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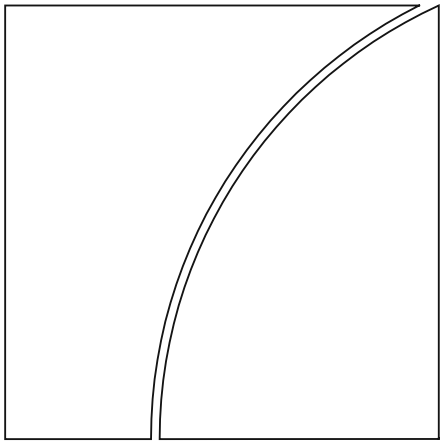

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Macroprudential Policies in Peru: The effects of Dynamic Provisioning and Conditional Reserve Requirements

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Macroprudential Policies in Peru: The effects of Dynamic Provisioning and Conditional Reserve Requirements

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Abstract

Over the past decade, credit has grown significantly in Peru, a small and partially dollarised economy, and the mounting credit risk attached to foreign currency credit created severe challenges for financial regulators. This paper assesses the effectiveness of two macroprudential measures implemented by regulators: dynamic provisioning, to reduce the procyclicality of credit and conditional reserve requirements, to diminish the degree of dollarisation of the economy. Using credit register data that covers the period of 2004-2014, we find evidence that dynamic provisioning has decelerated the rapid growth of commercial bank lending. Moreover, mortgage dollarisation declined significantly after the implementation of the conditional reserve requirement scheme.[1]

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1 Introduction

This paper assesses the effects of macroprudential tools on a partially dollarised economy, such as Peru, in which banks can grant loans in both domestic and foreign currency. Such a partly dollarised banking system can be vulnerable to an abrupt weakening of the national currency against the US dollar, because there are important currency mismatches in debtors' incomes and expenses as well as in their assets and liabilities. In fact, a sharp depreciation of domestic currency can lead to substantially higher principal and interest payments for debtors that have incomes and assets denominated mainly in local currency. This is known in the literature as the balance sheet effect.

In the case of Peru, favourable economic conditions and flexible bank lending standards led to a strong credit growth. For example, total credit grew at 39% annually in 2008, more than five times the growth of gross domestic product (GDP). In that context, macroprudential policies were introduced with the aim of reducing the procyclicality of credit and the degree of dollarisation.

Jimenez, Ongena, Peydró and Saurina (2009) explored the effects of overnight interest rates and the stance of monetary policy on the risk-taking behaviour of banks in their allocation of credit. Their findings suggest that low short-term interest rates – in periods that were previous to loan origination – caused a relaxation of lending standards as banks granted loans to riskier clients (ie with a higher default probability). In this context, macroprudential policies can be introduced with the aim of limiting excessive credit growth and balance sheet expansion in order to preserve financial stability, and as complements to monetary policy. For instance, dynamic provisioning was one of the macroprudential instruments implemented one year before the Central Reserve Bank of Peru reduced its policy rate to a very low level (1% in 2009). In addition, the central bank introduced conditional reserve requirements (RR) as a macroprudential tool aimed at curbing excessive growth of credit in foreign currency (given low interest rates in international markets).

A number of Latin American countries introduced a variety of macroprudential instruments over the past few decades (see Tables 1, 2 and 3). For example, Colombia introduced countercyclical reserve requirements during 2007–2008 to limit liquidity risk, and introduced marginal reserve requirements and a dynamic provisioning scheme to stabilise credit growth in late 2007. The Colombian authorities also established liquidity ratio restrictions in 2009 to limit liquidity risk. In the case of Mexico, the authorities established dynamic provisioning in 2011. On the other hand, Argentina y Brazil, have not set up dynamic provisioning yet, but imposed limits on loan to value (LTV) for mortgage.

In spite of the advances in the design and application of macroprudential instruments by central banks and financial regulators, there has been little empirical research on the effects of macroprudential instruments on credit dynamics.

Table 1: Capital based instruments

	Dynamic Pro-visioning	Limits on dividend distribution	Other capital-based tools
Argentina	No	Yes (2010, 2012)	Changes in risk weights for specific operations
Brazil	No	No	Change of risk weights for some types of loans
Chile	No	No	No
Colombia	Yes (2007)	Yes (2008)	Higher LGD for some consumer loans in 2011
Mexico	Yes (2011)	No	No
Peru	Yes (2008)	No	Yes (on specific operations 2010, 2012)

Note: The number in brackets indicates the year of modification or use of macroprudential instrument.
Source: BIS

Table 2: Asset based instruments

	LTV and DTI limits	Limits on exchange rate risk	Limits on derivatives
Argentina	Yes (LTV for mortgages)	Yes	Yes
Brazil	Yes (LTV for mortgages)	Yes (2007)	Yes (2011)
Chile	No	Yes	No
Colombia	Yes (1999)	Yes (2005)	Yes(2007)
Mexico	No	Yes (1997)	Yes(2001)
Peru	Yes	Yes (2010-2011)	Yes(2011)

Note: The number in brackets indicates the year of modification or use of macroprudential instrument.
Source: BIS

Table 3: Liquidity based instruments

	Countercyclical reserve requirements	Liquidity ratios
Argentina	Yes (but not countercyclical)	Yes (2008)
Brazil	Yes (2008, 2009, 2011, 2012)	Yes. Liquidity measures and taxes on capital flows
Chile	No	Yes
Colombia	Yes (2007)	Yes (2008)
Mexico	No	Yes
Peru	Yes (2010, 2011)	Yes (1997, 2012)

Note: The number in brackets indicates the year of modification or use of macroprudential instrument.
Source: BIS

In this paper, the effects of dynamic provisioning and conditional reserve requirements on credit growth, dollarisation and bank asset quality are evaluated. This is done by means of a novel credit register data set covering a long period of time (2004–2014) and containing detailed information about outstanding loans (at the bank-debtor level). By using panel data techniques, we find that dynamic provisioning helps to decelerate the growth of commercial bank lending (with the growth rate being 1.4% lower than normal if the dynamic provisioning tool is activated). In a related piece of research, Jimenez, *et al.* (2012) found a coefficient of –2% for the growth of committed lending, given the implementation of a dynamic provisioning scheme. Regarding conditional reserve requirements on foreign currency mortgage lending in Peru, there is statistically significant evidence that this macroprudential tool reduces dollarisation. However, the results are mixed in the case of non-performing loans.

This paper is organised as follows: section 2 presents a brief review of the literature; section 3 shows stylised fact relating to credit dynamics; section 4 describes the data set and variables used; section 5 documents the empirical strategy and its results; and, finally, section 6 presents a brief summary of our findings and sets out an agenda for future research.

2 Literature review

The 2008 financial crisis highlighted the need to change the financial regulatory framework of the research agenda, from one oriented to monitor bank's solvency to another orientated to a macroprudential perspective to reinforce a sound and safe banking system (Hanson, Kashyap and Stein (2010) and Shin (2010)).

Similarly, Hanson, Kashyap and Stein (2010) show that a micro-prudential regulation seeks to restore individual tier capital ratio when an adverse shock dampens it and it is not concerned about how banks can achieve it. One stylised fact during the last financial crisis shows that a shrinking balance sheet, for example by selling assets, is easier than issuing equity in order to meet tier capital requirements.

Shin (2010) states that in a booming economy, asset prices tend to rise, leading to an increment on credit risk. Thus, banks want to attract both domestic and foreign funding. This might cause a jump in the banking leverage ratio and banks tend to rely on non-core liabilities, causing both currency and maturity mismatches. Therefore, banks contract their balance sheet dramatically, sparking off a spiral process of reduction of asset prices and net worth when foreign funding becomes scarce.

In an applied work, Claessens, Ghosh and Mihet (2014) explore how macroprudential policies have been effective in emerging and developed economies. They use a panel data set that covers 48 countries and 2 800 banks from 2000 to 2010, and control for endogeneity[1]. The authors find that macroprudential measures aimed to restrain borrowers' risk taking behaviour and limiting

[1] A country could adopt measures in addition to macroprudential policies to deal with systemic risk.

banks´ balance sheet growth such as Loan to Value (LTV), Debt to Income (DTI) or Reserve Requirement restrictions have a curbing effect on the growth of risky assets.

On the contrary, the set of measures that encourage banks to build-up capital buffers, such as dynamic provisioning, exhibit slight effects. The results are similar if the sample is split between advanced and emerging economies, but in advanced economies measures oriented to limit borrowing are more effective at reducing asset growth than measures aimed to reduce available funds.

In line with this work, Cerutti, Claessens and Laeven (2015) report a recent IMF survey about the use of macroprudential policies and their effects among 119 countries over the 2000-2013 period. They conclude that macroprudential policies are used mainly in emerging countries, instead of borrower-based policies in the case of advanced economies. Also, the effects of borrower-based measures are stronger than other macroprudential policies. Dynamic provisioning and countercyclical reserve requirements decelerate credit growth. Additionally, they find evidence of asymmetric effects of macroprudential policies: these measures are more effective on boom periods than during bust episodes.

On the other hand, Drehmann and Gambacorta (2012) explore the effects of Basel III countercyclical capital buffers requirements through a counterfactual exercise, using information from 772 European banks between 1998 and 2009. The methodology computes additional capital requirements as if the Basel III regime would have been placed since 1986. Then, that additional requirements are put on a lending equation, controlling for macroeconomic factors and banking characteristics. They find that additional capital buffers requirements could moderate credit growth during boom periods. In particular, the cumulative reduction in the supply of credit over the period 1986 to 2007 would have been around 18 percent.

