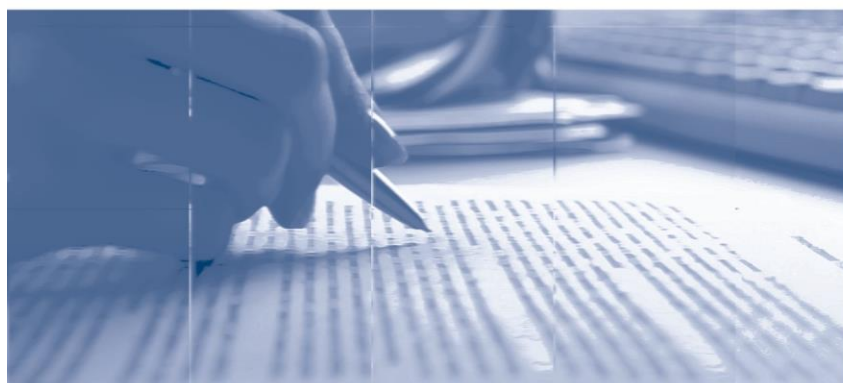


Implementing Loan-to-Value Ratios: The Case of Auto Loans in Brazil (2010-11)

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Implementing Loan-to-Value Ratios: The Case of Auto Loans in Brazil (2010-11)*

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Abstract

The Working Papers should not be reported as representing the views of the Banco Central do Brasil. The views expressed in the papers are those of the author(s) and do not necessarily reflect those of the Banco Central do Brasil.

This paper discusses the reasons and effects of the Central Bank of Brazil's decision to raise the risk weight factors (RWF) of auto loans with high LTV and long maturities in 2010. Concerns with origination standards and risk-underpricing, combined with early warnings of loan non-performance given by credit bureau data, led the Central Bank to raise RWF to new auto loans. The calibration of the measure used data on delinquency rates by LTV and maturity and respective LGDs. The measure successfully improved origination standards. Difference-in-difference estimations confirmed the effect of the measure in reducing the origination of new loans with long maturities and with high LTV; while these types of loans became more expensive to borrowers thereby discouraging their demand. The results are important to help formulating and conducting central bank's monitoring, and prudential regulations.

Keywords: loan-to-value ratios, LTV, macroprudential policy.

JEL Classification: E50

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1. Introduction

In December 2010, the Central Bank of Brazil (CBB) doubled to 150% the risk weight (RW) applied on new auto loans with long maturities and high loan-to-value (LTV) ratios. Auto loans had been growing at a rapid pace, while maturities had been stretching and LTV had been increasing. The CBB took this trend as suggesting that origination standards were probably deteriorating, which raised concerns. NPL by vintage also suggested that the situation could be worse than the one depicted by the traditional NPL measure, which kept pointing to stable delinquency rates. Moreover, interest rates charged to these loans pointed to a possible mispricing of risks.

Since auto loans represented a significant share in the assets of the Brazilian financial system (in December 2010 it represented 25% of outstanding household loans and 11% of total outstanding loans), the CBB decided to take prudential measures to incentivize sound standards of origination of auto loans. To this end the CBB concluded that it was appropriate to increase the RW for those auto loans with characteristics combining the loans' maturities and LTV ratios. To calibrate the measure that concluded for doubling the RW, historical data on delinquencies and recoverability was used to proxy for the PD and LGD. A RW of 150% was considered conservative enough to provide the right incentives and to account for the higher risk in the auto loans.

At the time of the enactment, the CBB emphasized in its communication concerns with rapid household credit growth in general, and auto loans in particular. The CBB could not discuss the measure with the financial industry to prevent an even greater auto loan boom ahead of the measure enactment.

Dealing with policy leakages was relatively simple thanks to full subsidiarization of financial institutions in Brazil. All financial intermediation institutions operating in Brazil are subject to CBB regulation. The only institutions authorized to perform auto loans are the ones regulated and supervised by the CBB. Thus all banks in Brazil were automatically subject to the LTV-dependent risk weights. Cross border arbitrage or rebooking of loans in other jurisdictions was not an issue.

The measure was successful in reining in the pace of origination of auto loans and could be replaced by a simpler rule in less than one year. The origination of loans with high LTV and long maturities fell from 74% of all auto loans in November 2010 to

60% in December 2011, after the measure was replaced by a simpler measure where RW of auto loans did not depend on LTV ratios. Indeed, the measure's signaling effect was powerful in changing banks' own behavior and outlived the measure itself. Even after the measure's replacement in November 2011, the share of long-maturity, high-LTV loans continued decreasing and reached 50% in December 2012.

2. Setting the Stage

After a brief recession at the end of 2008 and beginning of 2009, the Brazilian economy revealed signs of a new expansionary cycle. This upswing, as shown by Gross Domestic Product (GDP) growth in the second and third quarters (Chart 1) has been led by domestic demand. A key element of the fast post-crisis recovery has been the resilience of household consumption, which accounts for 60% of GDP, boosted by rising real income, lower unemployment rate (Chart 2), and also, by easier credit conditions. Consumer inflation reached 5.9% in 2010, higher than the 4.5% target, but still below the upper bound of the inflation band (Chart 3).

By that moment, the behavior of financial markets and even of the real economy, in particular the rapid credit growth (Chart 4) and increased maturity and LTV ratios of certain operations, triggered concerns of prudential nature. Between December 2007 and December 2010, total credit in Brazil increased from 35.5% to 45.4% of GDP. Credit for individuals increased significantly: 23.7% in 2008, 17.3% in 2009 and 23.8% in 2010, despite the internal impact of the international financial crisis. The economic literature shows evidence that periods of rapid credit growth are likely associated with the loosening of underwriting standards and the consequent increase in defaults and banking crises in subsequent periods¹.

Brazil's credit-to-GDP ratio continues to lag behind mature economies and the process of convergence in relation to the international average is natural and desirable². Still, this accelerated expansion requires the prudential regulator a close examination of operations, particularly with regard to maturities and collateral, and, if necessary, actions to prevent the materialization of imbalances that may have systemic implications later on. In order to curb credit expansion and, consequently, prevent

¹ G. Dell'Ariccia, D. Igan, and L. Laeven. (2008) "Credit Booms and Lending Standards: Evidence from the Subprime Mortgage Market". IMF WP106. G. Jimenez, and J. Saurina. (2006) "Credit Cycles, Credit Risk, and Prudential Regulation". International Journal of Central Banking, n° 2, vol 2: pp. 65-98.

