on December, 3rd of 2010, with a format close to sectoral capital requirements, but not exactly the same (BCB, 2010). Capital requirement was raised for particular targets within the consumer auto loan sector, with those targets being new loans with long maturities and high LTVs. More specifically, risk weights were doubled, from 75% to 150%, for the universe of auto loans presented in table 1.[1] The remaining

[1] Currently in Brazil, the capital charge for each credit exposure is 11% multiplied by its risk weight. Credit risk internal models approach has not been adopted in Brazil yet.

auto loans did not suffer any capital increase and continued to be weighted 75%.[2] Such within-sector capital requirement policy was largely unexpected to market participants since it was the first capital-based macro prudential instrument implemented in Brazil.

Table 1: Universe of loans targeted by new regulation				
Maturity (months)	(24-36]	(36-48]	(48-60]	>60
LTV(%)	>80	>70	>60	All

At the previously mentioned figures, one can notice on December, 2010 a sharp contraction in the monthly volume of new auto loans, with a somewhat stabilization thereafter, and a clear reversion in the trajectories of maturity and LTV, both with a reduction tendency thereafter. Also, the behavior of lending spreads and credit volumes, according to whether loans were targeted or not by the new regulation, can be seen in the following figures 1 and 2. At figure 1, on December 2010, we notice a sharp increase of spreads of new targeted loans relatively to new untargeted loans. That would be consistent with banks passing on largely to targeted loans their higher funding costs derived from the higher capital requirements.[3] Notice also at figure 2 that total credit to targeted loans decreases sharply since December 2010 until March 2011, whereas total credit to untargeted loans maintains a moderate increase tendency since June 2010 and during most of the time shown. Therefore, the movements of targeted loans, with increase in spreads and decrease in volumes, is likely to be supply driven.

[2] The additional required capital for loans granted after December, 3th of 2010 needed to be in place on July 1st, 2011. Although around seven months were given for banks adjust their reactions, the pricing response was immediate as the next paragraph informs.

[3] Figure 1 is computed based on a slightly different universe of auto-loans from the one underlying the computation of figure 6. Therefore, loan spread levels are not exactly the same between the figures.

Figure 1: Loan spread charged on new auto loans (monthly average - %)

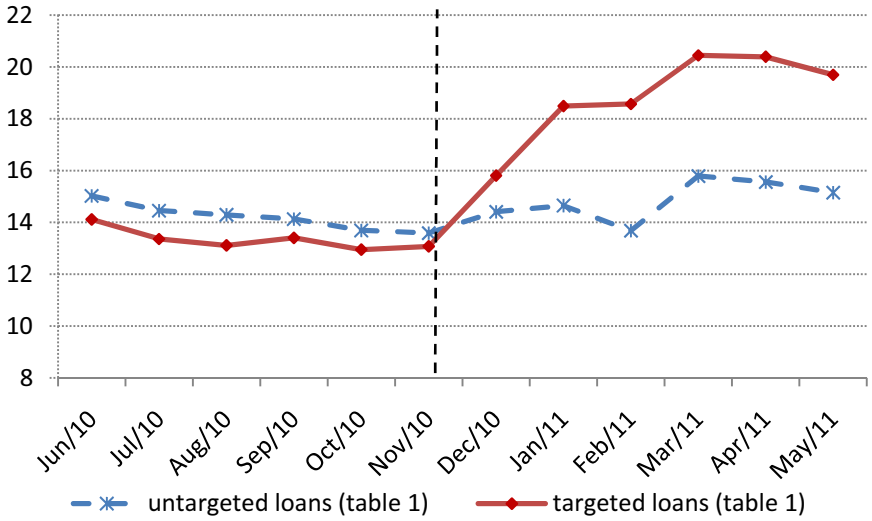
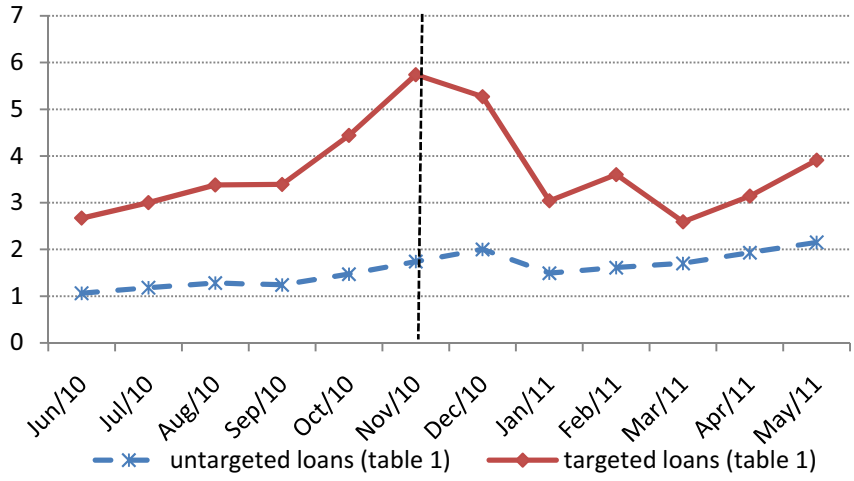


Figure 2: Total credit to new auto loans (R$ billions)



On November 11th, 2011, regulation was changed again, abolishing most of the previous risk weight increases for auto loans (BCB, 2011). More specifically, previously affected auto loans satisfying the criteria of table 2 (which are a strict subset of table 1) returned to the 75% weight. Auto loans with maturities greater than 60 months remained risk-weighted high, at 150%, and auto loans with maturities shorter than 24 months loans remained risk-weighted low, at 75%.[4] In contrast to the introduction of the regulation, figures 3, 4 and 5 of the appendix do not show any remarked change in the trajectories of total credit of new auto loans, their maturities or LTVs around the time of the regulatory change, on November,

[4] Risk weights were also altered for consumer credit loans, depending on their maturities.

2011. On the other hand, figure 7 of the appendix shows, after January, 2012, a reduction in the spread gap between new loans that were targeted by the regulatory modification and new untargeted loans. That would be consistent with banks passing on largely to targeted loans their lower funding costs derived from the smaller capital requirements.[5]

Table 2: Universe of loans targeted by modification of the new regulation			
Maturity (months)	(24-36]	(36-48]	(48-60]
LTV(%)	>80	>70	>60

The conjecture of causality from higher capital requirements to higher banks' loan spreads assumes the following transmission mechanism. First, higher capital requirements increase the optimal target for banks' capital ratios (e.g. Berrospide and Edge, 2009; Francis e Osborne, 2009).[6] The need to constitute more capital may be then addressed by charging higher lending spreads. Additionally, the higher (future) capital position increases banks' total financing costs due to the presence of financial frictions (e.g. Admati, 2011), which are passed on to lending spreads.[7] However, the true intensity of those financial frictions and, therefore, of the increase in banks' loan spreads is a matter of substantial debate in the recent literature about bank capital regulation (e.g. BCBS, 2010a; Kashyap *et al*., 2010; Miles *et al*., 2013). This paper contributes to this debate by providing new evidence of material effects on loan spreads of capital requirement increases.

More specifically, this paper's main contribution is to examine the consequences on loan spreads of the novel macro prudential within-sector capital measure, previously described.[8] The fact that only part of the auto loan sector was targeted by the regulation naturally motivates the question of how spreads of targeted loans

[5] The fact that the average spread of untargeted loans has increased in that period is related to a higher realization of auto loan credit risk then. More importantly, however, is the fact that the average spread of targeted loans has not followed the same movement.
[6] That does not mean that banks have *ex-ante* actual capital equal to minimum capital requirements, but simply that capital requirements are binding restrictions on banks' capital decisions.
[7] Besides passing on this higher cost to borrowers through increases in loan spreads, banks may also adopt other strategies, such as cutbacks in operational expenditures through productivity increases, but those may be feasible only in the medium to long run. Higher capital requirements may also imply in higher credit rationing by banks.
[8] Variations in the sizes, maturities and LTVs of the loans granted as well as more general variations in the risk-composition of the bank portfolios (risk shifting) are not directly analyzed in this paper.

changed in relation to those of untargeted ones. If banks price each loan based on its marginal funding cost, then banks will increase more the spread of targeted loans than of untargeted ones, after the new regulation. The previous graphical analysis suggests this is the case and this hypothesis is econometrically investigated in the following sections. In doing that, a caveat is that the set of untargeted loans is not a perfect control group for the capital increase treatment to the extent that it may also be indirectly affected by the macro prudential measure. Migration of demand from targeted to untargeted loans (the traditional substitution effect) could increase the spread of loans not targeted by the regulation. It is also possible that banks partly offset the capital increase in targeted loans by increasing the spread also of untargeted loans. We come back to those issues when analyzing our results.