For emerging markets, Bruno, Shim and Shin (2017) analyse the effects of macroprudential and capital flow policies on credit growth across 12 Asia-Pacific countries between 2004 and 2013. They examined 177 domestic macroprudential policies, such as LTV or DTI restrictions, and 152 capital flow management policies. The authors find that macroprudential and capital flow policies reduce both banking and bond inflows. Additionally, they find some evidence about spillover effects of these policies. For instance, bank inflow controls tend to increase international debt securities before 2007, and bond inflow controls tend to increase cross-border bank lending and domestic bank credit after 2009. Regarding the interaction between monetary and macroprudential policies, the authors suggest that macroprudential measures have a stronger effect if such policies are reinforced by the stance of monetary policy.

Jimenez, Ongena, Peydró and Saurina (2012) analyse the impact of the Spain´s dynamic provisioning scheme on credit supply, using a credit register database provided by the Bank of Spain. In particular, they consider commercial and industrial loans (80 percent of total loans) granted to more than 100 000 non-financial companies by 175 banks in any given year. In the case of Spain, countercyclical provision is based on the comparison of the average of specific provisions over the last lending cycle with the current specific provision, so in good (bad) times, when non-

performing loans are low (high), specific provisions are low (high) with respect to the average of the cycle provisions producing (drawing down) the dynamic provision funds, together with floor and ceiling values set for general loan loss provisions. The results suggest that dynamic provisions help to smooth credit supply cycles and in bad times have positive effects on firm credit availability, assets, employment and probability of survival.

In the case of Latin American economies, Chan-Lau (2012) explores the impact of dynamic provisioning on bank solvency and credit procyclicality, using information of 14 large Chilean banks for the 2004-2010 period. The author analyses the solvency of those banks under two scenarios: (i) Chile´s provisioning scheme of 2011; (ii) dynamic provisioning as detailed in the work of Jimenez, *et at.* (2009). The main conclusion is that the dynamic provisioning scheme builds-up more capital buffers in order to cover loan losses than the current Chilean scheme. Additionally, she shows that credit and output lead the evolution of credit provisioning; therefore, credit provisioning could not have any effect on credit evolution.

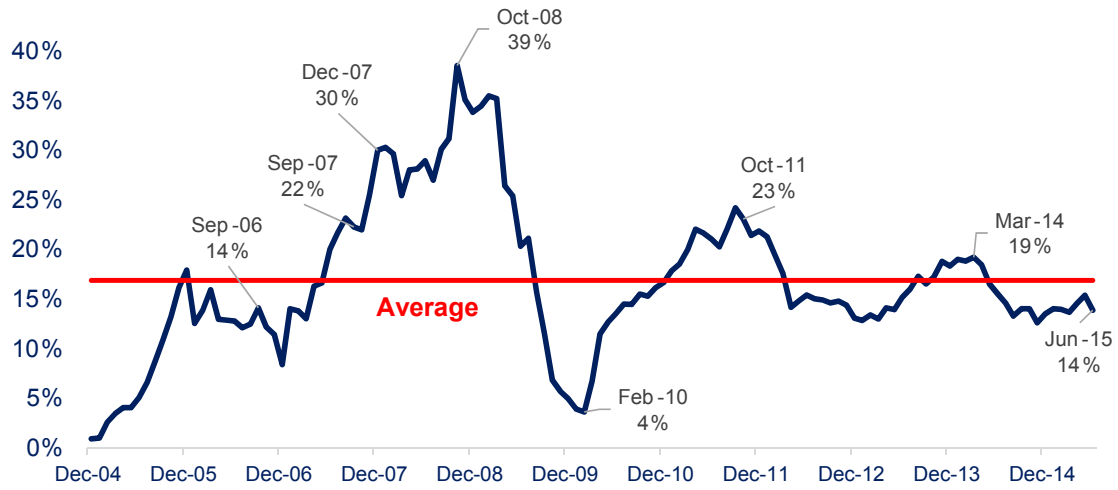
For the Uruguayan case, Dassatti and Peydró (2014) study the effects of a change of reserve and liquidity requirements on bank risk-taking behaviour. Using a credit register database and a difference-in-difference approach, they find that increases in reserve and liquidity requirements for distinct funding sources (deposits, short-term funding and others) reduce loan supply to the non-financial sector. This effect is asymmetric: larger banks are more capable to mitigate the effects of the lending channel. At firm level, higher reserve requirements increase their real costs, although the effect is also asymmetric: firms with better credit rating or with a better network with larger banks are able to reduce those costs.

Many emerging economies under an Inflation Targeting regime have stopped using reserve requirements as a monetary policy instrument. However, these economies have actively used RRs on banking and non-banking liabilities to handle systemic risk. Tovar, García-Escribano and Vera (2012) remark the variety of purposes that RRs can achieve. First, RRs can be used for managing the credit cycle countercyclically. Second, they can be employed to improve the funding structure of banking system. For instance, the Peruvian scheme of RRs on foreign liabilities with short-term maturity has limited the banking system´s exposure to short-term debt. Third, RRs can substitute for traditional monetary policy in order to preserve financial stability. For example, many emerging economies raised their policy rate in a context of large capital inflows. This policy response, whose goal was to increase the cost of credit, could lead to more capital inflows because the yield of domestic assets could be higher than international ones and foster the expansion of loans. The authors show results that suggest limited effects of RRs on credit growth. Therefore, RRs should be reexamined regularly in order to preserve their effects on credit dynamic.

3 Credit dynamics and the Peru's macroprudential toolkit

In the last decade, credit to the private sector has grown steadily in Peru. The average growth rate of credit between 2004 and 2014 was around 15 percent. The highest growth rate was of 39 percent at the end of 2008, in a context of solid economic activity (the average growth rate of GDP was around 6 percent) and abundant international liquidity. In fact, international interest rates near to zero triggered great capital inflows to emerging markets.

Figure 1: Credit Growth (Var. % YoY)



In this environment, Peruvian authorities implemented different macroprudential measures aimed to preserve financial stability. According to Chang and Choy (2014), those measures were to mitigate the following critical issues: credit procyclicality, exchange rate credit risk, and exposure to short-run capital inflows. The main measures adopted were as follows:

(i) The Superintendency of Banking, Insurance and Pension Funds (SBS), the home banking regulator and supervisor, established procyclical provisioning (see the dynamic provisioning scheme table); higher requirements of tier capital for loan in the consumption and mortgages credit segments, and an additional requirement for FX mortgages; tier capital requirements for exposition to FX credit risk; limits to FX exposure of financial institutions; limits on FX negotiation by pension fund companies.

(ii) The central bank introduced higher reserves requirements in foreign currency; additional reserves requirements conditional to the dynamics of FX mortgages and automobile loans; and additional reserves requirements for deposits of foreigners and for short-term external debt.

Dynamic provisioning is part of generic provisions, but depends of the type of loan. Before July 2010, loans granted to firms were classified as microbusiness (firms with total debt in the financial system lower than US$ 30 000) and commercial (the rest of firms). In July 2010, the SBS stablished an accounting change creating more categories of firm loans: corporate, large companies, medium-size companies, small business and microbusiness (the SBS redefined this category for firms with total debt lower than US$ 6 000). That accounting change and other limitations about the microbusinesses database present a challenge in the study of the impact of macroprudential tool over the credit growth. Therefore, we chose to analyse only commercial loans with a minimum outstanding debt of one million soles (over US$ 300 000), which represent at least one quarter of the sample and cover around 80% of total commercial loans.

Table 4: Provisioning Requirements (general and dynamic) for normal portfolio of credits to businesses 1/ (%)

a)Applicable form December 2008 until June 2010

Business loans by type	General provision rate	Dynamic provision rate	
		Unsecured loans	Loans with selfquidating collateral
Comercial loans	0.70	0.45	0.30
Microbusinesses	1.00	0.50	0.00

b) Applicable form July 2010 until now

Business loans by type	General provision rate	Dynamic provision rate	
		Unsecured loans	Loans with selfquidating collateral
Corporate	0.70	0.40	0.30
Large companies	0.70	0.45	0.30
Medium-size enterprises	1.00	0.30	0.00
Small business	1.00	0.50	0.00
Microbusinesses	1.00	0.50	0.00

1/ Debtors that presents a liquid and strong financial position, with low debt and good ability to generate profits. Cash flow is not susceptible to a significant worsering

Chang and Choy (2014) sum up the dynamic provisioning scheme in Peru, whose rules of activation and deactivation depend on the GDP growth (Table 5). Thus, dynamic provisioning is activated or deactivated when the GDP growth rate crosses certain thresholds. When the rule is activated, dynamics provision rate is added to general provision rate to get stricter generic provision requirements.

Table 5: Dynamic provisioning scheme in Peru

Activation rule	**Deactivation rule**
1. The average YoY GDP growth rate in the last 30 months changes from less than 5% to 5% or more	1. The average YoY GDP growth rate in the last 30 months changes from a level equal or greater than 5% to one less than this threshold.
2. When the average YoY GDP growth rate in the last 30 months exceeds 5%, and the average GDP growth rate in the last 12 months is higher by 2% to this same indicator calculated a year earlier	2. The average YoY GDP growth rate in the last 12 months is lower by 4% to this same indicator calculated a year earlier
3. When the average YoY GDP growth rate in the last 30 months exceeds 5%, and 18 months have elapsed since the pro-cyclical rule was deactivated	

Source: Chang and Choy (2014)

To evaluate the effect of the dynamic provisioning scheme in Peru, first we describe how this tool has been activated and deactivated since 2008, year in which this scheme was introduced. The SBS activated the dynamic provision scheme in December 2008 during a context of a high GDP growth rate (at 9.1% that year) and a rapid increase of the rate growth of credit (at 39% annual in October 2008).