² Indeed, the strong increment in the 5 year period that preceded the measures boosted the impact of the monetary and macroprudential policies in the economy through the credit channel.

additional softening of credit standards that usually follows abundant liquidity, the Central Bank of Brazil (CBB) deployed a comprehensive set of measures, including macroprudential and demand management measures. First, the CBB published on December 3, 2010, Circular 3,515, which was a set of macroprudential measures targeting loans to individuals, which is the main subject of this study. Additionally, Brazil used standard instruments for aggregate demand management, such as tight fiscal and monetary policy, to deal with inflationary pressures, making it clear that macroprudential measures are not a substitute for monetary policy and are primarily directed to financial stability risks³.

Further, the CBB reversed some reserve requirement allowances introduced during the global financial crisis. During the 2008-09 crisis, Brazil had used reserve requirements as an important mechanism to support financial stability and to facilitate liquidity reallocation among financial institutions (Silva and Harris, 2012). In particular, in order to support the small and medium size banks, the CBB allowed larger banks to draw on portions of their reserves if these funds were to be used to extend liquidity to small and medium-sized banks. These measures were progressively reversed and, in December 2010, the CBB moved further with the recomposition of reserves requirement by gradually eliminating these allowances. In addition, at the end of 2010 and in 2011, the CBB increased the reserves requirement rates, raising unremunerated reserve requirements on term deposits from 15% to 20% and the additional remunerated reserve requirement on demand and term deposit from 8% to 12%⁴.

Other prudential policies related to the financial cycle had also been implemented complementarily. Table 1⁵ shows the timeline of monetary, fiscal, and short-term capital inflow policies.

Specifically about the macroprudential measures, Circular 3,515, of 2010, introduced a differentiation in prudential treatment given to certain classes of loans targeted to individuals which at the time received a risk weight (RW) of 75%. The reasons underlying this concern are outlined in Section III. Regarding the auto loans, the CBB decided that a RW of 150% should be applied to exposures contracted by individuals from December 6, 2010 on, relating to new credit and leasing operations i)

³ See CBB, “Relatório de Estabilidade Financeira” (2011).

⁴ Nevertheless, the CBB continued to exempt the longer-term bank notes (“Letras Financeiras”) from reserve requirement.

⁵ For more on other policies, besides the macroprudential on auto loans, see Silva and Harris, 2012.

with maturity exceeding 24 months, and ii) that had a high ratio between the loan granted and the value of the collateral (loan-to-value). The RW of 150% applies to a combination of LTV and maturity (Table 2). For instance, if the LTV was higher than 80% for any maturity above 24 months the RW should increase to 150%. Similarly, if the maturity was higher than 60 months even with low LTVs, the RW would also increase to 150%.

Table 2: Change of risk weight for auto loans

Operation	Maturity and LTV	Change of risk Weight
Vehicles (financing and leasing)	24-36 months and LTV > 80% 36-48 months and LTV > 70% 48-60 months and LTV > 60% more than 60 months and any LTV	from 75% to 150%

Some loan classes were not included in the higher RW treatment. Specifically, agricultural, housing credit operations and housing financial leasing would be excluded from the proposed increase of the RW, because they observe specific rules and generally rely on real guarantees constituted in the form of mortgage or fiduciary lien of real estate property. Similarly, investment finance for firms, such as loans with transferred funds or special programs of the Federal Government and truck financing, would not be reached by the new rule, since they are normally associated with supporting economic activity.

Although the macroprudential measures targeted loans to individuals, with the exceptions described above, this study will focus only on auto loans, given that this was the only credit modality to which the applicable regulation used the LTV ratio as a parameter for determining the RW.

3. Monitoring Systemic Risk

The CBB uses a variety of indicators to assess the buildup of systemic risks. Some of them, which were used in evaluating auto loan growth from December 2008 to October 2010, will be described in the sequence.

All the indicators analyzed warned that auto loans origination standards were softening given that maturities had been stretching and LTV had been increasing. Moreover, interest rates charged in these loans pointed to a possible mispricing of risks. Since auto loans were a significant share of loans in the Brazilian financial system (in

December 2010 it represented 25% of outstanding household loans and 11% of total outstanding loans), the CBB decided to take prudential measures to avoid that auto loans continued in that fashion posing potential risks to financial stability.

One of the most important indicators used was the NPL⁶ ratio. This indicator is used to show the risk of a loan portfolio. However, it has some limitations that can impair the analysis of the evolution of loan portfolio quality. One of the most significant limitations is that, in periods of rapid loan growth, a deterioration of the quality of the loans can be hidden⁷. This happens because the loan growth impacts immediately the denominator of the ratio, while the impact on the numerator will take at least three months to be visible. Therefore, NPL decreases regardless of the loan quality (Chart 5). In addition, new vintages have small weight in the loan stock. If a financial institution loosens the lending criteria and starts to operate with riskier borrowers, this deterioration will be clear just after some months, when these loans start to have a significant weight in outstanding loans. This was exactly what happened from December 2008 to October 2010 (Chart 5). Thus, other indicators have to be used to deal with these issues.

The vintage analysis of NPLs is one of these indicators. Once NPLs are broken down by specific vintages and measured after a short period of time (six months in this study), it becomes possible to identify a deterioration of a loan portfolio earlier. Nevertheless, this indicator is much more complex to calculate, because it requires detailed data at the level of the loan. The CBB, through its Credit Information System (SCR)⁸, has access to detailed loan data and has been calculating and monitoring this indicator since 2005. By assessing this indicator and comparing it with the traditional NPL (Chart 6), it became clear that, from December 2009 on, while the traditional NPL was decreasing, NPL by vintage was increasing. This was an early warning that the financial institutions were being less strict when extending new loans.

⁶ NPLs are defined in this study as a percentage of loans with payments of principal and interest past due for more than 90 days.

⁷ See Coelho and Vivan (2013) for further discussion on this issue.

⁸ SCR is a credit information system managed by the CBB. It has to goals: to provide loans information for the CBB to monitor the Brazilian financial system and to serve as a credit bureau by the banks. All financial institutions under the CBB's supervision are obliged to send, on monthly basis, detailed data about their loans above a certain value, such as NPL, new originations, maturity and collaterals. The value was R\$ 5,000.00 (USD 2,642.99) until April 2012 and it decreased to R\$ 1,000.00 (USD 494.49) from May 2012 on.