This paper is linked to the empirical literature on the effects of bank capital shocks on bank lending. This literature faces the challenge of disentangling supply from demand effects. Indeed, poor economic conditions may produce bank losses and decrease bank capital and, at the same time, generate smaller number and amounts of loans being granted due to fewer lending opportunities. One way to deal with this challenge is to use "natural experiments" where the shock to capital is unrelated to lending opportunities. Peek and Rosengreen (1997) and Houston et al. (1997) are examples of that approach, in which capital shocks and affected supply occur at different parts of the bank holding company[9]. Aiyar et al. (2012) and Jimenez et al. (2012) are also examples of that approach, but in which capital shocks derive from specific regulatory changes. However, regulatory actions may still be partly endogenous to characteristics of bank lending so that both these studies try to control for bank cross-sectional variation of credit demand. An effective way to control for demand effects is to use loan-level data and include fixed effects (e.g. Jimenez et al., 2012). This paper makes use of a capital regulatory change and fixed effects on loan-level data to control for unobserved variations in loan demand. Notice that fixed effects are particularly important for analyzing within sector capital requirements because migration of demand may clearly change unobserved borrower characteristics of the groups of targeted and

[9] In the case of Peek and Rosengreem (1997), they also occur at different countries.

untargeted loans within each bank. Finally, it is worth remarking that, differently to most of the bank capital literature (e.g. Aiyar et al., 2012, Jimenez et al., 2012), our focus is on prices rather than on quantities. In this sense, this paper is also linked to the empirical literature on changes of loan pricing policies. In particular, in terms of methodology, this paper is close to Santos (2011), who investigates corporate loan pricing behavior of US banks following the subprime crisis.

The remainder of the paper is organized as follows. Section 2 presents and discusses the methodology, section 3 describes and characterizes the data, section 4 presents and discusses the results and section 5 concludes.

2. Methodology

We estimate the following equation that explains the spread $Loan\_spread_{i,b,l,t}$ charged on borrower *i* by bank *b* for the new auto loan *l* at time *t*.

$$\log(Loan\_spread_{i,b,l,t}) = c + \gamma \cdot \text{Loan targeted(table\_1)}_l + \alpha \cdot \text{New regulation}_t + \beta \cdot \text{New regulation}_t \times \text{Loan targeted(table\_1)}_l + \text{bank controls}_{b,t-1} + \text{loan controls}_l + \text{time controls}_t + \text{fixed effect}_{i,b} + \text{error term}_{i,b,l,t} \quad (1)$$

where New regulation$_t$ = 1 after December, 3rd, 2010 and 0 before, Loan targeted(table_1)$_l$ = 1 if new loan l fits within the criteria of table 1 and 0 otherwise.

Coefficient β is the parameter of most interest in (1). It measures the relative impact of the regulatory capital increase on the spread charged on auto loans that have been applied higher risk weights in comparison to untargeted loans. If banks price each loan based largely on its marginal funding cost, then banks will increase the spread after the new regulation mostly of targeted loans (table 1), that is $\beta>0$. Also, as the reduction of credit supply for targeted auto loans (with now higher risk weights) helps, to a greater extent, banks to cope with the higher overall capital requirement than a corresponding reduction in untargeted auto loans, we expect banks to increase more the spread of targeted loans after the new regulation than of untargeted ones, which leads again to $\beta>0$. The variable *New regulation* captures aggregate factors that affect loan spreads over time in the

same way for all auto loans, regardless of whether they fit within or without the criteria of table 1. On the other hand, some pass-through of the higher bank total financing costs to untargeted loans and migration of demand from targeted to untargeted loans after the new regulation (the traditional substitution effect) may also produce increases in the spread of untargeted loans, which would be consistent with a positive sign also for α.[10] In other words, loans outside the criteria of table 1 may also be indirectly affected. However, a precise identification of those effects through coefficient α is unfeasible in equation (1) because there is no control group for the set of untargeted loans.

Loan spread is computed as the difference between the loan lending rate and the Brazilian basic interest rate (daily SELIC). We use the logarithm of the spread (*Lspread*= log(*Loan spread*)) as our dependent variable. Bank controls comprise indicators of bank financial position, bank risk and bank efficiency. They include capital to assets ratio (*Capital*), logarithm of total assets (*Lassets*), holdings of cash and marketable securities over total assets (*Liquidity*), bank reserves over total assets (*Reserves*), non-performing auto loans (*Npl*) and return on assets (*Roa*), among others. Time dummies (one for each month) capture the phase of the business cycle and secular trends. The set of loan controls include the logarithm of loan amount (*Lamount*), the logarithm of loan maturity (*Lmaturity*) and loan-to-value (LTV). Larger or longer loans, or loans with smaller relative collateral, may represent higher credit risk, so the effect of those variables on loan spreads can be positive. On the other hand, these loan controls are jointly determined with loan spreads and also reflect credit demand characteristics. For example, more expensive loans may be associated to less demand for larger amounts and a preference for shorter maturities, so that negative signs may also be found. We estimate our models both with and without loan controls[11].

In a similar fashion, the indicator variable *Loan targeted* is possibly determined jointly with loan spreads and reflects also borrowers' decisions. However, it lies at

[10] Those factors may also reduce the original impact for targeted loans but, since targeted and untargeted loans are not perfect substitutes, the expectation for $\beta>0$ remains unaltered. Finally, notice at (1) that *Loan targeted* controls for discrete differences between the groups of targeted and untargeted loans, whereas the loan controls deal with continuous differences between the two groups.

[11] Notice that, as only new loans are considered, there is no option to use lags of the loan variables as instruments.

the core of the analysis and it is not meaningful to estimate (1) without it. To address concerns about the influence of its endogeneity (and again of the loan controls too) on our estimations, we adopt a matched loan approach. It means that, when performing the fixed effect transformation, we additionally only consider auto loans with similar maturities, sizes and LTVs or that, at least, fit all within or all without the criteria of table 1 (no migration). Notice that this approach is equivalent to adding a loan type dimension to the fixed effects of equation (1). Finally, in a further robustness control, matched loans are restricted to be sufficiently close, so as to disregard borrowers whose characteristics may vary too much along the period analyzed.

The regulatory capital modification, occurred at the end of 2011, canceled most of the previous auto loan risk weight increases. This naturally motivates the question of whether spreads of loans targeted by the regulatory modification decreased in comparison to loans whose risk weights remained unaltered. If so, it is also natural to ask whether this relative spread decrease has been of similar magnitude to the original relative spread increase when the new regulation was introduced. That is an important issue to the debate of whether macro-prudential measures could have asymmetric effects with regard to their implementations and their withdrawals. Equation (2) below is adopted to investigate the consequences on spreads of the regulatory modification.

$$\log(\text{Loan\_spread}_{i,b,l,t}) = c + \zeta \cdot \text{loan targeted(table\_1)}_l + \gamma \cdot \text{loan targeted(table\_2)}_l + \alpha \cdot \text{modification regulation}_t + \beta \cdot \text{modification regulation}_t \times \text{loan targeted(table\_2)}_l + \text{bank controls}_{b,t-1} + \text{loan controls}_l + \text{time controls}_t + \text{borrower-bank fixed effect}_{i,b} + \text{error term}_{i,b,l,t} \quad (2)$$

where modification regulation$_t$ = 1 after November, 11th 2011 and 0 otherwise, loan targeted(table_j)$_l$ = 1 if loan l fits within the criteria of table j and 0 otherwise, j=1,2.[12]

[12] Notice that variable *Loan targeted(table_2)* controls at (2) for discrete differences between loans that experience reduction in risk weights and others, whereas *Loan targeted(table_1)* controls for loans that have higher risk weights before the regulatory change.