Therefore, the scheme was activated following the second rule of activation which states an average GDP growth rate YoY of the last 30 months higher than 5% (8.7% in October 2008), and the average GDP growth rate YoY of the last 12 months higher by 2% to this same indicator a year earlier (2.5% in October 2008). The dynamic provision scheme was active until September 2009 (ten months). In June 2009, the average GDP growth rate YoY of the last 12 months was lower by 5.7% to this same indicator calculated a year earlier, meeting the second rule of deactivation.

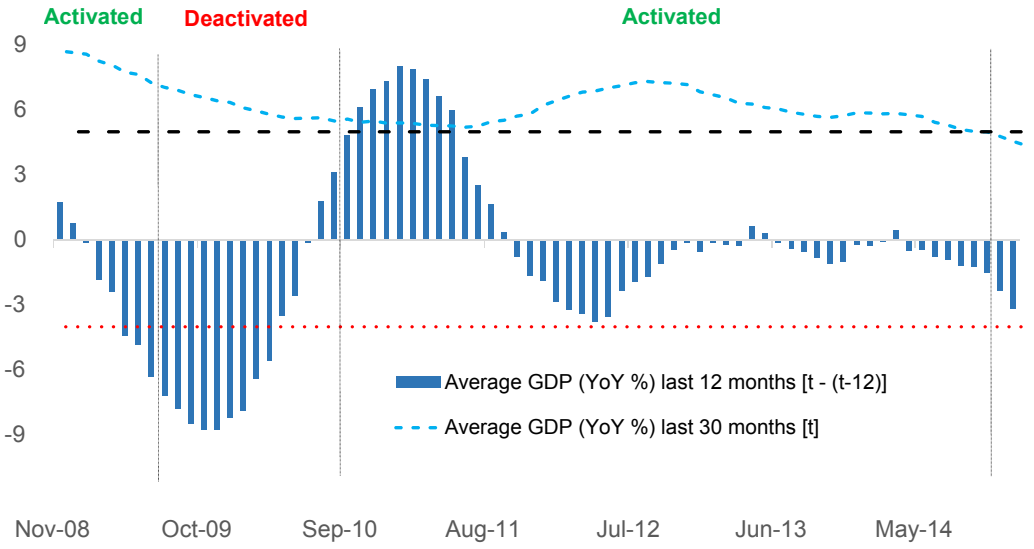
In 2010, Peruvian economy recovered after the international financial crisis allowing the activation of the dynamic provisions from October 2010 until November 2014 (50 months). This activation met the second rule which states an average GDP growth rate YoY of the last 30 months higher than 5% (5.86% in July 2010) and the average GDP growth rate YoY of the last 12 months higher by 2% to this same indicator a year earlier (2.04% in July 2010).

As can be noticed, the growth rate of GDP growth has a lag of two months, given delay in the official publication of this indicator. The periods of activation and deactivation rules are illustrated in Figure 2.

On the other hand, the SBS has established stricter and higher capital requirements for consumption loans and mortgages denominated in foreign currency to cope with higher foreign capital inflows since January 2013. In turn, Central Reserve Bank of Peru established in 2008 a

marginal reserve requirements on deposits of foreign financial entities in the banking system. This measure imposed a reserve requirement of 120% for liabilities with foreign financial entities.

Figure 2: Activation and deactivation rule of dynamic provisioning



That policy discouraged banks to take foreign short-run funding, which proved to revert rapidly in response to external volatility[2]. This mitigated an eventual abrupt movement in the interest rates and the exchange rate; therefore it prevented an increase in credit dollarisation.

Regarding FX credit risk, the Central Bank has implemented some macroprudential tools to address that risk, given high levels of credit dollarisation. The Dedollarisation Programme of the Central Bank discourages credit dollarisation, through additional reserve requirements in foreign currency conditional to credit evolution.

At the beginning, the scheme was conditional on credit growth. There were three limits (10%, 15% and 20%) to total credit growth in foreign currency[3], if banks exceeded these limits, they faced additional requirements of to 1.5%, 3% and 5%, respectively. In the case of households, automobile loans and mortgages were imposed with limits to growth that were 10% and 20%, and the associated additional reserve requirements were 0.75% and 1.5%, respectively. These reserve requirements were added to the usual reserve requirements in foreign currency[4] as a punishment for banks whose dollar credit growth surpassed those limits.

The measure mentioned above had the expected impact on the dollar credit growth. Loans in foreign currency in Peru had a very low growth between the years 2013 and 2014. However, the

[2] In 1998, the banking system was overexposed to short-run external funding. When the international risk aversion went up, the capital outflow was around US$ 1 484 million (2.5% of GDP)
[3] Loans to foreign trade operations were excluded.
[4] Reserve requirements are a percentage on liabilities in foreign currency and banks must keep liquid assets for at least the same percentage.

high level of the stock of those loans was still a vulnerability of the Peruvian banking system. For that reason, the authorities assessed proactive measures to reduce the stock of dollar credit.

In the end of 2014, the previous scheme was changed to a new set-up that required reductions in dollar loans. Under this new scheme, banks had to reduce, by June 2015, the stock of total credit in foreign currency (excluding foreign trade operations) to at least 95 percent of the comparable balance as of September 2013.

In the case of automobile loans and mortgages, banks had to reduce, by June 2015, their stock for this type of credit to at least 90 percent of the balance as of February 2013. If banks had not met these conditions, they would have faced additional reserve requirements proportional to their total liabilities in foreign currency[5]. This measure became more demanding for December 2015, since banks had to reduce their balances of total dollar denominated loans to at least 90 percent of the September 2013 balance. Table 6 presents the rules for conditional reserve requirements scheme.

Table 6: Conditional reserve requirements in foreign currency

Scheme A: Dedollarisation conditional on credit growth
From March 2013 to May 2015

	Targets of Credit Growth*			Additional RR		
	I	II	III	I	II	III
Total Credit excluding foreign trade loans (C_t) (Sep.13=100)	5,0%	10,0%	15,0%	1,50%	3,0%	5,0%
Mortgage and Car Loans (CHV_t) (Feb.13=100)	10,0%	20,0%		0,75%	1,50%	

Scheme B: Dedollarisation conditional on decrease of dollar credit outstanding
Since June 2015

	Required Stock*	Additional RR
Total Credit1/ (Set.13=100)	0,95 times (reduction of 5%)	$0,3 \times \left(\frac{C_t}{C_{s13}} - 0,95\right) \times TLiab$
Mortgage and Car Loans (Feb.13=100)	0,90 times (reduction of 10%)	$0,15 \times \left(\frac{CHV_t}{CHV_{f13}} - 0,90\right) \times TLiab$

Since December 2015

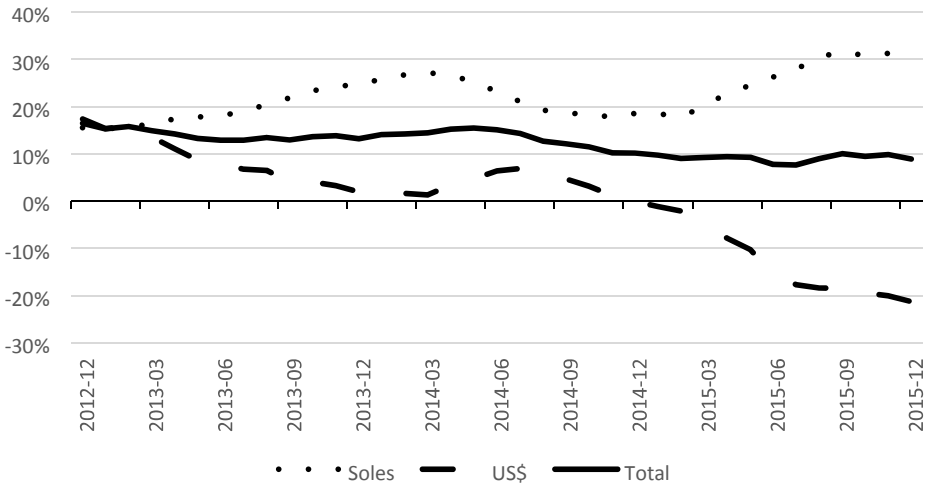
	Required Stock*	Additional RR
Total Credit1/ (Set.13=100)	0,90 times (reduction of 10%)	$0,3 \times \left(\frac{C_t}{C_{s13}} - 0,90\right) \times TLiab$
Mortgage and Car Loans (Feb.13=100)	0,85 times (reduction of 15%)	$0,15 \times \left(\frac{CHV_t}{CHV_{f13}} - 0,85\right) \times TLiab$

*These targets do not apply if total credit stock in foreign currency is lesser than bank net worth, and if mortgages and car loans are lesser than a fifth of bank net worth.
1/ Excludes foreign trade loans, and credits whose maturity exceeds 3 years and volume is higher than USD 10 millions.
TLiab: Total Liabilities in foreign currency (includes Deposits, debt and bons).

[5] They Include deposits, bonds and external liabilities.