Another important indicator monitored by the CBB – for credit operations with real collaterals – is the LTV. In theory, the lower this relation, the smaller is the risk of the loan, given that both the loss given default and also the incentive for the borrower to default are lower. As it can be seen in Chart 7, loans with LTV over 80% increased constantly in the period analyzed. In December 2008 loans within this range represented 35% of total monthly origination. By October 2010, the figure had gone up to 48%.

Originations and average maturity regarding auto loan were also being closely monitored during that period. Both had been increasing since 2008 (Chart 8). New originations increased almost fourfold in less than two years, from R\$ 2.8 billion in December 2008 to R\$ 10.2 billion in October 2010. Average maturity increased from 41 to 50 months in the same period.

High LTV combined with long maturities and constant installment amortization scheme, which is the prevalent amortization scheme in Brazil for household loans, were a specific concern to auto loans given the speed of price decay of cars that could cause loans to become underwater.

Besides, interest rate charged in this kind of loan was decreasing in the period by a faster pace than other modalities of loans. This became clear by comparing auto and payroll-deducted loans, two of the most important categories of loans to households. In December 2008, interest rate charged in auto loans stood at 36.5% p.a., thus above the rate for payroll-deducted which was 30.8% p.a. In October 2010, interest rate for auto loans (25.2% p.a.) had fallen below for payroll deducted loans (27.2% p.a.) (Chart 9). This happened in spite of the fact that auto loans' NPL and write-off⁹ were higher than payroll-deducted loans' NPL (Chart 10). This interest rate reduction seemed incompatible with the risk. This was probably happening because of fierce competition among the most important players in this market.

4. Using the Tools

A. Calibration

As mentioned in the previous sections, auto loans for individuals were growing at rapid pace, and this growth was happening based on longer maturity and higher LTV.

⁹ In this study, the percentage of write-off is the 12-month accumulated write-off divided by the outstanding loans of the previous twelve months.

This brought additional concern, since the collateral offered, in case the own vehicle, tended to deteriorate and lose market value in the course of time at high rates.

Long maturity loans, as well as high LTV loans, have the potential for higher delinquencies. Therefore, the CBB measured this relationship by analyzing the NPL after twelve months of seven vintages, from April 2009 to October 2010 (Table 3). The NPL was calculated for each maturity vis-à-vis each LTV. It was found that, as a general rule, the greater the maturities and the LTV, the greater the NPL. This would indicate that the RWs should reflect both factors, even within a context of standardized approach of capital requirement.

Another aspect considered to calibrate the parameters to the macroprudential measures was the difference of capital allocation between the standardized approach and the advanced approach (IRB), both established under Basel II agreement. In the first case, auto loan operations for individuals were considered as retail, as long as it fulfilled certain parameters¹⁰, and received the RW of 75%, irrespective of loan maturities and collaterals. In the second case, these factors are taken into consideration and the RW are calculated according to the probability of default (PD) and the loss given default (LGD).

To analyze the RW that would be applied if the advanced approach was used, simulations were carried out based on paragraph 330 of the Basel II agreement, which presents the methodology for calculating credit risk based on the internal models method. Historical data for NPLs were used as a proxy for PD¹¹. As for LGD values, they are mainly influenced by the existence and the quality of the collaterals, for which there was no information at the time. However, Silva and Neves (2009) estimated that the LGD values in Brazil were between 47% and 92%. Thus, using three ranges of LGD (45%, 75% and 100%) and the estimated PD, it was possible to estimate the correspondent RW to each of the maturities, as in Table 4.

¹⁰ Before the issuance of Circular n. 3,515, of 2010, the majority of the auto loans were risk weighted at 75 percent because they usually qualify as retail. For operations to qualify as retail, the following criteria must be attended cumulatively:

- I – their counterparty is a natural person or a small-sized private legal entity;
- II – they take the form of a financial instrument directed at the counterparties mentioned in item I;
- III – the sum of exposures with the same counterparty does not exceed 0.2% of the retail portfolio of the institution; and
- IV – the total value of the exposures with the same counterparty does not exceed R\$600,000.00.

The auto loans that did not qualify as retail were risk weighted at 100%.

¹¹ This simulation was performed using three modalities of loans: payroll-deducted, non payroll deducted and auto loans

Finally, based on these surveys and studies, the CBB concluded that it was appropriate to take into account the loans' maturities and LTV. In addition, based on the values in Tables 3 and 4, the CBB decided that a RW of 150% was conservative enough to provide the right incentives and to account for the higher risk in the auto loans that meet the criteria in Table 2.

B. Application and Enforcement

The auto loans affected by the LTV rule were those collateralized by the vehicle financed via car title lien¹² or financial lease, encompassing all auto loans in Brazil. Under the Brazilian regulatory framework, the new RW of 150 percent was equivalent to a CAR of 16.5 percent (11 percent \times 150 percent) of the RWA.

Only those loans originated after December 6, 2010, would have the new, higher RW, not the existing stock at the time of the publication of the rule. Applying the measure to the entire auto loan stock would have an undesired effect of causing the higher risk weight auto loans to be mispriced in terms of cost, with interests rates inconsistent with the amount of banks' capital required to fund the loans. In addition, setting different capital requirements on new exposures, instead of the entire stock, could have a greater signaling effect on banks.

In addition, the phase-in would last 7 months in the sense that the new weight would take effect from July 1, 2011. As soon as the phase-in was over, the rule was fully effective. The phase-in period was intended to allow time for banks to adapt their internal controls to the new system where the RWs would depend on the LTV ratios and original maturities. The phase-in time was not devised to give banks time to build capital; this wouldn't be necessary as the new RW would apply only to newly originated loans, not to the existing loan book.

The applicable LTV ratio to determine the RW is the one at origination. The RW would remain at 150 percent for the entire duration of the operation, even if the LTV ratio declined as the loan is paid down. Therefore, using LTV at origination represented a more conservative approach in terms of risk management. In addition, the RW of each loan would be constant throughout the life of the loan, which simplifies internal controls

¹² The car title lien ("*alienação fiduciária*") is an annotation in the car title that prevents it from being transferred to another owner without consent from the lender.

and monitoring. And finally, the collateral value at origination is easier to verify than during the life of the loan notwithstanding the availability of market prices of used cars.