The regulatory modification only reduces the risk weights of loans contained in the criteria of table 2, so that these loans are expected to suffer most of the impact of the regulatory modification, having their spreads decreased. The relative impact of this decrease in relation to loans that have retained the same risk weights is captured in coefficient β, for which we expect a negative sign. Also, the magnitude of this coefficient β can be compared to the magnitude of the analogous estimate of β in equation 1. Because immediately before the regulatory modification, the effect of the original capital increase of December, 2010 might have already been partly mitigated (due for instance to substitutions effects), the comparison of β's (difference-in-differences of spreads) among the two regulations is a proper way to compare between their effectiveness. On its turn, coefficient α, similarly to the discussion of equation (1), may capture a partial pass-through of the reduction of bank total financing costs to the set of untargeted loans and also substitution effects related to the migration of demand away from unaffected loans to the group of loans whose risk weights have decreased. Both of those effects would be consistent with a negative sign for α. However, as pointed out before, it is hard to disentangle with our data those effects from aggregate factors that affect loan spreads over time that are not related to the regulatory change.

3. Data and sample characterization

The data sources for this project come from Brazilian Public Credit Register (SCR- Credit Information System) and the accounting database of Brazilian financial institutions (COSIF), both owned and managed by Central Bank of Brazil. The former provides information on loan interest rates and loan controls, whereas the latter provides information on most of bank controls. The sample used in the estimation of equation (1) comprises new auto loans granted in the period from June 2010 to May 2011, whereas estimation of equation (2) involves a similar sample from July 2011 to March 2012.[13] We work with monthly data.

[13] We stop the sample in March 2012 not to be contaminated by the new loan pricing policies adopted by Brazilian government-owned banks from April 2012 onwards.

SCR is a huge repository of data of all loans above R$5000 (five thousand *reais*) of financial institutions in Brazil.[14] However, it contains vary little borrower-level information, so that we cannot appropriately control for the multifaceted aspects of borrowers' creditworthiness. Therefore, we adopt a similar strategy to Santos (2011) and use borrower or borrower-bank fixed effects in most of the regressions. Such fixed effects help control for unobserved borrower and bank characteristics. Consequently, most estimations are based only on borrowers that have taken out at least two loans (from the same bank, in the case of borrower-bank fixed effects) in the period analyzed. Notice that, as the sample period comprises at most only one year for the estimations of equations (1) and (2), we do not expect characteristics of the same borrower to change in a meaningful way along that period. Nevertheless, in some robustness exercises, we add the restriction that the multiple loans from the same bank to the same borrower be apart at most a specific number of months.

The sample related to the estimation of equation (1) has 3,072,068 new auto loans, 425 financial institutions[15] and 2,951,064 borrowers, after the removal of outliers. From those, 38,435 borrowers have taken out at least two auto loans from the same financial institution during the sample period. For 10,821 borrowers, such loans were taken out only before the new regulation; for 10,058 borrowers, such loans were taken out only after the new regulation, and for 21,382 borrowers, at least one loan was taken out before and one after the new regulation. Of those last borrowers, 14,851 borrowers have taken out the same type of loan both before and after the new regulation, whereas 3,368 borrowers have migrated from targeted loan(s) to untargeted one(s) and 3,574 borrowers have migrated in the opposite direction after the new regulation. There are 230 financial institutions that have granted at least two loans to the same borrower during the sample period.

The characterization of this sample in terms of loan variables is depicted at table 3. All loan variable differences between the two time periods (before and after new regulation) are significant at the 1% level due to the large number of

[14] The reporting threshold was later lowered and is currently R$1000 (one thousand *reais*).
[15] In the remainder of the paper, the term bank will be used to designate any financial institution allowed to grant loans.

observations. Average loan spreads after the new regulation are remarkably higher, which can be attributed to the behavior of targeted loans previously depicted at figure 1. Average loan amount, maturity and LTV are lower after the new regulation, which is consistent with demand responses to the higher spreads prevailing in that period. However, their reductions are small in relative terms, which may contribute to reduce the potential impact of their endogeneity on our estimations. The number of loans only marginally changes between the two time periods. The percentage of targeted loans becomes smaller after the new regulation, which may be related to a higher preference among borrowers and/or banks for untargeted loans in the second period.

[Table 3]

The sample related to the estimation of equation (2) has 2,901,256 new auto loans, 453 financial institutions and 2,799,468 borrowers, after the removal of outliers. From those, only 25,987 borrowers have taken out at least two auto loans from the same financial institution during the sample period. For 8,294 borrowers, loans were taken out only before the new regulation; for 5,989 borrowers, loans were taken out only after the new regulation, and for 14,430 borrowers, at least one loan was taken out before and one after the new regulation. Of those last borrowers, 9,805 borrowers have taken out the same type of loan both before and after the new regulation, whereas 3,258 borrowers have migrated from untargeted loan(s) to targeted one(s) and 2,357 borrowers have migrated in the opposite direction after the modification of the regulation. There are 156 financial institutions that have granted at least two loans to the same borrower during the sample period.

The characterization of this second sample in terms of loan variables is depicted at table 4. Given their respective levels, average loan spread and loan amount are rather constant between the two periods, whereas average maturity and LTV are slightly lower after the regulatory modification. The fact that the average spread is not smaller in the second period, in spite of the lower prevailing risk weights, may be related to the higher occurrence of non-performing auto loans in that period. Also, the number of loans is somewhat smaller in the second period. Contrary to

our expectations, the percentage of targeted loans according to table 2 becomes lower after the regulatory change.

[Table 4]

The auto-loan sector is highly concentrated with four financial institutions detaining around three quarters and eleven financial institutions detaining around 95% of the total auto credit. Those numbers are rather stable along the four time periods that comprise our two samples, with the figures being just a bit smaller for the period after the regulatory change in the second sample. The percentage of the auto loan market share held by each financial institution is also generally stable along the periods, with few financial institution exceptions located more again in the second period of the second sample.

4. Results

In order to ascertain if the new regulation was a contributing factor for the relative increase in targeted loan spreads, at table 5 we estimate equation (1), adding sequentially different sets of controls. Since borrower characteristics are a key component for any risk analysis underlying pricing decisions, model (1) is estimated with (only) borrower fixed effects. Because our sample does not contain borrower-level variables, fixed effects are the only way to account for borrower characteristics. Model (1) indicates that the spread of a targeted loan increased 26% higher than the spread of an untargeted loan after the regulation, for the same borrower. This is the magnitude of the coefficient of the interaction *New regulation* $\times$ *Loan targeted*, which is significant at the 1% confidence level. The 26% spread increase translates into an addition of 3.49 p.p. to the average spread level prevailing before the new regulation (table 3). Since bank characteristics also play a role on banks' loan pricing policies, bank controls are added in model (2). The coefficient of the interaction drops to 23% but continues significant at the 1% level. To control for the fact that borrowers may have taken out loans from different banks after the new regulation, borrower-bank fixed effects are included in model (3). As expected, this reduces our sample significantly. Model (3) indicates that the spread charged from the same bank on the same borrower increased after the new regulation 17% higher for a targeted loan in comparison to

an untargeted one. That effect remains significant at 1%. Because loan features are also key determinants of auto loan's riskiness and since some of them may be jointly determined with loan spreads, it is particularly important to examine what happens when loan controls are included in the regression. Model (4) shows that the magnitude of the interaction changes only slightly, remaining highly significant, while the quality of the adjustment rises substantially (adjusted-R^2). Finally, at model (5) the set of controls is augmented to include time dummies that could capture the influence of the business cycle and secular trends. Again, the coefficient of interaction changes only very slightly and remains highly significant. Results are robust when time dummies are replaced by linear trends (not shown).

[Table 5]

The coefficients of *Loan targeted* and of *Lmaturity*, whenever present at table 5, are always negative and significant. The reason may be demand-driven: more expensive loans could be associated to a lower preference for longer maturities and, therefore, targeted loans. Alternatively, the negative signs could also point to a context of a sharp expansion of supply for long-term auto loans before the new regulation. Notice that such expansion was behind the prudential concerns discussed in the introduction.[16] All models of table 5 also display a positive significant sign for *New regulation*, albeit with rather different magnitudes. That suggests that the spreads of untargeted loans also increased after the new regulation. Model (5) shows this increase equal to 6.46%, therefore almost 30% of the total spread increase of targeted loans (22.93% = 6.46% + 16.47%) We examine whether this increase for untargeted loans is robust to controls for further sets of unobserved heterogeneities at tables 6 and 7.