Figure 3 shows the evolution of credit growth by currency. The overall growth rate of credit to the private sector was 9.2%, which was lower than the growth rate registered at the end of 2014 (10.4%). By currency, loans denominated in soles accelerated their growth at the end of 2015 (28.0% annually). On the other hand, credit in foreign currency decreased, closing the year with an annual contraction of 21.0%. This evolution was partially associated with the implementation of the Dedollarisation Programme and the depreciation of domestic currency.

Figure 3: Credit to the private sector (Var. % YoY)



4 Data

The Credit Register database, provided by the SBS, contains information at a very disaggregate level of loans outstanding in both domestic and foreign currencies. Specifically, commercial loans from 2004:Q2 to 2014:Q4 are analysed to estimate the impact of macroprudential instruments on financial system' indicators.

There are two different accounting systems for businesses loans before and after July 2010. Therefore, only commercial loans with a minimum outstanding debt of one million soles (around US$ 300 000) are chosen. The latter are at least one quarter of the sample (covering around 80% of total commercial loans). In addition, macroeconomic indicators such as the interbank interest rate and the exchange rate are used as control variables.

The sample (2004:Q2 – 2014:Q4) contains information about 19 639 debtors whose loans were granted by 9 banks. Moreover, the number of bank-debtor relationships was 6 611 on average (with a maximum of 14 892 and a minimum of 568).

Regarding the sample for evaluation of conditional reserve requirements for banks that grant mortgages loans, the time frame is expanded until the third quarter of 2015 to have additional observations where RRs were active. For the lender based regression, there are forty two banks. In the case of lender-debtor based regressions, the numbers of banks is twelve, with 136 900 debtors, and the number of bank-debtor relationship is 12 118, on average (with a maximum of 46 251 and a minimum of 125).

The dependent variables are the real quarterly credit growth (calculated as the first difference of the natural logarithm of outstanding loans), the dollarisation ratio of mortgage loans, and the non-performing loans rate for mortgages. The total credit stock is deflated using the Consumer Price Index (CPI). Control variables are divided into two groups: banking controls and macroeconomic controls. Banking controls are: size (measured by total assets), leverage ratio, liquidity ratio (loan to deposits).

Macroeconomic controls are the quarterly change of interbank interest rate, the quarterly nominal depreciation, the annualised change of the current account and the annualised change of GDP.

Additionally, we control for reserve requirements for each bank in both currencies. To avoid extreme values, observations higher than the ninety percentile threshold and lower than the ten percentile thresholds are drop out. The empirical distribution of credit growth is shown in the Figure 4 and the summary of statistics of main variables in Table 7.

Figure 4: Empirical distribution of credit growth

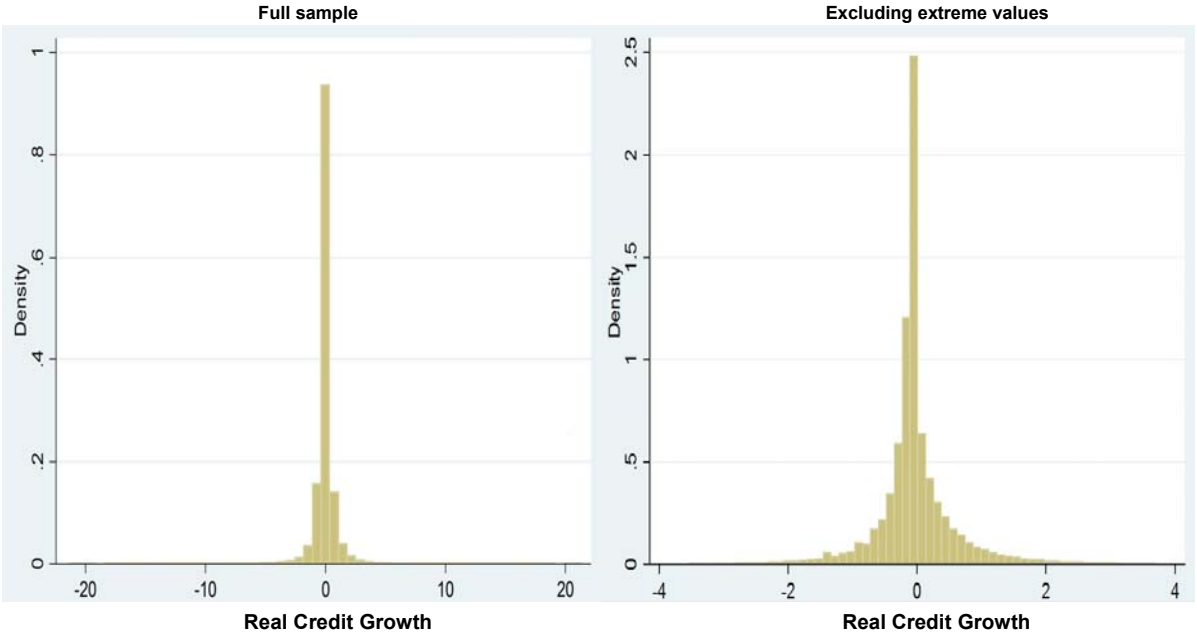


Table 7: Summary of statistics of main variables

	Mean	Median	Std. Dev.	10 Percentile	90 Percentile
Levels					
Bank Assets (Mill. S/)	28 699	22 852	23 732	3 113	62 413
Capital Ratio (%)	13.09	12.87	1.52	11.29	15.00
Deposits to Liabilities (%)	76.38	75.71	6.13	69.98	83.53
Liquidity Ratio (%)	39.57	36.62	16.48	20.35	64.40
RR in Domestic Currency (%)	10.13	7.65	5.02	6.00	17.41
RR in Foreign Currency (%)	29.65	27.84	6.56	24.35	41.40
Growth Rates					
Credit (%)	-2.66	-5.21	66.23	-56.65	59.79

5 Empirical strategy and results

This section presents the methodology to evaluate the effectiveness of the two macroprudential tools: dynamic provisioning and conditional reserve requirements.

Dynamic provisioning effects

In order to quantify the effects of dynamic provisioning on credit growth[6], the following base regression equation is performed:

$$Y_{i,b,t} = \sum_{j=0}^{3} X'_{t-j} \times \beta^j + \sum_{j=0}^{3} Z'_{b,t-j} \times \theta^j + \sum_{j=0}^{3} MP_{t-j} \times \gamma^1 + u_{i,b,t} \quad (1)$$

Where *i*, *b* and *t* represent debtor, bank and time indexes, respectively.

$Y_{i,b,t}$ is the real credit growth of debtor-*i* in bank-*b* at time *t*. X_{t-j} stands for the vector of macro control variables; $Z_{b,t-j}$ is the matrix of bank controls; and, MP_{t-j} expresses the dynamic provisioning scheme at time *t-j*.

The macroprudential policy variable was coded the following way. Disregarding the state of nature, each banking institution uphold provisions that are registered in the general provision account. However, according to what we explained in the previous section, there is a type of provisions that banking institutions need to uphold according to the business cycle (dynamic provisioning rule). In that sense, when the dynamic provisioning rule is activated, banks must register these provisions in a particular account that is different from the general provisioning account. Therefore, we code as 1 (dynamic provisioning is activated) when a bank starts to cumulate provisions in this special account and the value 1 is maintained until the bank starts to decrease its position. In such case, we code the macroprudential variable with the value of -1 (dynamic provisioning is deactivated). Finally, we code with a value 0 in any other period. To sum up, the dynamic provisioning variable is:

$$MP_t = \begin{cases} 1, & if\ a\ dynamic\ provisioning\ is\ "activated". \\ -1, & if\ a\ dynamic\ provisioning\ is\ "deactivated". \\ 0, & otherwise. \end{cases} \quad (2)$$

Using standard panel data estimation method, the idiosyncratic error ($u_{i,b,t}$) is:

$$u_{i,b,t} = \alpha_{i,b} + \varepsilon_{i,b,t} \quad (3)$$

[6] The methodology was proposed in the BIS CCA CGDFS Working Group Workshop.

Where $\alpha_{i,b}$ is the non-observable heterogeneity, and $\varepsilon_{i,b,t}$ represents an independent, identically distributed, random disturbance. Also, it is assumed that $\alpha_{i,b}$ is uncorrelated with $\varepsilon_{i,b,t}$.

According to Greene (2011), if the non-observable heterogeneity is uncorrelated with observable regressors, then the random effects estimator (a feasible GLS estimator) is both efficient and consistent. However, our base equation regression does not take into account individual control, such as debtor wealth or income and other characteristics, so it is difficult to believe that this omitted information is not correlated with macro controls or bank controls. Thus, we choose to estimate the models using fixed effects methodology (within estimator), which is not an efficient estimator but a consistent one.