While it was possible to circumvent the LTV rule, the supervision by the CBB had the tools to limit circumvention. Borrowers could borrow through other windows to finance the down payment and thus reduce the LTV so that the auto loan would have the lower weight. To be fair, this is a problem to which all LTV rules are subject. Anecdotal evidence reveals that this occurred in some cases but not on a systematic, collective fashion. Nevertheless, the supervision by the CBB could detect this kind of behavior through its credit information system. If the CBB detected that the same bank was granting both financing (the auto loan and the down payment loan), the supervision could require that specific bank to hold additional capital under Pillar 2 authority. To some extent, this possibility acted as a deterrent of circumvention. CBB Financial System Monitoring Department (DESIG) monitors the credit information system continuously.

The CBB judged that there was no other conduit outside the purview of the CBB through which lenders could channel funds for auto financing that would represent risks for financial stability. A hypothetical strategy of offloading the auto loan book to a special purpose vehicle was not a concern because, given that the bank would retain the risk, the loan would remain in the bank's RWA with a RW of 150 percent¹³. And there was no other window that car buyers could borrow at competitive rates to finance auto purchase. Therefore, no follow up regulation to close loopholes was necessary.

Business owners could circumvent the restriction in order to finance their personal cars by purchasing them with their businesses. They would benefit from lower interest rates. However, while this was a possibility, the incentive to do so was small because business loans for auto purchase were weighted at 100 percent. In addition, it was not problematic for financial stability as the circumvention technique itself provided additional guarantees that the loan would be repaid – as the businesses' assets would also guarantee the loan in case of default. And finally, the share of auto loans to business in the total auto loan book is small.

¹³ National Monetary Council (CMN) Resolution 3,533 of January 1, 2008.

C. Communication

The CBB could not discuss the measure with the financial industry. The measure was implemented without previous warning. This was necessary to prevent the public and the industry from rushing and causing an auto loan boom ahead of the measure enactment. This would have caused precisely what it was designed to prevent.

The CBB justified the new rule as a macroprudential measure to ensure sustainable credit growth in the context of withdrawal of the stimulus measures introduced with the global financial crisis. Simultaneously to the publication of the new regulation, a Press Statement was released to explain the measure¹⁴. In addition, a press conference and series of press interviews took place to explain the new rule, its motivation and objectives. The Financial Stability Reports published after the rule also addressed the motivations of Circular n. 3,515, of 2010¹⁵.

The CBB communication emphasized concerns with rapid household credit growth in general, and auto loans in particular. It highlighted the motivation of the rule, which included concerns with credit origination standards and maturity extension. In addition, there were emerging concerns with the impact of fast credit growth on the speed of economic activity. Communication argued that there was a need for macroprudential policy to support monetary policy. It was explained that, combined with the long maturities of several years and constant installment amortization schemes, high LTV ratios were a concern specific to auto loans given the speed of price decay of used cars that could cause loans to become underwater.

5. Taking Decisions

A. Institutions

The institutional framework in Brazil greatly facilitates monetary and macroprudential policy coordination and implementation. The CBB has powers over decision and implementation of both monetary and macroprudential policy. In addition, the CBB has authority over most types of capital flow management measures, including FX intervention, but not tax measures, which are under the Ministry of Finance. The CBB derives its powers from the National Monetary Council, which is the highest policy-making authority over the financial system, from the founding Law of the

¹⁴ <http://www.bcb.gov.br/pt-br/Paginas/cmn-e-bc-adoptam-medidas-de-carater-macroprudencial.aspx>

¹⁵ <http://www.bcb.gov.br/?id=RELESTAB&ano=2011>

National Financial System¹⁶, and from the Federal Constitution. All institutions engaged in financial intermediation are subject to the CBB's regulatory authority.

The Collegiate Directorate of the CBB is the single decision-making body in the Central Bank for macroprudential and monetary policy. The Collegiate Directorate comprises the President of the CBB and its Directors. This Directorate meets weekly to decide on administrative and policy-related topics. Macroprudential policy was discussed and decided upon on an "as needed" basis¹⁷. In addition, the Collegiate Directorate meets every 45 days under the name of Monetary Policy Committee ("COPOM") to set the level of interest rates in the inflation targeting regime in operation in Brazil.

While the CBB is de jure dependent, it has in practice enjoyed of large degree of de facto independence for many years now. The members of the Directorate are nominated by each President of the Republic to serve at his/her pleasure for open-ended terms. The nominations must be endorsed by the Economic Affairs Committee of the Senate.

At the time of implementation of the LTV-dependent risk weights, National Monetary Council Resolution n. 3,490 of August 29, 2007, had given powers to the CBB to set RWs for the calculation of banks' RWA. The CBB sets RWs by publishing regulations ("Circular"), which are binding for all financial institutions as specified therein. It enforces regulations by conducting on-site and off-site supervision and by applying penalties including, if necessary, liquidating non-complying banks.

B. Dealing with Policy "Leakages"

Given the specific circumstances and legislation in Brazil, dealing with policy leakages was a simple matter. To start, there was no need to coordinate with home supervisors of foreign banks in Brazil to prevent leakage. This was thanks to full subsidiarization of financial institutions in Brazil. All financial intermediation institutions operating in Brazil are subject to CBB regulation. This is because all are required to be a subsidiary, legally incorporated in Brazil according to Brazilian laws. Thus all banks in Brazil were automatically subject to the LTV-dependent risk weights.

¹⁶ Law n. 4,595 of 31 December, 1964. The CMN is composed of three members: the Minister of Finance, the Minister of Planning, Budget and Administration, and the President of the Central Bank.

¹⁷ Since 2011, after the enactment of the LTV-dependent risk weights, the Collegiate Directorate also meets periodically under the Financial Stability Committee ("COMEF") to "assess the financial stability and set the guidelines and strategies for the Central Bank for systemic risk mitigation".

Brazilian banks' downstream banks operating abroad were also affected given the consolidation rules.

The regulatory perimeter was appropriate. There was no concern with leakages for unsupervised entities. The only institutions authorized to perform auto loans are the ones regulated and supervised by the CBB.

Some institutions within the regulatory perimeter, such as funds and securitization companies, could acquire auto loans portfolios originated by banks. However, the CBB believed that these operations would not represent risk to financial stability. In addition, the CBB would continually reevaluate financial stability and retained powers to swiftly implement measures to stop circumvention but this showed unnecessary.