The signs of the (lagged) bank controls, omitted in the interest of space at table 5, are generally consistent with our expectations. We generally find positive significant effects for *Npl*, *Liquidity*, *Reserves* and *Roa*, and negative significant signs for *Lassets* and *Capital*. The sign of *Npl* may mean that banks that

[16] Furthermore, the negative sign for *Lamount* could be explained by a smaller demand for larger loans when spreads are higher. On the other hand, the positive significant sign of *LTV* is consistent with the behavior of banks' credit supply.

experience high credit risk levels require compensation in terms of greater spreads. Similarly, a bank with high *Liquidity* or high *Reserves* may choose higher spreads to compensate for the low return of its liquid assets and reserve deposits, explaining the positive signs. On the other hand, the positive sign for *Roa* could have an endogenous reasoning, that is, that higher profitability is generally obtained with the help of higher spreads. As for the negative effect of *Lassets*, larger banks are more diversified, suggesting lower portfolio risk, and may also have better access to funding markets, suggesting lower funding costs. Both of these implications lead to lower spreads. Finally, higher (lagged) *Capital* translates an improved financial position of the bank, leading to lower costs of funding and, at the same time, reduced need to build up financial capital. Both of these implications lead again to lower spreads.[17]

Table 6 examines the robustness of our estimates to sequentially adding further controls for unobserved effects, while maintaining in the regressions the full set of observable variables. Model (3) is our baseline model with borrower-bank fixed effects, identical to model (5) of table 5. Models (1) and (2) have fewer controls for unobserved effects than model (3), whereas models (4) to (7) have more. Model (1) does not control for any unobservable characteristic, in particular, for borrower characteristics. This allows model (1) estimates to be based on the full set of auto loan borrowers, who may have taken out only one loan during the sample period. Notice that the number of observations used in this estimation is approximately 40 times the corresponding number of the baseline model. The coefficient of the interaction *New regulation* $\times$ *Loan targeted* is again equal to 26%, while the coefficient of *New regulation* (and of *Lmaturity*) become insignificant. Model (2) has borrower fixed effects and, therefore, its estimates are based on borrowers with multiple auto loans but not necessarily from the same bank. The number of observations is almost three times the corresponding number of the baseline model. The coefficient of the interaction is 20%, higher but already closer to that of the baseline model. Baseline model (3) is based on borrowers with multiple auto loans from the same bank and was already commented previously. On its turn, model (4) is estimated based on only those borrowers who

[17] Notice that this is not in opposition to the positive *contemporaneous* effect of the regulatory capital increase on loan spreads (the main focus of the paper).

have taken out loans before and after the new regulation, from the same bank, in order to reduce concerns with sample selection. This reduces our sample substantially, to around half of the baseline sample, but adjusted-R^2 is higher than in model (3). All shown estimates (including the interaction coefficient) are also very close in terms of significancy and magnitude to those of the baseline model, apart from the effect of *New regulation* whose magnitude decreases and becomes only weakly significant. In that model, the spread increase of untargeted loans is only 17.5% of the total increase of targeted loans (20.00%= 3.51% +16.49%).

[Table 6]

To help to address concerns about the endogeneity of loans controls and of the *Loan targeted* indicator, matched loan approaches are adopted in models (5) and (6) of table 6. As a first matching strategy, we only consider (for the same borrower and bank) auto loans that all fit within or without the criteria of table 1.[18] This rules out, for example, borrowers that have migrated from targeted loans before the new regulation (e.g. long maturity) to untargeted loans after the new regulation (e.g. short maturity). Therefore, this approach controls, in particular, for the possibility that banks have priced their loans differently according to whether or not borrowers have changed their loan type. Notice that the presence or not of change for each individual borrower may add information to banks about the riskiness of this borrower. All shown estimates at model (5), including the interaction coefficient, are again very close in terms of significancy and magnitude, to those of models (3) and (4), but *New regulation* loses significancy. Therefore, it is not possible to argue, according to model (5), that untargeted loans also experienced higher spreads after the new regulation. In model (6), matched auto loans have additionally the restriction of similar maturities, sizes and LTVs (at most 20% distant at each variable). This approach controls, for example, for effects of interactions of unobserved borrower characteristics with the observable loan features, which may be important in pricing decisions. The coefficient of *New regulation* $\times$ *Loan targeted* is still highly significant, with magnitude similar to previous models, and *New regulation* remains insignificant. This last matching

[18] When there is no migration and fixed effects are employed, the effect of *Loan_targeted* cannot be identified.

strategy makes the sample around 6 times smaller than in model (5) but a substantially higher adjusted-R^2 is obtained. The insignificancies of *Lmaturity* and *LTV* result from the fact that this matching approach reduces a lot the variability of these loan features within each pair borrower-bank.

Even after matching loans, unobserved borrower characteristics may vary along time affecting our results. Therefore, at model (7), matched loans are restricted to be sufficiently close (at most 90 days apart) or, otherwise, not considered for the estimation. With such short distance, the more similar becomes the risk profile of the borrower at the points in time when he takes out new auto loans. The resulting estimation is based on the lowest number of observations of all models of table 6 (almost 5 times smaller than in model (6)) but *New regulation* $\times$ *Loan targeted* remains significant at the 1% confidence level (with a magnitude smaller than in the previous models). According to model (7), banks have increased 13% the spread charged on the same borrower for similar auto loans that fit within the criteria of table 1 after the new regulation was introduced. The 13% spread increase translates into an addition of 1.74 p.p. to the average spread level prevailing before the new regulation (table 3). That is still a sizable effect, as the average targeted loan spread increased a parcel of 2.73 p.p. from November 2010 to the next month (figure 1). There was no significant increase for spreads of loans outside the criteria of table 1, according to models (5) to (7). Results of model (6) are qualitatively similar when different loan distances are used in the matching by maturity, size and LTV. Results of model (7) are qualitatively similar when larger time distances are used to select loans taken out in neighboring dates.

Because of the potential endogeneity of loan controls, the same models of table 6 are estimated without them at table 7. In the new estimates, the coefficient of the interaction *New regulation* $\times$ *Loan targeted* is always significant at the 1% level, with magnitudes generally very close to those of the corresponding models of table 6.[19] Also importantly, except for model (3), the coefficient of *New regulation* is never significant.[20] Therefore, the combined evidence of tables 6 and 7 does not allow us to conclude that the spread of untargeted loans has also

[19] The magnitudes are a bit farther apart for models (1) and (2).
[20] And this insignificancy is maintained if the time dummies are replaced by a linear trend.

increased due to the introduction of the new regulation. Consequently, substitution effects related to the migration of demand from targeted loans to untargeted loans should have been limited. The same could be said about the potential pass-through of higher bank total financing costs to the set of loans not targeted by the regulation.

[Table 7]

The effect of the regulatory change that decreased risk weights of auto loans satisfying the criteria of table 2 is investigated through the estimations of equation (2) contained at table 8. Estimations are carried out sequentially adding controls for unobserved effects in the same manner as in table 6.[21] Notice that the numbers of observations employed by models of table 8 is of similar magnitude to those of the corresponding models at table 6, despite the slightly shorter time period covered. We find in all models that banks charged significantly smaller spreads after the regulatory change on their auto loans whose capital requirements decreased (table 2), comparatively to untargeted loans. In fact, the coefficient of *Modification regulation* $\times$ *Loan targeted* is significant at the 1% level in the first five models and significant at that 10% level in the last two models, which are estimated with a rather reduced number of observations. According to the baseline model (3), the spread charged by the same bank on the same borrower decreased 6.5% for a loan targeted by the regulatory modification and did not varied significantly for an untargeted loan. Also importantly, the absolute magnitudes of the interaction coefficient at table 8 are rather smaller (at most 56%) than the magnitudes of the coefficient of *New regulation* $\times$ *Loan targeted* in the corresponding models of table 6. Therefore, when measured relatively through differences-in-differences, the cancelation of the previous capital requirement increase had a smaller absolute impact on spreads than the original capital increase. This could be related to a more precautionary behavior adopted by banks as a result of market pressures and of the signaling effect of the original regulatory within-sector capital measure. In that sense, the absence of a response of the same magnitude when previous capital requirement increase is withdrawn may indeed

[21] When there is no migration and borrower fixed effects are employed, the effects of *Loan_targeted(table_1)* and *Loan_targeted (table 2)* cannot be identified.

contain evidence that the original increase was effective beyond the introduction of the higher requirement itself.