The fixed effects methodology (within estimator) consists in transform the dataset. The time average can be removed from (1). Then, it is possible to re-write it as:

$$Y_{i,b,t} - \bar{Y}_{i,b} = \sum_{j=0}^{3}\left[X_{t-j} - \bar{X}_{i,b}\right]' \times \beta^j + \sum_{j=0}^{3}\left[Z_{b,t-j} - \bar{Z}_{i,b}\right]' \times \theta^j + \sum_{j=0}^{3}\left[MP_{t-j} - \overline{MP}_{i,b}\right] \times \gamma^1 + \bar{u}_{i,b,t} \quad (4)$$

Moreover, some dummy variables are added to control some time-invariant effects (τ_t), such as seasonality (for instance, after the Christmas campaign, many firms diminish their production, and therefore require less funding), and bank-specific effects (γ_b). Additionally, the presence of heteroscedasticity is corrected, and then the variance-covariance matrix was estimated by debtor (cluster). With this in mind, the equation is:

$$\tilde{Y}_{i,b,t} = \gamma_b + \tau_t + \sum_{j=0}^{3} \tilde{X}'_{t-j}\,\beta^j + \sum_{j=0}^{3} \tilde{Z}'_{b,t-j}\,\theta^j + \sum_{j=0}^{3} \psi^j MP_{t-j} + \tilde{u}_{i,b,t} \quad (5)$$

The results (see Tables A1 and A2 in the Appendix) show that dynamic provisioning tends to reduce the procyclicality of commercial loans for a restricted estimation. Therefore, if the dynamic provisioning scheme was tightened on the previous period, the real credit growth is expected to diminish by 1.4 percent in the current period. Moreover, as can be noticed in Table 2, the cumulated effect of dynamic provisioning is also significant and greater than the first-lag effect. Regarding macroeconomic controls, the estimated coefficient for the exchange rate is significant and negative, reflecting the fact that a depreciation of domestic currency reduces the growth of commercial loans. However, a significant and positive relationship between the change of the interbank rate and the growth of commercial loans is founded, an unusual and counterintuitive result, inasmuch as a tightening in monetary conditions tends to increase borrowing costs and corporate firms can substitute bank loans.

Furthermore, there is an inverse relationship between bank-size and credit growth. It might be that small banks (which possess lower assets) tend to expand their balance sheets more than larger ones because the former are in an expansionary phase. Additionally, regarding liquidity bank characteristics, the evidence is mixed but not significant. In this line, [Claessens, *et al.*] find that banks with less deposits are riskier than others. Small banks are willing to expand their balance sheets, but this fact could prevent them from doing so.

Then, the impact of the dynamic provisioning scheme is evaluated, splitting tightening periods from easing periods, on the credit growth of commercial loans (Figure 2) according with the following equation:

$$\tilde{Y}_{i,b,t} = \gamma_b + \tau_t + \sum_{j=0}^{3} \tilde{X}'_{t-j}\,\beta^j + \sum_{j=0}^{3} \tilde{Z}'_{b,t-j}\,\theta^j + \sum_{j=0}^{3} \psi^j_{tight} Tightening_{t-j} \sum_{j=0}^{3} \psi^j_{ease} Easing_{t-j} + \tilde{u}_{i,b,t} \qquad (6)$$

Throughout the analysis of alternative estimations (see Appendix, Table A3 and A4), similar results are found regarding the sign of coefficients and the significance for macroeconomic and bank controls. Regarding the main variable (dynamic provisioning), a tightening position in the macroprudential tool tends to reduce credit growth, and an easing position tends to increase credit growth, although the latter effect is not statistical significant. A similar effect is found when the cumulative effect of tightening and easing position of our macroprudential tool is analysed. This suggests that dynamic provisioning tends to reduce the procyclicality of credit.

A third equation was estimated (see Appendix, Tables A5 and A6) to include interactions between the macroprudential variable and the bank characteristic variables.

$$\tilde{Y}_{i,b,t} = \gamma_b + \tau_t + \sum_{j=0}^{3} \tilde{X}'_{t-j}\,\beta^j + \sum_{j=0}^{3} \tilde{Z}'_{b,t-j}\,\theta^j + \sum_{j=0}^{3} \psi^j MP_{t-j} + \sum_{j=0}^{3} [\tilde{Z}'_{b,t-j} \times MP_{t-j}]\phi^j + \tilde{u}_{i,b,t} \qquad (7)$$

Similar results are found for macroeconomic controls. Additionally, the coefficients of interactions show that when dynamic provisioning is activated, well capitalised banks (with higher tier capital ratio) reduce the growth to commercial loans, and larger banks (with higher total assets) reduce more the growth of commercial loans. The last result suggests that dynamic provisions tend to reduce growth of commercial loans.

There are some shocks, like the 2008 financial crisis, that affect the identification of macro and firm-fixed effects. In this case, it is quite useful to employ the bank cross-section information. For instance, Chang and Choy (2014) state that different provisioning rate are used depending on the type of credit, thus provisioning effect will depend on loan structure that a bank can have in their portfolio. Thus, it is used the interaction between loan structure of commercial credits and the macroprudential tool. Besides, instead of using our current definition for the macroprudential tool it is employed a sort of cumulative index, 1 when the countercyclical rule is active, 0 otherwise. Additionally, the first lag term for macro and bank-characteristics is used (see Table 8). There is a relevant remaining effect of dynamic provisioning on deceleration of credit growth, and the interaction of that macroprudential tool and the loan structure does not have a significant effect.

Conditional reserve requirements effects

For Conditional Reserve Requirements, the dummy variables are encoded as following:

$$PdDollar_t = f(x) = \begin{cases} 1, & if\ De-Dollarization\ Program\ is\ active \\ 0, & otherwise. \end{cases} \qquad (8)$$

The dependent variable analysed is: the change in the mortgage dollarisation rate, calculated at a constant exchange rate. There is an inverse contemporaneous effect of conditional reserve requirements on dollarisation rate, but it is insignificant (See Table A8 and A9). Domestic currency depreciation shows a positive and non-significant relation with the change of dollarisation, which is unexpected since a depreciation of domestic currency would lead to a substitution between loans denominated in dollars by credit in local currency. Besides, an increase of the monetary policy rate leads to a rise on mortgage dollarisation, followed by a substitution between loans granted in soles for credit in dollars. The higher reserve requirement for foreign currency does not affect the dollarisation rate. Finally, positive dynamic in economic activity lead to a decrease of dollarisation. Besides, larger banks have lower dollarisation rates.

A similar result is found when the first lag of the macroprudential dummy variable employed. However the effect of conditional reserve requirements is statistically significant, the implementation of Dedollarisation Programme leads a deceleration of dollarisation by 1.02 percent points, on average. When contemporaneous and lagged effects (up to the third lag) are included, the scheme of conditional reserve requirements triggers a significant deceleration of the change of dollarisation rate by 1.02 percent points, on average.

Now, by controlling for the proportion of dollarised mortgages and taking into account the first – lag of the control variables, the macroprudential tool has not an effect by it-self (Table A10). However, the interaction between macroprudential tool and the proportion of dollarized mortgages is significant, so banks have greater incentives than others to reduce the dollarisation of its mortgages loan portfolio.

In the case of non-performing loans, the evidence shows that depreciation of domestic currency diminishes the change in this variable, but this effect is statistically insignificant (at least up to the second lag). That result is quite counter-intuitive, since, in theory, a depreciation in dollarized economy triggers a negative balance-sheet effect, worsening the financial position of households with currency mismatches. Besides, an adjustment on monetary conditions has mixed effects on the change of the non-performing loans rate of mortgages in foreign currency, but those effects are not significant. Though, the effect of GDP growth is significant and negative. Regarding the De-Dollarisation Programme, the macroprudential tool has not effect on non-performing loans (see Table A11 and A12). That result is similar by controlling for the proportion of dollarized mortgages (see Table A13).

6 Conclusions

This paper uses micro registry data to analyse the impact of dynamic provisioning and conditional reserve requirements on commercial credit growth, mortgage dollarisation and non-performing loan rates. The implementation of dynamic provisioning in Peru elicited substantial academic debate about its impact on the banking system. Moreover, the Dedollarisation Programme had not been analysed empirically in detail.

We find that a tightening (easing) of dynamic provisioning in Peru decelerated (accelerated) the growth of commercial lending. This suggests that implementation of this macroprudential instrument contributed partially at reducing credit procyclicality and, thus, diminishing potential adverse effects on financial stability of excessive credit expansion. At this point, it is important to note that banks with higher capital ratios have a better ability to expand credit than other banks, thereby mitigating the impact of dynamic provisioning. In the case of the Dedollarisation Programme, our empirical evidence is that the programme creates incentives for banks to substitute dollar-denominated loans and expand credit in domestic currency, especially in sectors with high exposure to exchange rate-related credit risk, such as mortgages loans. However, the effect of the programme on the non-performing loans rate – an alternative measure of financial vulnerability – is not conclusive.

Additionally, we find that the positive relationship between the interbank interest rate (a proxy for the policy rate) and credit growth, changed when the interaction between the policy rate and dynamic provisioning are included. Therefore, there is room for further work on this point, since the main objective of this paper, as a first step, was to assess the impact of a number of macroprudential tools on credit growth. Moreover, we find that a decline of the national currency against the US dollar leads to a significant increase in non-performing loans denominated in dollars due to the adverse impact of balance-sheet effects on the financial position of debtors with currency mismatches.

Finally, further research is needed on the wide range of macroprudential policies implemented in Peru – especially within a general equilibrium framework – as all trade-offs need to be taken into account.