Cross border arbitrage or rebooking of loans in other jurisdictions were not an issue. Because foreign borrowing by households is not common, there was no concern that this would replace the domestic lending channel. In addition, there was no concern that banks would redirect their funds to provide auto loans to non residents as banks in Brazil cannot channel domestic funds to foreign lending.

6. Evaluating Effectiveness

The significant increase of auto loans operations had been happening at the expense of lengthening of maturities, increases in LTVs, and reductions on interest rates incompatible with the risk taken. All these raised concerns from CBB and led it to take measures to correct the excesses and to discipline the market, aiming at a sustainable growth of this credit modality, and, consequently, mitigating potential risks for the stability of the Brazilian financial system. The CBB chose to increase the RWs on auto loan operations to address these concerns. This measure was considered successful in achieving its objective.

By increasing the RWs from 75% to 150% for operations with long maturities and with high LTV, these operations became more expensive to borrowers thereby discouraging their demand. Martins and Schechtman (2013) investigated the impact of these measures on the spread of the affected loans. Their result showed increased spreads charged on the same borrower for similar auto loans targeted by the regulatory measure. In comparison to a 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. 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. They conclude, therefore, that those spillovers, if present, have been limited.

Also, they show that the subsequent withdrawal of the measure was, similarly, associated to lower spreads charged on the same borrower for similar auto loans whose capital charges have decreased. Nevertheless, this reduction in spreads was smaller than the original increase. They understand that this could be associated to a more precautionary behavior adopted by banks after the measure introduction that lasted beyond the measure replacement.

After the measure introduction, the origination of affected auto loans fell from 74% of all auto loans in November 2010 to 60% in December 2011 (Chart 10). In addition, the signaling effect of the measures was powerful and outlived the measure itself. Indeed, even after the repeal of the dependence of the RW on the LTV ratio in November 2011, the share of long-maturity, high-LTV loans continued decreasing and reached 50% in December 2012. Table 5 brings the descriptive statistics per year.

We ran difference-in-difference estimations which confirmed these findings. The idea was to investigate whether the treated variable (new targeted loans) was affected by the measure (augmented RWs for certain combinations of LTV and maturity), when comparing to a control variable (new untargeted loans). As these two series are subjected to the same economic, seasonal and legal environment, the difference in the levels should be explained by the regulatory change of RWs.

We present estimations of the impact of the introduction and the replacement of the macroprudential measure on loan origination. For each event (introduction or replacement), we constructed 3 sub-samples comprising different time spans. For the first study we considered 3, 6 and 9 months before and the same period after the measure introduction (Table 6). For the second study we considered the last 3, 6 and 9 months before the measure withdrawal and the following 3, 6 and 9 months after the withdrawal, respectively (Table 7).

New loans are considered the dependent variable as a block¹⁸. Dummy treatment is 0 for untargeted and 1 for targeted loans. Dummy measure is 0 before the event (3, 6 or 9 months) and 1 after the event (3, 6 or 9 months). The events are the introduction of the measure in the first case study and its withdrawal in the second case.

The three columns on Table 6 show that the coefficients for the interaction among treatment and measure dummies are negative, thereby suggesting that the origination of new targeted loans decreased with the measure. The result is highly statistically significant and robust across all sub-sample estimations. New targeted loans were between 56% and 64% higher than the untargeted loans, depending of the sub-sample regression and, after the measure, this difference decreased to between 23% and 27%¹⁹.

Table 7 brings the results for the estimation of the impact of the measure withdrawal on auto loan origination. It also shows that the coefficients for the interaction among treatment and measure dummies are negative although only significant where the period length has 12 months or more (equations 2 and 3 of Table 7). This suggests that the withdrawal of the measure may have also implied a decrease of the targeted loans (although this result is less robust and has smaller R^2). The key finding here is that the measure removal did not cause a return to previous standards of loan origination because banks had changed their own behavior.

Another perspective to analyze the effectiveness of the measures is with regards to NPL ratio, both the traditional measure and NPL ratio by vintages (Chart 11). Considering monthly origination and their NPL after six months, it was increasing continuously since April 2010, when it was at 1.8%. This process continued until April 2011, as it reached 3.9%, four months after the entry into force of the macroprudential measures, and it remained at this level for four months. From September 2011 on, the new vintages already showed lower NPL. In December 2012, it was at 2.6%.

On the other hand, the traditional NPL ratio decreased until December 2010, influenced by the significant credit growth that took place until that moment. From January 2011 on, it began to increase until reaching 7.2% in July 2012, when it starts to decrease. As we commented earlier, this ratio has some limitations, such as taking time

¹⁸ For example, the regression for the subsample of 3 months before and 3 months after the implementation of the measure will have 12 observations, of which 6 observations are untargeted loans and 6 are targeted loans.

¹⁹ This is the difference between the coefficient treatment and the coefficient of dummies treatment and measure interaction.

to warn change in trends. The improvement in new loans was reflected just after eleven months in the traditional NPL ratio.

There were also clear changes in the LTVs of auto loans originated before and after the measures (Chart 12). From December 2008 to October 2010, the share of auto loans with LTV greater than 80% was increasing continuously until it reached 48% of new loans. Subsequently, this share started to reduce until it reached 27% in December 2012. On the other hand, the share of auto loans with LTV lower than 60% increased from 21% to 31%, on the same basis of comparison.

With regard to maturities (Chart 13), there was a significant change in the composition of new loans. The loans with maturities between four and five years, which accounted for 41% of the total granted in October 2010, reduced to 16% in December 2012. On the other hand, the loans with the maturity range that increased more its participation were the ones between three and four years, which increased from 24% to 42%, in the same period.

Regarding interest rates charged in auto loans, they raised after the measure (Chart 14). In November 2010, they were in 23% p.a. and reached the level of 28%, a consequence of both increasing costs due to a higher RW (upward pressure) and redistribution of loans to shorter and lower LTV auto loans (downward pressure), remaining at this level from March to July 2011. However, in an attempt to increase their market share, some banks controlled by the Federal Government started to reduce their interest rate at the beginning of 2012, which probably influenced the interest rate reduction in the financial system as a whole to levels lower than those prior to the entry into force of Circular 3,515.