[Table 8]

The lowest estimated coefficient for *Modification regulation* × *Loan targeted* is obtained by model (6).[22] According to this model, after the regulatory change banks have decreased 4.5% the spread charged on the same borrower for similar auto loans that fit within the criteria of table 2. The 4.5% spread decrease translates into a subtraction of 0.75 p.p. from the average spread level prevailing before the regulatory change (table 4). That is less than half of the previously referred low estimation of 1.74 p.p. for the spread increase as of the introduction of the new regulation.

The same models of table 8 are estimated without loan controls at table 9. The significance levels of the interaction *Modification regulation* × *Loan targeted* are similar to those of the corresponding models of table 8.[23] On the other hand, the coefficient of *Modification regulation* becomes insignificant in all models but (1). At table 8, it was already insignificant in models (3), (6) and (7) and weakly significant in model (4). In sum, there is no strong evidence that auto loans that continued to receive the same risk weight have been charged different or lower spreads. This result also indirectly informs that substitution effects related to migration of demand away from untargeted loans to loans whose risk weights have decreased may have been limited with regard to the modification of the regulation. Similarly, there is no strong evidence that banks have partially passed through to untargeted loans the reduction of total funding costs derived from the capital requirement decrease.

[Table 9]

[22] It is interesting to note that the behavior of the magnitude of the interaction coefficient across the models is less monotonic at table 8 than at table 6. For example, it increases from model (2) to model (5). On the other hand, the adjusted-R^2 measure behaves more monotonically across models at table 8. In particular, it decreases from model (4) to model (7).

[23] The magnitudes of the interaction are also similar apart from models (1) and (2).

5. Conclusion

This paper investigates the consequences on loan spreads of a within-sector macro prudential capital-based measure in Brazil. Due to concerns related to a possibly too fast and unbalanced expansion of the auto-loan sector, regulatory capital requirements were raised for auto-loans with specific long maturities or high LTVs. This paper shows that Brazilian banks increased spreads charged on the same borrower for similar auto loans after the capital regulatory increase, for the set of loans targeted by the new regulation. In comparison to the set of untargeted loans, the increase was at least of 13%. This result is highly statistically significant and robust to a variety of controls for unobserved heterogeneities and to sub-sample estimations. On the other hand, the evidence on the increase of spreads charged for the set of untargeted auto loans is not strong, given the lack of robustness. In theory, spillovers to the set of untargeted auto loans could be caused by partial pass-through of higher total financing costs also to these loans and/or by migration of demand from targeted loans to untargeted ones. We conclude, therefore, that those spillovers, if present, have been limited. Also, this paper shows that the following withdrawal of the regulatory capital increase was, similarly, associated to lower spreads charged on the same borrower for similar auto loans whose capital charges have decreased. Nevertheless, when measured relatively, this reduction in spreads was smaller than the original increase. This could be associated to a more precautionary behavior adopted by banks after the first regulation that lasted beyond its regulatory modification.

To assess bank supply effects, this paper has made use of a largely unexpected new bank capital regulation and fixed effects on loan-level data. To better identify supply effects, an additional strategy would be to explore variations of spread changes in the cross-section of banks. For example, banks with different capital buffers or banks with different market powers might have reacted with different magnitudes after the new regulation. However, results not shown in this version of the paper do not contain robust evidence of such meaningful cross-sectional variations. To some extent, this may be due to the little bank cross-section variability in our sample.

6. References:

Admati, Anat R., Peter M. DeMarzo, Martin F. Hellwig, and Paul Pfleiderer (2011), "Fallacies, irrelevant facts and myths in the discussion of capital regulation: Why bank equity is *not* expensive," *Working Paper*, Stanford University.

Aiyar, Shiekhar, Charles W. Calomiris e Tomasz Wieladek (2012), "Does macro-pru leak? Evidence from a UK policy experiment", NBER Working Paper 17822.

Banco Central do Brasil (2010), "Circular 3515", December.

Banco Central do Brasil (2011), "Circular 3563", November.

Basel Committee on Banking Supervision (2010a), "An assessment of the long-term economic impact of stronger capital and liquidity requirements", Bank for International Settlements, August 2010.

Basel Committee on Banking Supervision (2010b), "Guidance for national authorities operating the countercyclical capital buffer", Bank for International Settlements, December 2010.

Berrospide, Jose M. and Rochelle M. Edge (2009), "Linkages between the financial and real sectors: some lessons from the subprime crisis", Federal Reserve Board working paper.

Committee on the Global Financial System (2012), Operationalizing the selection and application of macro prudential instruments, CGFS papers no 48.

Francis, William and Matthew Osborne (2009), "Bank regulation, capital and credit supply: Measuring the impact of Prudential Standards", *FSA Occasional paper no, 36*.

Jimenez, Gabriel, Ongena, Steven, Peydró, José L. and Jesús Saurina, (2012), Credit Supply: identifying balance-sheet channels with loan applications and granted loans, *American Economic Review* vol. 102(5), pages 2301-26, August.

Jimenez, Gabriel, Jesus Saurina, Steven Ongena, and Jose-Luis Peydro (2012), "Macroprudential Policy, Countercyclical Bank Capital Buffers and Credit Supply: Evidence from the Spanish Dynamic Provisioning Experiment," Working Paper 628, Barcelona Graduate School of Economics.

Houston, Joel, Christopher James, and David Marcus (1997), "Capital market frictions and the role of internal capital markets in banking, *Journal of Financial Economics* 46, 135-164.

Kashyap, Anil, K., Jeremy C. Stein, and Samuel Hanson (2010), "An Analysis of the Impact of "Substantially Heightened" Capital Requirements on Large

Financial Institutions," Working Paper, University of Chicago and Harvard University.

Miles, David, Jing Yang and Gilberto Marcheggiano (2013), "Optimal Bank Capital," *The Economic Journal*, volume 123, issue 567, pages 1–37

Modigliani, Franco, and Merton H. Miller (1958), "The Cost of Capital, Corporation Finance, and the Theory of Investment," *American Economic Review* 48, 261-297.

Peek, Joe, and Eric Rosengren (1997), "The international transmission of financial shocks: The case of japan," *American Economic Review* 87, 495-505.

Santos, João A. C., (2011), Bank corporate loan pricing following the subprime crisis. *Review of Financial Studies*, 24(6): 1916-1943.

Silva, Luiz A. Pereira, and Ricardo E. Harris (2012), "Sailing through the Global Financial Storm: Brazil´s recent experience with monetary and macro prudential policies to lean against the financial cycle and deal with systemic risks, Central Bank of Brazil, Working paper series 290.

7. Appendix: figures and tables

Figure 3: Credit to new auto loans (R$ bill)

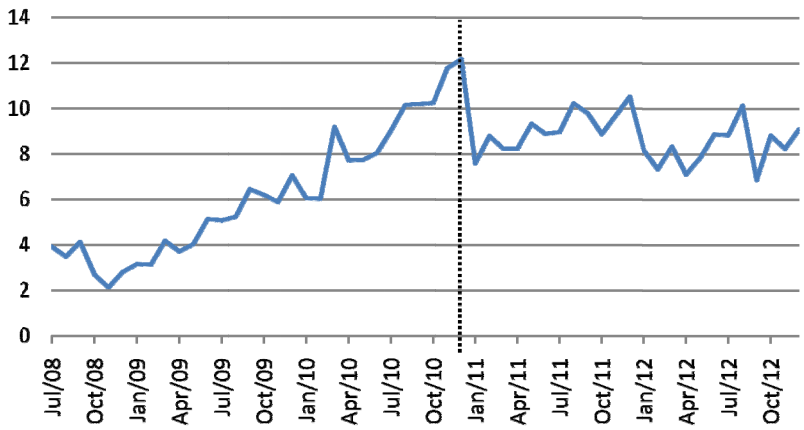


Figure 4: New auto loans by maturity (share - %)