7 References

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8 Appendix

Table A1

Regression for two alternative models of Equation 5

(Equation 1: First lag effect and Equation 2: Contemporaneous and lagged effect)

	Equation 1		Equation 2	
	Coef.	p-value	Coef.	p-value
Macroeconomic controls				
Δ Exchange rate (t)	-0,065 *	0,10	-0,095 **	0,03
(t-1)	-0,203 ***	0,00	-0,204 ***	0,00
(t-2)	-0,148 ***	0,00	-0,099 *	0,07
(t-3)	0,146 ***	0,00	0,140 ***	0,01
Δ Interbank rate (t)	0,002	0,45	-0,001	0,81
(t-1)	0,004	0,14	0,009 **	0,02
(t-2)	0,009 ***	0,00	0,007 **	0,04
(t-3)	0,007 ***	0,00	0,017 ***	0,00
Δ Current Account (t)	-0,000007 ***	0,00	-0,000006 ***	0,00
(t-1)	0,000004 ***	0,01	0,000003 *	0,07
(t-2)	0,000004 **	0,02	0,000004 **	0,03
(t-3)	-0,000001	0,63	0,000000	0,83
Bank controls				
Capital Ratio (t)	0,001	0,51	0,001	0,60
(t-1)	-0,001	0,50	-0,001	0,67
(t-2)	0,005 ***	0,00	0,005 ***	0,00
(t-3)	-0,001	0,18	-0,001	0,28
Liquidity ratio (t)	0,000	0,24	0,000	0,12
(t-1)	0,000	0,41	0,000	0,69
(t-2)	0,000 ***	0,01	0,000 ***	0,01
(t-3)	0,000 **	0,02	0,000 **	0,02
Log (Total assets) (t)	-0,098 ***	0,00	-0,092 ***	0,00
(t-1)	0,090 ***	0,01	0,091 ***	0,01
(t-2)	-0,082 ***	0,01	-0,093 ***	0,00
(t-3)	-0,023	0,32	-0,008	0,73
Deposits to Liabilities (t)	0,000	0,35	0,000	0,43
(t-1)	0,002 ***	0,00	0,002 ***	0,00
(t-2)	-0,002 ***	0,00	-0,002 ***	0,00
(t-3)	0,001 ***	0,00	0,001 ***	0,00
Monetary conditions				
Reserve Requirement PEN (t)	-0,002 **	0,04	-0,003 ***	0,01
(t-1)	0,003 ***	0,01	0,003 ***	0,00
(t-2)	0,003 ***	0,01	0,003 ***	0,00
(t-3)	0,001	0,20	0,001	0,24
Reserve Requirement USD (t)	0,000	0,97	0,000	0,64
(t-1)	-0,002 ***	0,01	-0,002 **	0,03
(t-2)	-0,002 ***	0,01	-0,002 ***	0,00
(t-3)	0,002 ***	0,00	0,002 ***	0,00
Dynamic Provisions				
Prov (t)			-0,011 **	0,03
(t-1)	-0,014 ***	0,00	-0,009	0,06
(t-2)			-0,012 ***	0,01
(t-3)			0,010 ***	0,00
Others:				
Seasonal effects	Yes		Yes	
Constant	1,046 ***	0,00	0,938 ***	0
Number of banks	9		9	
Number of obs.	841 144		841 144	

Table A2
Alternative models of Equation 5 – joint significance tests

	First Lag Effect		Contemporanuos and Lagged Effects	
	Coef.	p-value	Coef.	p-value
Macroeconomic controls				
Δ Exchange rate	-0.270 ***	0.00	-0.258 ***	0.00
Δ Interbank rate	0.022 **	0.02	0.032 **	0.04
Δ Current Account	0.000001	0.70	0.000001	0.66
Bank controls				
Capital Ratio	0.004 ***	0.00	0.004 ***	0.00
Liquidity ratio	0.000 ***	0.00	0.000 ***	0.00
Log (Total assets)	-0.113 ***	0.00	-0.103 ***	0.00
Deposits to Liabilities	0.001	0.11	0.001 *	0.06
Reserve Requirements				
Domestic Currency	0.005 ***	0.00	0.005 ***	0.00
Foreign Currency	-0.001	0.42	-0.002	0.30
Dynamic Provisions	-0.014 ***	0.00	-0.022 ***	0.00
Others:				
Seasonal effects	Yes		Yes	
Constant	1.046	0.00	0.938	0
Number of banks	9		9	
Number of obs.	841,144		841,144	

Table A3

Regression results for two alternative models of Equation 6

(Equation 1: First lag effect and Equation 2: Contemporaneous and lagged effect)

	Coef.	p-value	Coef.	p-value
Macroeconomic controls				
Δ Exchange rate (t)	-0,069 *	0,08	-0,055	0,22
(t-1)	-0,124 **	0,02	-0,197 ***	0,00
(t-2)	-0,101 **	0,05	-0,095	0,12
(t-3)	0,227 ***	0,00	0,157 ***	0,01
Δ Interbank rate (t)	-0,001	0,82	-0,003	0,54
(t-1)	0,002	0,53	-0,002	0,67
(t-2)	0,010 ***	0,00	0,005	0,15
(t-3)	0,005 **	0,03	0,019 ***	0,00
Δ Current Account (t)	-0,000004 **	0,02	-0,000005 ***	0,01
(t-1)	0,000005 ***	0,00	0,000003 *	0,08
(t-2)	0,000005 ***	0,01	0,000005 ***	0,01
(t-3)	-0,000001	0,60	0,000002	0,31
Bank controls				
Capital Ratio (t)	0,001	0,62	0,001	0,46
(t-1)	0,000	0,88	0,000	0,90
(t-2)	0,005 ***	0,00	0,004 ***	0,01
(t-3)	-0,001	0,42	-0,001	0,39
Liquidity ratio (t)	0,000	0,25	0,000 **	0,02
(t-1)	0,000	0,24	0,000	0,23
(t-2)	0,000 **	0,04	0,000 **	0,02
(t-3)	0,000 *	0,06	0,000 ***	0,00
Log (Total assets) (t)	-0,101 ***	0,00	-0,093 ***	0,00
(t-1)	0,098 ***	0,00	0,099 ***	0,00
(t-2)	-0,080 ***	0,01	-0,075 **	0,02
(t-3)	-0,005	0,82	-0,012	0,64
Deposits to Liabilities (t)	0,000	0,42	-0,001	0,12
(t-1)	0,002 ***	0,00	0,002 ***	0,00
(t-2)	-0,002 ***	0,00	-0,002 ***	0,00
(t-3)	0,001 ***	0,00	0,001 ***	0,01
Monetary conditions				
Reserve Requirement PEN (t)	0,000	0,99	-0,002 *	0,10
(t-1)	0,003 ***	0,00	0,002	0,15
(t-2)	0,004 ***	0,00	0,005 ***	0,00
(t-3)	0,003 ***	0,01	0,004 ***	0,00
Reserve Requirement USD (t)	0,000	0,57	0,000	0,91
(t-1)	-0,002 ***	0,02	-0,001	0,20
(t-2)	-0,002 ***	0,02	-0,002 ***	0,00
(t-3)	0,002 ***	0,00	0,002 ***	0,00
Dynamic Provisions				
Tightening (t)			-0,036 ***	0,00
(t-1)	-0,040 ***	0,00	-0,029 **	0,05
(t-2)			0,004	0,80
(t-3)			0,009	0,58
Easing (t)			-0,032 ***	0,01
(t-1)	-0,005	0,41	0,001	0,97
(t-2)			0,046 ***	0,01
(t-3)			-0,010	0,58
Others:				
Seasonal effects	Yes		Yes	
Constant	0,798 ***	0	0,752 ***	0,00
Number of banks	9		9	
Number of obs.	841 144		841 144	

Table A4
Alternative models of Equation 6 – joint significance tests

	First Lag Effect		Contemporanuos and Lagged Effects	
	Coef.	p-value	Coef.	p-value
Macroeconomic controls				
Δ Exchange rate	-0.067 ***	0.00	-0.190	0.16
Δ Interbank rate	0.016	0.61	0.018 ***	0.00
Δ Current Account	0.000005 **	0.05	0.000006 **	0.05
Bank controls				
Capital Ratio	0.004 ***	0.00	0.004 ***	0.00
Liquidity ratio	0.000 ***	0.00	0.000 ***	0.00
Log (Total assets)	-0.088 ***	0.00	-0.080 ***	0.00
Deposits to Liabilities	0.001 **	0.04	0.000	0.24
Reserve Requirements				
Domestic Currency	0.010 ***	0.00	0.009 ***	0.00
Foreign Currency	-0.001	0.72	-0.001	0.63
Dynamic Provisions				
Tightening	-0.040 ***	0.00	-0.052 ***	0.00
Easiing	-0.005	0.41	0.005	0.61
Others:				
Seasonal effects	Yes		Yes	
Constant	0.798	0.00	0.752	0.00
Number of banks	9		9	
Number of obs.	841,144		841,144	

Table A5

Regression results for two alternative models for Equation 7

(Equation 1: First lag effect and Equation 2: Contemporaneous and lagged effect)