The macroprudential measure (Circular 3,515) adopted by CBB to ensure sound standards of auto loan origination was successful. The characteristics of new auto loans changed significantly after the entry of the measures into force. Supervisory intelligence revealed that the measure had worked as an alert signal to banks. Indeed, banks indicated that they realized they had effectively taken excessive risk and, thus, they started to implement more stringent underwriting practices voluntarily, irrespective of the measure. The measure became redundant and ceased to be a binding constraint for banks. The new RWs changed banks' own behavior and improved the auto loan underwriting standards, generating vintages with lower risk. Econometric evidence, as presented in this section, confirms this view (Table 7). As these new vintages become

relevant in the total stock of the modality, they influenced the reduction of traditional NPL.

Once the CBB realized that banks had changed their behavior regarding new auto loans, Circular 3,515 could be repealed and was succeeded by Circular 3,563, of November 11, 2011, which eliminated the dependence of the RW on the LTV ratio. Instead, a simpler system came into effect where the higher weight would apply only to auto loans with maturity above 60 months, irrespective of the LTV ratio. This simplified implementation and supervision without reducing its effectiveness.

7. Conclusion

It is important to closely monitor the financial system and have the tools to take swift action in case financial imbalances are building up. Using its monitoring capability provided by the credit bureau, the Central Bank of Brazil detected in late 2010 a deterioration of the origination standards and risk mispricing in the auto loan segment, an important part of banks' portfolio. The Central Bank acted preventively to improve the standards of origination of auto loans by doubling the risk weight factors for loans with certain characteristics. The measure was well targeted to new auto loans with a combination of high LTV and long maturities. This macroprudential policy adopted on origination of auto loans was effective. The characteristics of newly originated auto loans, such as LTV and maturity, improved after the adoption of the measure. Moreover, the measure successfully signaled to banks the need to maintain sound origination standards as these did not worsen after the measure was withdrawn in 2011.

The Brazilian experience leads to some lessons on monitoring and macroprudential policy. First, that it is important to have a comprehensive credit database and to make creative use of it to identify early warnings of deterioration of new loans. The CBB manages a detailed credit register bureau that makes it possible to continuously monitor the financial system. NPL by vintage, LTV, monthly loans originated and maturities were some of the indicators that revealed the loosening of underwriting standards and the unsustainable credit growth in the auto loan segment.

Second, that the prudential regulator should have the powers to take prompt prudential measures to correct the buildup of systemic risk. Once issues that have the potential to put the financial system at risk are identified, the CBB had all the powers to

take prompt corrective measures. Acting in a timely manner is paramount when dealing with financial stability.

Finally, macroprudential tools that target the quality of credit origination can have a powerful signaling effect. The signaling channel between the CBB and the financial institutions was effective. After the LTV measure was enacted, banks revised their lending practices and corrected the lending excesses that had been taking place. They continued to do so even after the measure was relaxed.

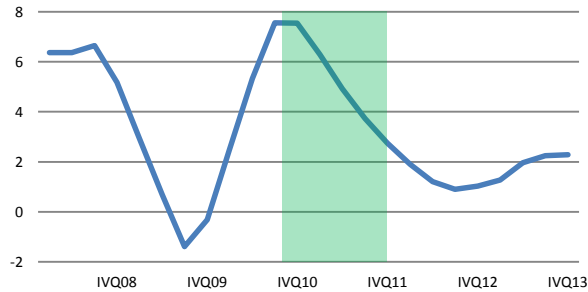
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Charts and Tables

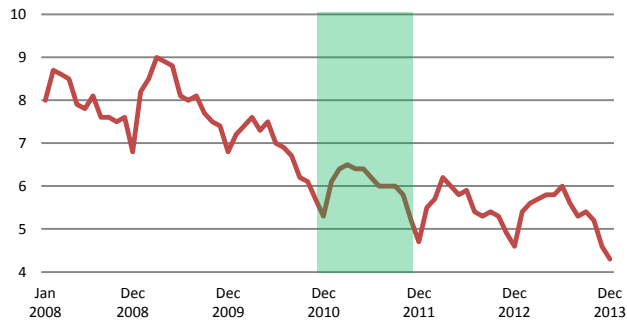
2. Setting the Stage

Chart 1 - GDP real growth (%)



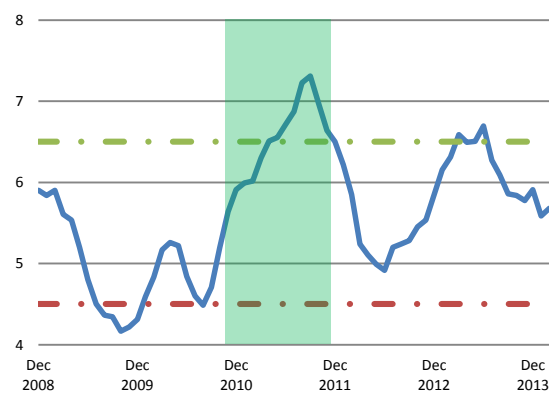
Source: IBGE

Chart 2 - Unemployment rate (%)



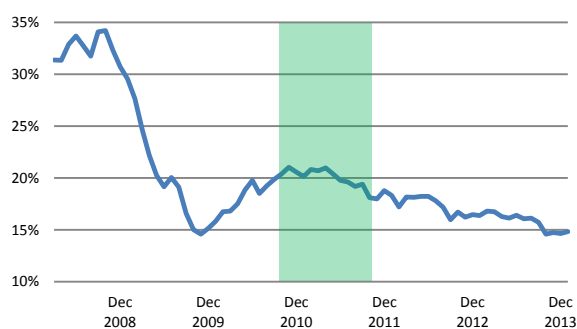
Source: IBGE

Chart 3 - 12-m accum. IPCA, inflation target and upper limit (%)



Source: IBGE

Chart 4 – Credit annual growth (%)