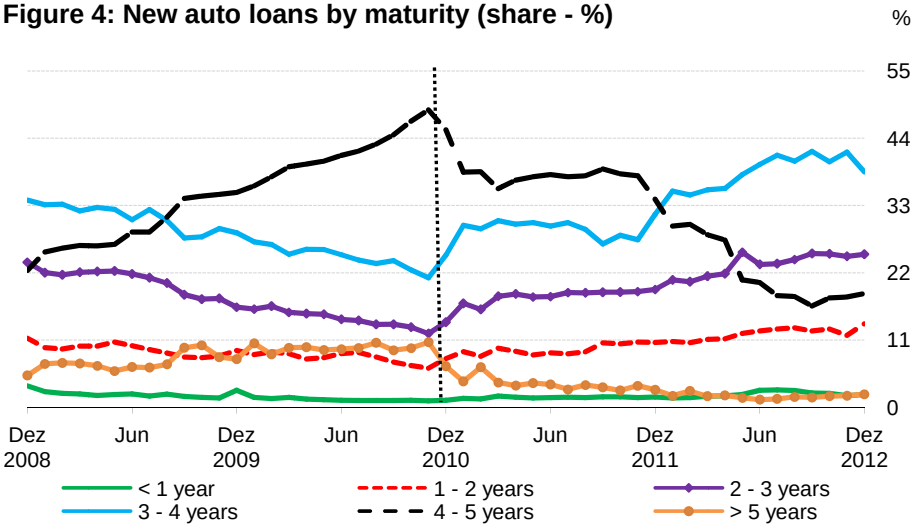


Figure 5: New auto loans by LTV (share - %)

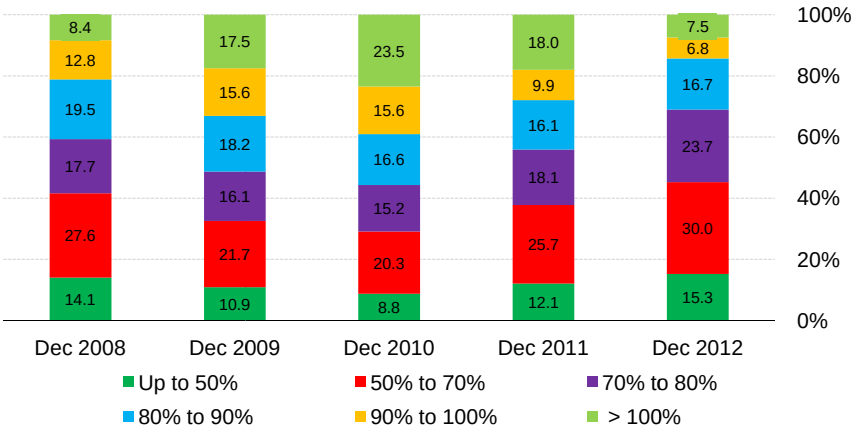


Figure 6: Loan Spread (monthly average - %)

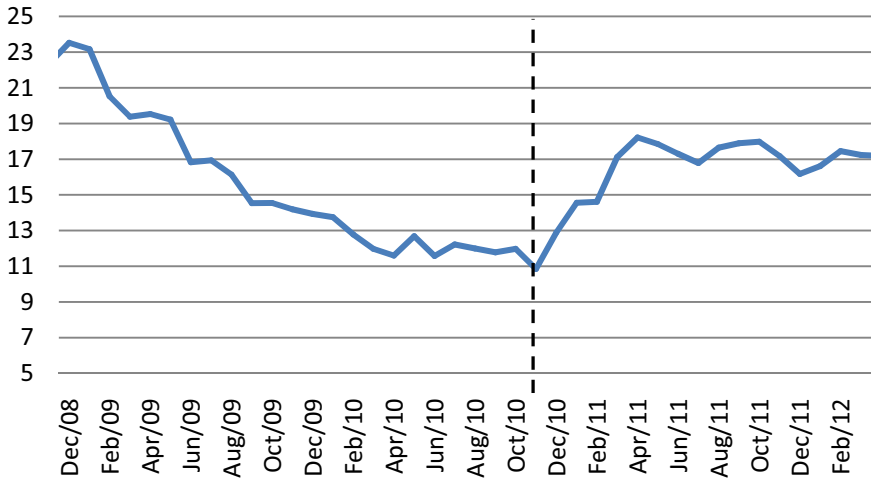


Figure 7: Loan spread (monthly average - %)

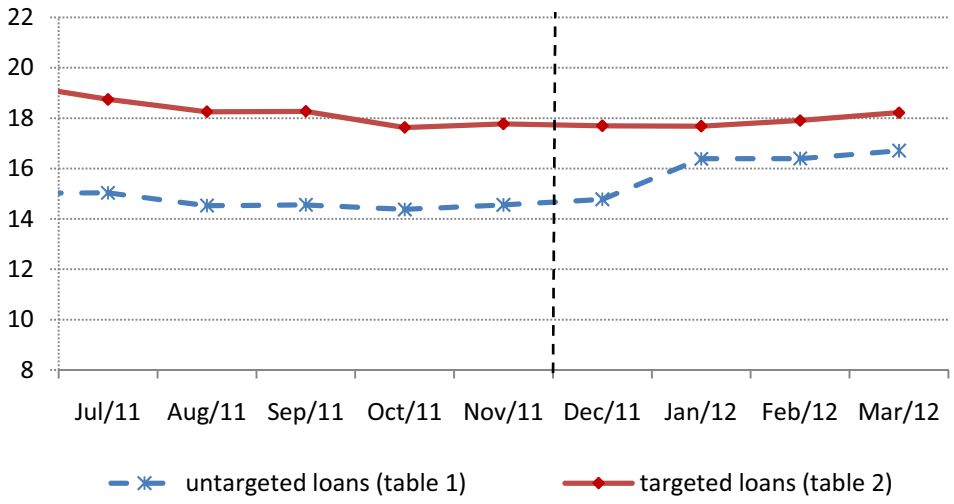


Table 3: Loan descriptive statistics: sample used in models for equation 1

Loan variables	Before new regulation	After new regulation	Difference	t-statistic
Loan spread (annual rate)	13,41	17,32	3.91***	4,60E+02
Amount (R$)	20841	20187	-654***	-34,57
Maturity (months)	48,65	46,96	-1.69***	122,88
LTV	0,81	0,78	-0.028***	-110,41
% of targeted loans	0,6976	0,6404	-0.057***	-106,81
Number of loans	1525914	1546154	20240	

Table 4: Loan descriptive statistics: sample used in models for equation 2

Loan variables	Before regulatory change	After regulatory change	Difference	t-statistic
Loan spread (annual rate)	16,59	16,7	0.113***	11,64
Amount (R$)	20455	20512	57.44***	3,06
Maturity (months)	46,4	44,96	-1.44***	-99,37
LTV	0,77	0,73	-0.043***	-156,7
% of targeted loans	0,6061	0,5358	-0.0702***	-120,94
Number of loans	1553448	1353008	-200440	

Table 5: Models for equation (1)

Dependent variable: Lspread	(1)	(2)	(3)	(4)	(5)
Loan targeted	-0.1973***	-0.1366***	-0.1174***	-0.0675***	-0.0649***
	(0.0039)	(0.0041)	(0.0062)	(0.0073)	(0.0072)
New regulation	0.0536***	0.0252***	0.0810***	0.0911***	0.0646***
	(0.0041)	(0.0054)	(0.0082)	(0.0078)	(0.0141)
New regulation x Loan targeted	0.2599***	0.2300***	0.1675***	0.1680***	0.1647***
	(0.0050)	(0.0051)	(0.0076)	(0.0071)	(0.0071)
Lamount				-0.2378***	-0.2382***
				(0.0045)	(0.0045)
Lmaturity				-0.1087***	-0.1135***
				(0.0098)	(0.0098)
LTV				0.3020***	0.3175***
				(0.0153)	(0.0152)
Borrower fixed effects	Yes	Yes	-	-	-
Borrower-bank fixed effects	-	-	Yes	Yes	Yes
Bank controls	No	Yes	Yes	Yes	Yes
Loan controls	No	No	No	Yes	Yes
Time controls	No	No	No	No	Yes
Number of observations	229,332	212,366	71,909	71,909	71,909
R^2 (adj)	0.0960	0.2150	0.1046	0.2455	0.2604

Note: *, ** and *** indicate coefficients statistically significant at 10%, 5% and 1%, respectively. Robust standard errors are in brackets.