	Coef.	p-value	Coef.	p-value
Macroeconomic controls				
Δ Exchange rate (t)	-0,072 *	0,08	-0,122 ***	0,01
(t-1)	-0,247 ***	0,00	-0,233 ***	0,00
(t-2)	-0,191 ***	0,00	-0,136 **	0,02
(t-3)	0,159 ***	0,00	0,155 ***	0,00
Δ Interbank rate (t)	0,002	0,59	0,001	0,79
(t-1)	0,005	0,27	0,006	0,16
(t-2)	0,005	0,17	0,005	0,12
(t-3)	0,013 ***	0,00	0,017 ***	0,00
Δ Current Account (t)	-0,000005 ***	0,01	-0,000004 **	0,02
(t-1)	0,000002	0,23	0,000002	0,27
(t-2)	0,000005 **	0,02	0,000004 **	0,05
(t-3)	0,000001	0,58	0,000001	0,64
Bank controls				
Capital Ratio (t)	0,003 **	0,03	0,002 *	0,06
(t-1)	-0,001	0,36	-0,001	0,49
(t-2)	0,006 ***	0,00	0,005 ***	0,00
(t-3)	-0,001	0,23	-0,001	0,32
Liquidity ratio (t)	0,000	0,21	0,000	0,14
(t-1)	0,000	0,36	0,000	0,61
(t-2)	0,000	0,13	0,000	0,25
(t-3)	0,000 ***	0,04	0,000	0,12
Log (Total assets) (t)	-0,089 ***	0,00	-0,084 ***	0,00
(t-1)	0,098 ***	0,00	0,104 ***	0,00
(t-2)	-0,107 ***	0,00	-0,117 ***	0,00
(t-3)	-0,014	0,56	-0,010	0,66
Deposits to Liabilities (t)	-0,001	0,19	0,000	0,55
(t-1)	0,002 ***	0,00	0,002 ***	0,00
(t-2)	-0,002 ***	0,00	-0,002 ***	0,00
(t-3)	0,001 ***	0,00	0,001 ***	0,00
Monetary conditions				
Reserve Requirement PEN (t)	-0,004 ***	0,00	-0,004 ***	0,00
(t-1)	0,003 ***	0,02	0,003 ***	0,00
(t-2)	0,004 ***	0,00	0,004 ***	0,00
(t-3)	0,001	0,55	0,000	0,78
Reserve Requirement USD (t)	0,000	0,75	0,000	0,65
(t-1)	-0,001 *	0,10	-0,001	0,21
(t-2)	-0,001 **	0,08	-0,001 *	0,06
(t-3)	0,003 ***	0,00	0,003 ***	0,00
Dynamic Provisions				
Prov (t)			0,037	0,46
(t-1)	-0,005	0,89	0,065	0,30
(t-2)			-0,152 ***	0,01
(t-3)			0,009 ***	0,01
Interactions between bank controls and macroprudential policy				
Prov (t) * Capital Ratio (t)	-0,005 ***	0,00	-0,005 ***	0,000
(t-1)	0,002	0,40	0,000	0,803
(t-2)	-0,003 **	0,05	-0,002	0,337
Prov (t) * Liquidity Ratio (t)	0,000	0,38	0,000	0,373
(t-1)	-0,001 ***	0,00	-0,001 ***	0,009
(t-2)	0,001 **	0,02	0,000 *	0,060
Prov (t) * Log (Total assets) (t)	0,003 *	0,06	0,002	0,360
(t-1)	0,000	0,89	-0,002	0,646
(t-2)	0,002	0,36	0,006 **	0,029
Prov (t) * Dep.to.Liabilities (t)	0,000	0,15	0,000	0,807
(t-1)	0,000	0,93	-0,001	0,315
(t-2)	0,000	0,78	0,001 **	0,047
Others:				
Seasonal effects	Yes		Yes	
Constant	1,01419 ***	0,000	0,965 ***	0,00
Number of banks	9		9	
Number of obs.	841 144		841 144	

Table A6
Alternative models of Equation 7 – joint significance tests

	First Lag Effect		Contemporanuos and Lagged Effects	
	Coef.	p-value	Coef.	p-value
Macroeconomic controls				
Δ Exchange rate	-0.351 ***	0.01	-0.336 **	0.01
Δ Interbank rate	0.024 ***	0.00	0.030 ***	0.00
Δ Current Account	0.000003	0.27	0.000002	0.30
Bank controls				
Capital Ratio	0.006 ***	0.00	0.006 ***	0.00
Liquidity ratio	0.000 **	0.04	0.000 *	0.07
Log (Total assets)	-0.111 ***	0.00	-0.107 ***	0.00
Deposits to Liabilities	0.000	0.25	0.001	0.18
Reserve Requirements				
Domestic Currency	0.003 *	0.09	0.004 **	0.04
Foreign Currency	0.000	0.81	0.001	0.58
Dynamic Provisions	-0.005	0.89	-0.040	0.41
Interactions between bank controls and macroprudential policy				
Prov (t) * Capital Ratio (t)	-0.005 ***	0.00	-0.005 ***	0.000
(t-1)	0.002	0.40	0.000	0.803
(t-2)	-0.003 **	0.05	-0.002	0.337
Prov (t) * Liquidity Ratio (t)	0.000	0.38	0.000	0.373
(t-1)	-0.001 ***	0.00	-0.001 ***	0.009
(t-2)	0.001 **	0.02	0.000 *	0.060
Prov (t) * Log (Total assets) (t)	0.003 *	0.06	0.002	0.360
(t-1)	0.000	0.89	-0.002	0.646
(t-2)	0.002	0.36	0.006 **	0.029
Prov (t) * Dep.to.Liabilities (t)	0.000	0.15	0.000	0.807
(t-1)	0.000	0.93	-0.001	0.315
(t-2)	0.000	0.78	0.001 **	0.047
Others:				
Seasonal effects	Yes		Yes	
Constant	1.01419	0.000	0.965	0.00
Number of banks	9		9	
Number of obs.	841,144		841,144	

Table A7
New Equation 5 for commercial credit growth

	Coefficient	Standard Error	t-statistic	P-value
Macroeconomic Controls				
Δ Interbank Rate (t-1)	0.016	0.002	8.42	0.000
Δ Exchange Rate (t-1)	-0.104	0.030	-3.44	0.001
Δ Current Account (t-1)	0.000	0.000	2.51	0.012
Reserve Requierement in Domestic Currency (t-1)	0.004	0.001	5.79	0.000
Reserve Requierement in Foreign Currency (t-1)	-0.001	0.001	-1.99	0.047
Bank Controls				
Capital Ratio (t-1)	0.002	0.001	2.69	0.007
Liquidity Ratio (t-1)	0.000	0.000	0.05	0.961
log of Assets (t-1)	-0.101	0.004	-25.71	0.000
Deposits to Liabilities (t-1)	0.000	0.000	0.57	0.569
Macroprudential Tool				
Dinamyc Provission (Cummulative Index)	-0.031	0.021	-1.51	0.132
Dinamyc Provission (t-1)	-0.035	0.027	-1.32	0.188
Dinamyc Provission (t-2)	0.034	0.018	1.86	0.063
Dynamic Provissions*Loan Structure	0.000	0.000	0.14	0.890
Dynamic Provissions*Loan Structure (t-1)	0.001	0.000	2.1	0.036
Dynamic Provissions*Loan Structure (t-2)	-0.001	0.000	-2.49	0.013
Constant	0.979	0.047	20.87	0.000
Seasonal Effects				Yes
Bank Fixed Effects				Yes
Observations				862,461

Table A8
Regression results for mortgage dollarisation rate

	Contemporaneous Effect		First Lag Effect		Contemporaneous and Lagged Effects	
	Coef.	P-value	Coef.	P-value	Coef.	P-value
Macroeconomic controls						
Δ Exchange rate (t)	5,885	0,327	7,530	0,135	6,172	0,279
(t-1)	9,132 *	0,082	11,621 **	0,020	8,972	0,108
(t-2)	-2,997	0,459	0,228	0,958	0,918	0,837
(t-2)	10,963 ***	0,001	13,388 ***	0,000	14,374 ***	0,000
Δ Interbank rate (t)	-0,304	0,343	-0,298	0,349	-0,269	0,382
(t-1)	1,290 ***	0,001	1,229 ***	0,001	1,238 ***	0,001
(t-2)	-0,014	0,909	-0,078	0,535	-0,015	0,923
(t-3)	1,253 ***	0,000	1,226 ***	0,000	1,174 ***	0,000
Δ Gross Domestic Product (t)	80,436 ***	0,004	73,872 ***	0,007	28,824	0,318
(t-1)	-120,534 ***	0,003	-108,405 ***	0,007	-69,581 **	0,045
(t-2)	8,243	0,773	21,697	0,442	8,376	0,818
(t-3)	-77,699 **	0,016	-80,796 **	0,019	-60,325 **	0,039
Δ Current Account (t)	0,000	0,619	0,000	0,608	0,000	0,748
(t-1)	0,000	0,426	0,000	0,128	0,000 **	0,049
(t-2)	0,000	0,775	0,000	0,692	0,000	0,553
(t-3)	0,000	0,527	0,000	0,151	0,000 *	0,075
Reserve Requirements						
Foreign Currency (t)	0,033	0,454	0,024 **	0,563	0,018	0,665
(t-1)	0,081 *	0,088	0,072	0,123	0,063	0,198
(t-2)	-0,056	0,208	-0,056	0,184	-0,063	0,144
(t-3)	-0,026	0,433	-0,022	0,472	-0,029	0,347
Bank controls						
Capital Ratio (t)	-0,083	0,109	-0,100 *	0,065	-0,118 **	0,044
(t-1)	0,156 ***	0,006	0,159 ***	0,005	0,170 ***	0,002
(t-2)	-0,036	0,500	-0,020 **	0,699	-0,019	0,729
(t-3)	0,126 **	0,030	0,130 **	0,026	0,121 **	0,039
Liquidity ratio (t)	0,033	0,119	0,031	0,143	0,031	0,147
(t-1)	0,015	0,107	0,014 *	0,099	0,011	0,225
(t-2)	-0,006	0,641	-0,004 ***	0,743	-0,003	0,820
(t-3)	-0,035 **	0,046	-0,035 **	0,046	-0,035 **	0,041
Log (Total assets) (t)	-3,504 ***	0,007	-3,383 ***	0,007	-3,091 ***	0,008
(t-1)	0,292	0,717	0,295	0,639	0,221	0,696
(t-2)	0,374	0,647	0,480 **	0,529	0,436	0,548
(t-3)	2,317	0,115	2,313 *	0,088	2,098	0,112
PdDollar	-0,489	0,447			1,686	0,147
PdDollar (t-1)			-1,016 **	0,051	-2,362 ***	0,004
PdDollar (t-2)					0,785 *	0,098
PdDollar (t-3)					-1,130 *	0,085
Constant	2,964	0,576	0,808	0,869	1,389	0,783