Source: Central Bank of Brazil

Table 1 – Timeline of monetary, fiscal, and short-term capital inflow policies

	Unit	2009				2010				2011			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
On Activity													
Selic Base rate (average)	%	12.6	10.3	8.9	8.8	8.8	9.5	10.6	10.8	11.3	12	12.3	11.4
Selic Base rate change	(+ bps)	-250	-200	-50	0	0	150	50	0	100	50	-25	-100
On Credit													
Reserve Requirements (RR)													
Outstanding RR	R\$	174.9	179.4	186.0	193.6	233.2	279.5	301.3	395.2	400.9	418.6	434.7	448.5
Outstanding RR	% credit	14.0	13.9	13.7	13.6	15.9	18.1	18.5	23.0	22.7	22.7	22.4	22.0
Average ratio on Demand Deposits	%	42.0	42.0	42.0	42.0	42.0	42.0	42.9	43.0	43.0	43.0	43.0	43.0
Average ratio on Term Deposits	%	15.0	15.0	14.5	13.5	13.5	14.9	15.0	15.8	20.0	20.0	20.0	20.0
On Capital Flows													
Reserve requirement on Short FX Open Position in Spot Market	%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	min (60% of what exceeds USD 3bi, Tier 1 capital)	min (60% of what exceeds USD 1bi, Tier 1 capital)	min (60% of what exceeds USD 1bi, Tier 1 capital)	min (60% of what exceeds USD 1bi, Tier 1 capital)
FISCAL POLICY													
On Activity													
Primary Fiscal Surplus													
Target	% of GDP				2.5				3.1				3.09
Achievement	% of GDP				2.0				2.7				3.11
Public Debt (Net)	% of GDP	39.1	41.2	42.8	42.1	41.1	40.0	39.4	39.2	38.9	38.6	36.3	36.4
On Capital Flows													
Tax on Financial Transactions (IOF)													
Non resident Fixed Income	%	0	0	0	2	2	2	2	6	6	6	6	6
Derivative margin deposits	%	0.38	0.38	0.38	0.38	0.38	0.38	0.38	6	6	6	6	6
Equity	%	0	0	0	2	2	2	2	2	2	2	2	0
External Credit Inflows	%	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	6	6	6	6
taxable maturity	days	90	90	90	90	90	90	90	90	360	720	720	720
FX Derivatives	%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1	1
On Credit													
Tax on Financial Transactions (IOF) on domestic credit	%	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0082	0.0082	0.0082

Fonte: Silva and Harris, 2012

3. Monitoring Systemic Risk

Chart 5 - NPL versus Monthly granting

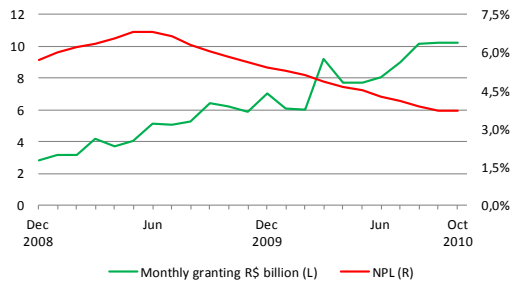


Chart 6 - Traditional NPL versus NPL by vintages

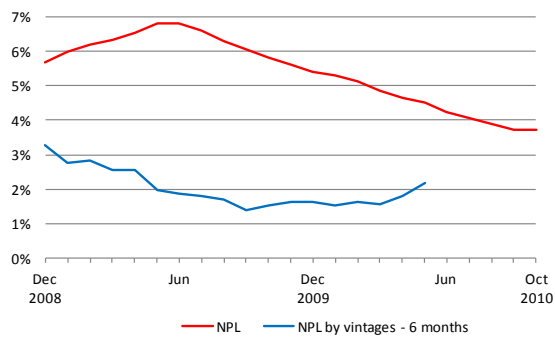


Chart 7 - Auto loan LTV

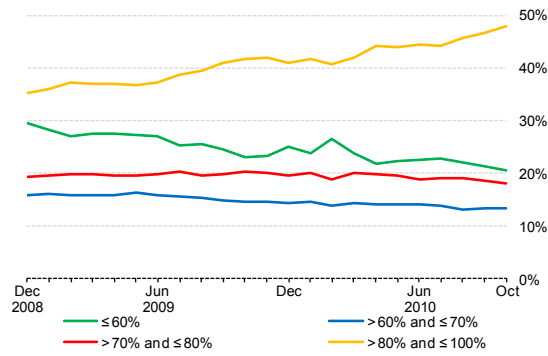


Chart 8 - Monthly granting and Maturity

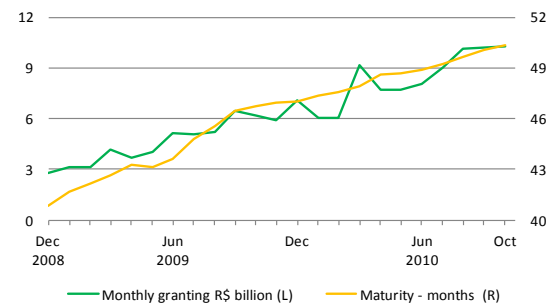


Chart 9 – Auto Loan versus Payroll-Deducted

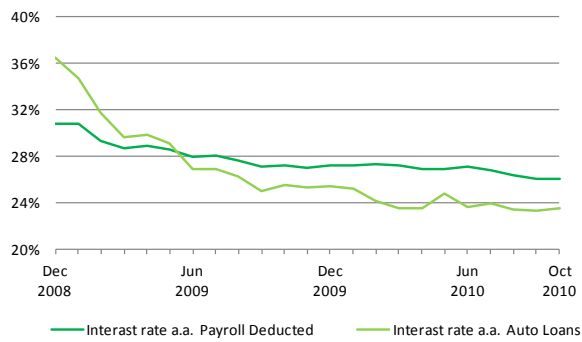
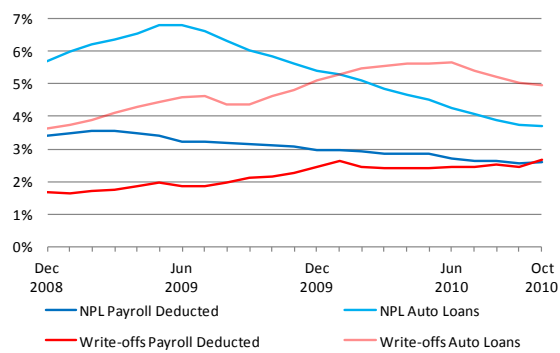


Chart 10 – NPL and Write-offs



4. Using the Tools

A. Calibration

Table 3 – Relationship between maturities, LTV and NPL

LTV \ Maturity	> 1 and ≤ 2 years	> 2 and ≤ 3 years	> 3 and ≤ 4 years	> 4 and ≤ 5 years
	≤ 60%	1,0%	1,9%	2,4%
> 60% and ≤ 70%	2,0%	3,4%	3,9%	3,6%
> 70% and ≤ 80%	3,0%	3,5%	4,3%	4,0%
> 80% and ≤ 100	3,4%	4,0%	5,9%	4,6%