Table 6: Robustness on models for equation (1)

Dependent variable: Lspread	(1)[1]	(2)[2]	(3)	(4)	(5)	(6)	(7)
Loan targeted	-0.0624*	-0.0681***	-0.0649***	-0.0702***			
	(0.0372)	(0.0047)	(0.0072)	(0.0097)			
New regulation	-0.0040	0.0273***	0.0646***	0.0351*	0.0248	0.0781	0.0497
	(0.0382)	(0.0083)	(0.0141)	(0.0206)	(0.0268)	(0.0506)	(0.0854)
New regulation x Loan targeted	0.2618***	0.2033***	0.1647***	0.1649***	0.1570***	0.1646***	0.1284***
	(0.0491)	(0.0046)	(0.0071)	(0.0084)	(0.0097)	(0.0197)	(0.0346)
Lamount	-0.4104***	-0.2870***	-0.2382***	-0.2272***	-0.2395***	-0.2095**	-0.2754
	(0.0213)	(0.0025)	(0.0045)	(0.0064)	(0.0085)	(0.0897)	(0.1806)
Lmaturity	-0.1022	-0.1549***	-0.1135***	-0.1062***	-0.1122***	0.4268	-0.9645
	(0.0670)	(0.0065)	(0.0098)	(0.0129)	(0.0199)	(0.3705)	(1.0536)
LTV	0.6106***	0.3454***	0.3175***	0.3185***	0.3013***	0.0435	0.3858*
	(0.0747)	(0.0087)	(0.0152)	(0.0205)	(0.0287)	(0.1068)	(0.2145)
Fixed effects	No	borrower	borrower-bank	borrower-bank	borrower-bank	borrower-bank	borrower-bank
Before and after new regulation	No	No	No	Yes	Yes	Yes	Yes
Matched by loan type (no migration)	No	No	No	No	Yes	Yes	Yes
Matched also by (maturity, LTV, amount)	No	No	No	No	No	Yes	Yes
Short distance between matched loans	No	No	No	No	No	No	Yes
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Loan controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	2,851,357	212,366	71,909	38,038	21,110	3,401	729
R^2 (adj)	0.5029	0.4078	0.2604	0.2905	0.3211	0.4483	0.3884

Note: *, ** and *** indicates statistically significance at the 10%, 5% and 1% level, respectively. Robust standard errors are in brackets.

[1] Standard errors adjusted for 101 clusters in bank. [2] Bank dummies are also included.

Table 7: Robustness on models for equation (1)

Dependent variable: Lspread	(1)[1]	(2)[2]	(3)	(4)	(5)	(6)	(7)
Loan targeted	0.0235	-0.1317***	-0.1122***	-0.1091***			
	(0.0668)	(0.0041)	(0.0062)	(0.0081)			
New regulation	-0.0329	0.0071	0.0612***	0.0118	-0.0022	0.0695	0.0395
	(0.0265)	(0.0096)	(0.0158)	(0.0229)	(0.0304)	(0.0506)	(0.0842)
New regulation x Loan targeted	0.3024***	0.22813***	0.1632***	0.1566***	0.1505***	0.1634***	0.1272***
	(0.0360)	(0.0051)	(0.0076)	(0.0089)	(0.0103)	(0.0197)	(0.0345)
Fixed effects	No	borrower	borrower-bank	borrower-bank	borrower-bank	borrower-bank	borrower-bank
Before and after new regulation	No	No	No	Yes	Yes	Yes	Yes
Matched by loan type (no migration)	No	No	No	No	Yes	Yes	Yes
Matched also by (maturity, LTV, amount)	No	No	No	No	No	Yes	Yes
Short distance between matched loans	No	No	No	No	No	No	Yes
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Loan controls	No	No	No	No	No	No	No
Number of observations	2,851,357	212,366	71,909	38,038	21,110	3,401	729
R^2 (adj)	0.2213	0.2259	0.1176	0.1747	0.2039	0.4457	0.3755

Note: *, ** and *** indicates statistically significance at the 10%, 5% and 1% level, respectively. Robust standard errors are in brackets.

[1] Standard errors adjusted for 101 clusters in bank. [2] Bank dummies are also included.

Table 8: Robustness on models for equation (2)

Dependent variable: Lspread	(1)[1]	(2)[2]	(3)	(4)	(5)	(6)	(7)
Loan targeted (table 1)	0.0278	0.0638***	0.0501***	0.0396*			
	(0.0326)	(0.0092)	(0.0146)	(0.0205)			
Loan targeted (table 2)	0.0692*	0,0053	0.0251*	0.0325*			
	(0.0393)	(0.0086)	(0.0138)	(0.0195)			
Modification regulation	0.0501**	0.0194***	0,0067	0.0271*	0.0478**	0.0379	0.0411
	(0.0203)	(0.0074)	(0.0119)	(0.0160)	(0.0218)	(0.0475)	(0.0492)
Modification regulation x Loan targeted (table 2)	-0.0806***	-0.0536***	-0.0649***	-0.0783***	-0.0879***	-0.0445*	-0.0518*
	(0.0224)	(0.0047)	(0.0075)	(0.0089)	(0.0101)	(0.0253)	(0.0310)
Lamount	-0.3966***	-0.2575***	-0.2665***	-0.2722***	-0.2793***	-0.8931***	-0.8428***
	(0.0281)	(0.0028)	(0.0053)	(0.0073)	(0.0107)	(0.2626)	(0.3104)
Lmaturity	-0.0016	-0.1494***	-0.1327***	-0.1355***	-0.1406***	1.4244*	1.7344*
	(0.0562)	(0.0067)	(0.0109)	(0.0147)	(0.0231)	(0.7391)	(0.9098)
LTV	0.6147***	0.4694***	0.4466***	0.4564***	0.3952***	0.4668*	0.5118
	(0.0811)	(0.0094)	(0.0159)	(0.0222)	(0.0328)	(0.2785)	(0.3401)
Fixed effects	No	borrower	borrower-bank	borrower-bank	borrower-bank	borrower-bank	borrower-bank
Only borrowers before and after modification regulation	No	No	No	Yes	Yes	Yes	Yes
Matched by loan type (no migration)	No	No	No	No	Yes	Yes	Yes
Matched also by (maturity, LTV, amount)	No	No	No	No	No	Yes	Yes
Short distance between matched loans	No	No	No	No	No	No	Yes
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Loan controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	2.862.479	191.648	52.970	28.243	14.717	1.228	885
R^2 (adj)	0,3818	0,4659	0,2107	0,2182	0,2060	0,1583	0,0951

Note: *, ** and *** indicates statistically significance at the 10%, 5% and 1% level, respectively. Robust standard errors are in brackets.

[1] Standard errors adjusted for 101 clusters in bank. [2] Bank dummies are also included.

Table 9: Robustness on models for equation (2)

Dependent variable: Lspread	(1)[1]	(2)[2]	(3)	(4)	(5)	(6)	(7)
Loan targeted (table 1)	-0.0385	-0.0577***	-0.0630***	-0.0856***			
	(0.0516)	(0.0096)	(0.0157)	(0.0219)			
Loan targeted (table 2)	0.3025***	0.1363***	0.1229***	0.1431***			
	(0.0427)	(0.0094)	(0.0155)	(0.0219)			
Modification regulation	0.0654**	0,0094	0.0003	0.0051	0.0351	0.0333	0.0366
	(0.0261)	(0.0081)	(0.0132)	(0.0178)	(0.0242)	(0.0489)	(0.0506)
Modification regulation x Loan targeted (table 2)	-0.1036***	-0.0442***	-0.0698***	-0.0832***	-0.0896***	-0.0486*	-0.0518*
	(0.0273)	(0.0051)	(0.0083)	(0.0098)	(0.0112)	(0.0259)	(0.0316)
Fixed effects	No	borrower	borrower-bank	borrower-bank	borrower-bank	borrower-bank	borrower-bank
Only borrowers before and after modification regulation	No	No	No	Yes	Yes	Yes	Yes
Matched by loan type (no migration)	No	No	No	No	Yes	Yes	Yes
Matched also by (maturity, LTV, amount)	No	No	No	No	No	Yes	Yes
Short distance between matched loans	No	No	No	No	No	No	Yes
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Loan controls	No	No	No	No	No	No	No
Number of observations	2.862.479	191.648	52.970	28.243	14.717	1.228	885
R^2 (adj)	0,1618	0,2979	0,2107	0,2182	0,2060	0,1583	0,0951

Note: *, ** and *** indicates statistically significance at the 10%, 5% and 1% level, respectively. Robust standard errors are in brackets.

[1]Standard errors adjusted for 101clusters in bank. [2]Bank dummies are also included.