Table A9

Regression results for mortgage dollarisation rate

Joint significance test

	Contemporaneous Effect		First Lag Effect		Contemporaneous and Lagged Effects	
	Coef.	P-value	Coef.	P-value	Coef.	P-value
Macroeconomic controls						
Δ Exchange rate	5.885	0.112	7.530 **	0.023	6.172 **	0.031
Δ Interbank rate	-0.304 ***	0.009	-0.298 **	0.011	-0.269 **	0.014
Δ Gross Domestic Product	80.436	0.107	73.872	0.160	28.824	0.179
Δ Current Account	0.000	0.261	0.000 *	0.090	0.000 **	0.039
Reserve Requirements						
Foreign Currency	0.033	0.741	0.024	0.848	0.018	0.914
Bank controls						
Capital Ratio	-0.083	0.234	-0.100	0.215	-0.118	0.246
Liquidity ratio	0.033	0.619	0.031	0.601	0.031	0.718
Log (Total assets)	-3.504	0.233	-3.383	0.425	-3.091	0.382
Conditional Reserve Requirements	-0.489	0.447	-1.016 *	0.051	-1.022 *	0.077
Constant	2.964	0.576	0.808	0.869	1.389	0.783

Table A10

Regression results for mortgage dollarisation rate
(controlling for the proportion of dollarised mortgages)

	Coefficient	Standard Deviation	t-statistic	P-value
Macro Controls				
Δ GDP (t-1)	-31.18	22.85	-1.36	0.20
Δ Current Account (t-1)	0.00	0.00	2.03	0.07
Δ Interbank Rate (t-1)	0.87	0.33	2.62	0.03
Δ Exchange Rate (t-1)	7.96	4.39	1.81	0.10
Δ Reserve Requirements in Foregin Currency (t-1)	0.08	0.03	2.59	0.03
Bank Controls				
log Assets (t-1)	-0.82	0.40	-2.02	0.07
Capital Ratio (t-1)	0.60	0.26	2.27	0.05
Liquidity Ratio (t-1)	-0.02	0.01	-1.52	0.16
Macro Prudential Tool				
MP	1.65	1.08	1.52	0.16
MP (t-1)	-0.62	0.74	-0.84	0.42
MP (t-2)	1.63	0.58	2.83	0.02
MP (t-3)	-1.55	0.56	-2.79	0.02
MP*Loan Structure	-0.04	0.07	-0.55	0.60
MP*Loan Structure (t-1)	-0.15	0.05	-3.28	0.01
MP*Loan Structure (t-2)	0.02	0.03	0.64	0.54
MP*Loan Structure (t-3)	0.05	0.04	1.22	0.25
Constant	-1.11	4.88	-0.23	0.83
Bank Fixed Effects				Yes
Seasonal Effects				No
Observations				451
Number of Banks				11

Table A11

Regression results for mortgage non-performing loan rate

	Contemporaneous Effect		First Lag Effect		Contemporaneous and Lagged Effects	
	Coef.	P-value	Coef.	P-value	Coef.	P-value
Macroeconomic controls						
Δ Exchange rate (t)	-0,557	0,769	-2,108	0,514	-4,880 **	0,016
(t-1)	0,889	0,726	-1,214	0,547	-3,310 *	0,070
(t-2)	-16,152	0,252	-18,366	0,384	-36,929 **	0,024
(t-2)	-9,886 *	0,085	-3,989	0,448	-11,343 **	0,038
Δ Interbank rate (t)	0,330	0,300	0,330	0,435	0,852 **	0,017
(t-1)	-0,196	0,611	0,269	0,243	0,025	0,876
(t-2)	-0,272	0,439	0,154	0,350	-0,287	0,205
(t-3)	0,402	0,133	0,405	0,330	0,818 **	0,036
Δ Gross Domestic Product (t)	100,559 **	0,046	60,643	0,384	191,909 **	0,043
(t-1)	-84,464 **	0,046	-55,132	0,381	-195,840 **	0,049
(t-2)	15,452	0,447	-13,543	0,417	29,578	0,189
(t-3)	-68,776 **	0,032	-48,379	0,314	-132,325 **	0,041
Δ Current Account (t)	0,000	0,192	0,000	0,450	0,001 **	0,034
(t-1)	0,000	0,696	0,000	0,311	0,000	0,682
(t-2)	0,000	0,216	0,000	0,244	0,000	0,155
(t-3)	0,000	0,107	0,000	0,432	-0,001 **	0,028
Reserve Requirements						
Foreign Currency (t)	0,031	0,444	-0,014 **	0,081	0,038	0,361
(t-1)	0,061 **	0,050	0,037	0,282	0,072 *	0,053
(t-2)	0,008	0,582	0,009	0,348	0,010	0,562
(t-3)	0,016	0,359	0,005	0,556	0,024	0,428
Bank controls						
Capital Ratio (t)	0,005	0,522	0,005	0,575	0,005	0,523
(t-1)	0,005	0,379	-0,002	0,762	0,005	0,378
(t-2)	0,007	0,466	0,015 **	0,053	0,007	0,466
(t-3)	0,007	0,230	-0,010 **	0,043	0,007	0,230
Liquidity ratio (t)	-0,003	0,252	-0,001	0,390	-0,003	0,250
(t-1)	-0,002	0,500	-0,001	0,712	-0,002	0,500
(t-2)	0,006 **	0,069	0,007 ***	0,004	0,006 *	0,069
(t-3)	0,000	0,881	-0,004	0,126	0,000	0,883
Log (Total assets) (t)	0,321	0,225	0,141	0,418	0,320	0,225
(t-1)	0,104	0,517	0,158	0,381	0,104	0,516
(t-2)	-0,213	0,135	-0,397 **	0,016	-0,213	0,135
(t-3)	-0,214	0,231	0,096	0,489	-0,214	0,232
PdDollar	0,927 *	0,058			1,948 *	0,081
PdDollar (t-1)			0,591	0,390	omitted	
PdDollar (t-2)					-1,214 *	0,099
PdDollar (t-3)					0,685	0,218
Constant	-0,261	0,780	0,419	0,397	0,495	0,633

Table A12

Regression results for mortgage non-performing loan rate
Joint significance test

	Contemporaneous Effect		First Lag Effect		Contemporaneous and Lagged Effects	
	Coef.	P-value	Coef.	P-value	Coef.	P-value
Macroeconomic controls						
Δ Exchange rate	-0.557	0.172	-2.108	0.172	-4.880 **	0.023
Δ Interbank rate	0.330	0.812	0.330	0.812	0.852 **	0.020
Δ Gross Domestic Product	100.559	0.291	60.643	0.291	191.909 **	0.032
Δ Current Account	0.000	0.211	0.000	0.211	0.001	0.125
Reserve Requirements						
Foreign Currency	0.031	0.206	-0.014	0.206	0.038	0.216
Bank controls						
Capital Ratio	0.005 **	0.017	0.005 **	0.017	0.005 **	0.017
Liquidity ratio	-0.003	0.528	-0.001	0.528	-0.003	0.524
Log (Total assets)	0.321	0.980	0.141	0.980	0.320	0.977
Conditional Reserve Requirements	0.927 *	0.058	0.591	0.390	1.419 **	0.022
Constant	-0.261	0.780	0.419	0.397	0.495	0.633

Table A13

Regression results for mortgage non-performing loan rate
(controlling for the proportion of dollarised mortgages)

	Coefficient	Standard Deviation	t-statistic	P-value
Macro Controls				
Δ GDP (t-1)	-3.47	0.72	-4.79	0.00
Δ Current Account (t-1)	0.00	0.00	-3.69	0.00
Δ Interbank Rate (t-1)	0.05	0.03	1.83	0.10
Δ Exchange Rate (t-1)	1.47	0.61	2.43	0.04
Δ Reserve Requirements in Foregin Currency (t-1)	0.00	0.00	-0.39	0.71
Bank Controls				
log Assets (t-1)	-0.02	0.01	-1.40	0.19
Capital Ratio (t-1)	-0.01	0.01	-0.81	0.44
Liquidity Ratio (t-1)	0.00	0.00	0.38	0.71
Macro Prudential Tool				
MP	-0.14	0.10	-1.43	0.18
MP (t-1)	0.78	0.28	2.76	0.02
MP (t-2)	-1.37	0.56	-2.45	0.03
MP*Loan Structure	0.00	0.01	0.70	0.50
MP*Loan Structure (t-1)	-0.06	0.02	-2.91	0.02
MP*Loan Structure (t-2)	0.12	0.04	3.29	0.01
Constant	0.31	0.17	1.80	0.10
Debtor Fixed Effects				Yes
Seasonal Effects				No
Observations				1379207
Number of debtors				135465

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