Table 4 – RW by LGD and PD range for different maturities

LGD	Maturities (years)	PD	RWF
45%	> 1 and ≤ 2	1,66%	55%
	> 2 and ≤ 3	2,35%	60%
	> 3 and ≤ 4	4,34%	66%
	> 4 and ≤ 5	6,01%	68%
	> 5	5,76%	67%
75%	> 1 and ≤ 2	1,66%	92%
	> 2 and ≤ 3	2,35%	100%
	> 3 and ≤ 4	4,34%	109%
	> 4 and ≤ 5	6,01%	113%
	> 5	5,76%	112%
100%	> 1 and ≤ 2	1,66%	123%
	> 2 and ≤ 3	2,35%	134%
	> 3 and ≤ 4	4,34%	146%
	> 4 and ≤ 5	6,01%	151%
	> 5	5,76%	150%

6. Evaluating Effectiveness

Chart 10 - Monthly grant – untargeted and targeted loans

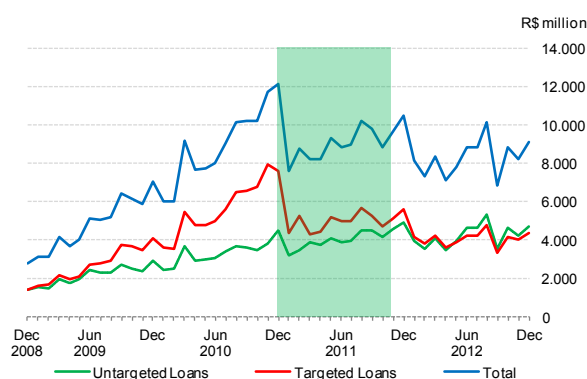


Table 5 – Descriptive statistics

	Targeted auto loans			Untargeted auto loans			(Targeted/total) auto loans	
	average (BRL million)	annual growth	std deviation	average (BRL million)	annual growth	std deviation	average	std deviation
2009	2,746.29		858.83	2,190.96		460.09	55.0%	3.03
2010	5,687.01	107.1%	1,437.92	3,339.25	52.4%	593.69	62.6%	2.65
2011	5,004.25	-12.0%	456.62	4,093.73	22.6%	489.81	55.1%	2.30
2012	4,086.10	-18.3%	379.64	4,229.26	3.3%	576.80	49.3%	1.70

Table 6 – Differences-in-differences regressions estimates: effects of augmented RWs for certain combinations of LTV and maturity on new auto loans

y = log(auto loans)

	eq 1	eq 2	eq 3
c	14.44*** (3.48)	11.80*** (2.15)	8.21*** (1.49)
dummy treatment	0.64*** (0.07)	0.60*** (0.04)	0.56*** (0.03)
dummy measure	0.03 (0.09)	0.09** (0.05)	0.14*** (0.03)
dummy treatment*	-0.37*** (0.10)	-0.36*** (0.06)	-0.33*** (0.05)
dummy measure	0.60*** (0.27)	0.81*** (0.17)	1.10*** (0.12)
R-squared	94.72%	94.17%	92.70%
Period	3 months before and 3 during the measure	6 months before and 6 during the measure	9 months before and 9 during the measure

Standard errors are shown in parenthesis.

*** and **: 1% and 5% statistical significance, respectively

Table 7 – Differences-in-differences regressions estimates: effects of return to previous RWs for that certain combinations of LTV and maturity on new auto loans

y = log(auto loans)

	eq 1	eq 2	eq 3
c	9.56*** (2.02)	8.86*** (1.89)	14.67*** (1.16)
dummy treatment	0.12** (0.05)	0.18*** (0.03)	0.18*** (0.04)
dummy measure	0.04 (0.05)	0.04 (0.04)	0.01 (0.04)
dummy treatment*	-0.04 (0.07)	-0.12** (0.05)	-0.17*** (0.05)
dummy measure	1.0*** (0.16)	1.06*** (0.15)	0.59*** (0.09)
R-squared	89.36%	85.61%	70.34%
Period	3 months during the measure and 3 after its withdrawal	6 months during the measure and 6 after its withdrawal	9 months during the measure and 9 after its withdrawal

Standard errors are shown in parenthesis.

*** and **: 1% and 5% statistical significance, respectively

Chart 11 - NPL versus NPL by vintages

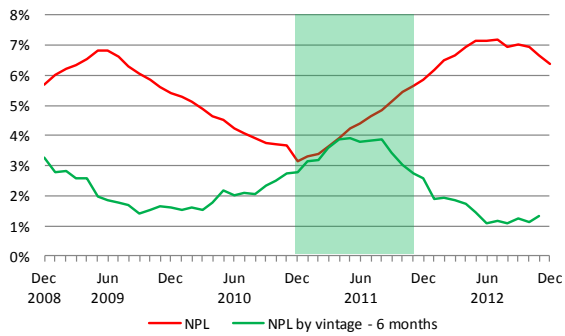


Chart 12 - Monthly granting by range of LTV

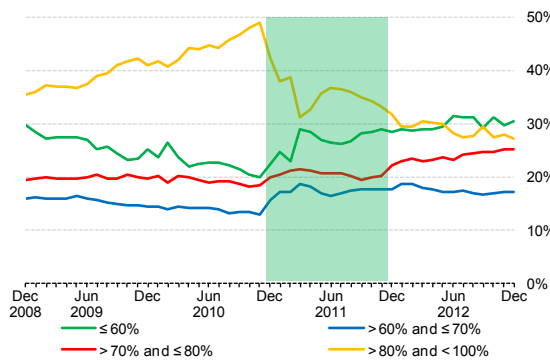


Chart 13 - Auto Loan granting by term to maturity

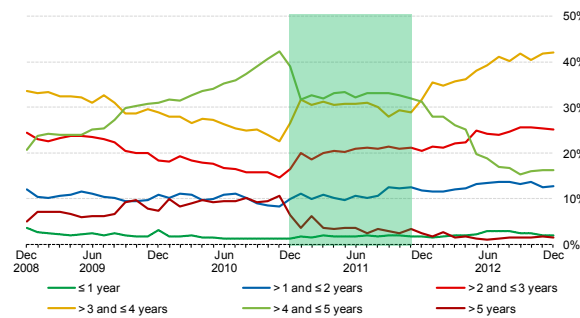


Chart 14 - Interest rate