Banco Central do Brasil

Trabalhos para Discussão

Os Trabalhos para Discussão do Banco Central do Brasil estão disponíveis para download no website http://www.bcb.gov.br/?TRABDISCLISTA

Working Paper Series

The Working Paper Series of the Central Bank of Brazil are available for download at http://www.bcb.gov.br/?WORKINGPAPERS

289	**Financial Stability in Brazil** *Luiz A. Pereira da Silva, Adriana Soares Sales and Wagner Piazza Gaglianone*	Aug/2012
290	**Sailing through the Global Financial Storm: Brazil's recent experience with monetary and macroprudential policies to lean against the financial cycle and deal with systemic risks** *Luiz Awazu Pereira da Silva and Ricardo Eyer Harris*	Aug/2012
291	**O Desempenho Recente da Política Monetária Brasileira sob a Ótica da Modelagem DSGE** *Bruno Freitas Boynard de Vasconcelos e José Angelo Divino*	Set/2012
292	**Coping with a Complex Global Environment: a Brazilian perspective on emerging market issues** *Adriana Soares Sales and João Barata Ribeiro Blanco Barroso*	Oct/2012
293	**Contagion in CDS, Banking and Equity Markets** *Rodrigo César de Castro Miranda, Benjamin Miranda Tabak and Mauricio Medeiros Junior*	Oct/2012
293	**Contágio nos Mercados de CDS, Bancário e de Ações** *Rodrigo César de Castro Miranda, Benjamin Miranda Tabak e Mauricio Medeiros Junior*	Out/2012
294	**Pesquisa de Estabilidade Financeira do Banco Central do Brasil** *Solange Maria Guerra, Benjamin Miranda Tabak e Rodrigo César de Castro Miranda*	Out/2012
295	**The External Finance Premium in Brazil: empirical analyses using state space models** *Fernando Nascimento de Oliveira*	Oct/2012
296	**Uma Avaliação dos Recolhimentos Compulsórios** *Leonardo S. Alencar, Tony Takeda, Bruno S. Martins e Paulo Evandro Dawid*	Out/2012
297	**Avaliando a Volatilidade Diária dos Ativos: a hora da negociação importa?** *José Valentim Machado Vicente, Gustavo Silva Araújo, Paula Baião Fisher de Castro e Felipe Noronha Tavares*	Nov/2012
298	**Atuação de Bancos Estrangeiros no Brasil: mercado de crédito e de derivativos de 2005 a 2011** *Raquel de Freitas Oliveira, Rafael Felipe Schiozer e Sérgio Leão*	Nov/2012

299	**Local Market Structure and Bank Competition: evidence from the Brazilian auto loan market** *Bruno Martins*	Nov/2012
299	**Estrutura de Mercado Local e Competição Bancária: evidências no mercado de financiamento de veículos** *Bruno Martins*	Nov/2012
300	**Conectividade e Risco Sistêmico no Sistema de Pagamentos Brasileiro** *Benjamin Miranda Tabak, Rodrigo César de Castro Miranda e Sergio Rubens Stancato de Souza*	Nov/2012
300	**Connectivity and Systemic Risk in the Brazilian National Payments System** *Benjamin Miranda Tabak, Rodrigo César de Castro Miranda and Sergio Rubens Stancato de Souza*	Nov/2012
301	**Determinantes da Captação Líquida dos Depósitos de Poupança** *Clodoaldo Aparecido Annibal*	Dez/2012
302	**Stress Testing Liquidity Risk: the case of the Brazilian Banking System** *Benjamin M. Tabak, Solange M. Guerra, Rodrigo C. Miranda and Sergio Rubens S. de Souza*	Dec/2012
303	**Using a DSGE Model to Assess the Macroeconomic Effects of Reserve Requirements in Brazil** *Waldyr Dutra Areosa and Christiano Arrigoni Coelho*	Jan/2013
303	**Utilizando um Modelo DSGE para Avaliar os Efeitos Macroeconômicos dos Recolhimentos Compulsórios no Brasil** *Waldyr Dutra Areosa e Christiano Arrigoni Coelho*	Jan/2013
304	**Credit Default and Business Cycles: an investigation of this relationship in the Brazilian corporate credit market** *Jaqueline Terra Moura Marins and Myrian Beatriz Eiras das Neves*	Mar/2013
304	**Inadimplência de Crédito e Ciclo Econômico: um exame da relação no mercado brasileiro de crédito corporativo** *Jaqueline Terra Moura Marins e Myrian Beatriz Eiras das Neves*	Mar/2013
305	**Preços Administrados: projeção e repasse cambial** *Paulo Roberto de Sampaio Alves, Francisco Marcos Rodrigues Figueiredo, Antonio Negromonte Nascimento Junior e Leonardo Pio Perez*	Mar/2013
306	**Complex Networks and Banking Systems Supervision** *Theophilos Papadimitriou, Periklis Gogas and Benjamin M. Tabak*	May/2013
306	**Redes Complexas e Supervisão de Sistemas Bancários** *Theophilos Papadimitriou, Periklis Gogas e Benjamin M. Tabak*	Maio/2013
307	**Risco Sistêmico no Mercado Bancário Brasileiro – Uma abordagem pelo método *CoVaR*** *Gustavo Silva Araújo e Sérgio Leão*	Jul/2013

308	**Transmissão da Política Monetária pelos Canais de Tomada de Risco e de Crédito: uma análise considerando os seguros contratados pelos bancos e o *spread* de crédito no Brasil** *Debora Pereira Tavares, Gabriel Caldas Montes e Osmani Teixeira de Carvalho Guillén*	Jul/2013
309	**Converting the NPL Ratio into a Comparable Long Term Metric** *Rodrigo Lara Pinto Coelho and Gilneu Francisco Astolfi Vivan*	Jul/2013
310	**Banks, Asset Management or Consultancies' Inflation Forecasts: is there a better forecaster out there?** *Tito Nícias Teixeira da Silva Filho*	Jul/2013
311	**Estimação não-paramétrica do risco de cauda** *Caio Ibsen Rodrigues Almeida, José Valentim Machado Vicente e Osmani Teixeira de Carvalho Guillen*	Jul/2013
312	**A Influência da Assimetria de Informação no Retorno e na Volatilidade das Carteiras de Ações de Valor e de Crescimento** *Max Leandro Ferreira Tavares, Claudio Henrique da Silveira Barbedo e Gustavo Silva Araújo*	Jul/2013
313	**Quantitative Easing and Related Capital Flows into Brazil: measuring its effects and transmission channels through a rigorous counterfactual evaluation** *João Barata R. B. Barroso, Luiz A. Pereira da Silva and Adriana Soares Sales*	Jul/2013
314	**Long-Run Determinants of the Brazilian Real: a closer look at commodities** *Emanuel Kohlscheen*	Jul/2013
315	**Price Differentiation and Menu Costs in Credit Card Payments** *Marcos Valli Jorge and Wilfredo Leiva Maldonado*	Jul/2013
315	**Diferenciação de Preços e Custos de Menu nos Pagamentos com Cartão de Crédito** *Marcos Valli Jorge e Wilfredo Leiva Maldonado*	Jul/2013
316	**Política Monetária e Assimetria de Informação: um estudo a partir do mercado futuro de taxas de juros no Brasil** *Gustavo Araújo, Bruno Vieira Carvalho, Claudio Henrique Barbedo e Margarida Maria Gutierrez*	Jul/2013
317	**Official Interventions through Derivatives: affecting the demand for foreign exchange** *Emanuel Kohlscheen and Sandro C. Andrade*	Jul/2013
318	**Assessing Systemic Risk in the Brazilian Interbank Market** *Benjamin M. Tabak, Sergio R. S. Souza and Solange M. Guerra*	Jul/2013
319	**Contabilização da Cédula de Produto Rural à Luz da sua Essência** *Cássio Roberto Leite Netto*	Jul/2013
320	**Insolvency and Contagion in the Brazilian Interbank Market** *Sergio R. S. Souza, Benjamin M. Tabak and Solange M. Guerra*	Aug/2013

321	**Systemic Risk Measures** *Solange Maria Guerra, Benjamin Miranda Tabak, Rodrigo Andrés de Souza Penaloza and Rodrigo César de Castro Miranda*	Aug/2013
322	**Contagion Risk within Firm-Bank Bivariate Networks** *Rodrigo César de Castro Miranda and Benjamin Miranda Tabak*	Aug/2013