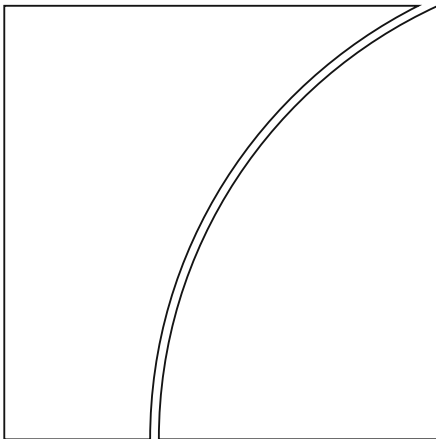BANK FOR INTERNATIONAL SETTLEMENTS

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by José Bustamante, Walter Cuba and Rafael Nivin

Monetary and Economic Department

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# Determinants of Credit Growth and the Bank Lending Channel in Peru: A Loan Level Analysis[*]

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July 15, 2019

## Abstract

This paper uses loan-level data from Peru's credit registry to determine how the role of bank-specific characteristics (i.e. bank size, liquidity, capitalization, funding, revenue, and profitability) may affect the supply of credit in domestic and foreign currency. Also, we analyze how these characteristics affect the banks' response to monetary policy shocks. Finally, we assess how the link between bank-specific characteristics and credit supply is affected by global financial conditions and commodity price changes. Our results show that well-capitalized, high-liquidity, low-risk, more profitable banks tend to grant more credit, especially in domestic currency. Moreover, we found evidence that reserve requirements both in domestic and foreign currency are effective in curbing domestic credit in Peru, giving support to the BCRP's active use of RRs as a macroprudential tool to smooth out the credit cycle. Last, we found that banks with more diversified funding sources are less affected after a negative commodity price change.

**JEL**: E44, G21, G32, L25

**Keywords**: Credit Channel, Monetary Policy, and Credit Registry Data

# 1 Introduction

There is a growing body of literature on how banking activity changed after the global financial crisis (GFC). For instance, Gambacorta and Marques-Ibanez (2011) and Roengpitya et al. (2017) find that banks' business model and market funding patterns changed after the GFC, and as consequence the bank lending channel of monetary policy has been affected. Additionally, the originate-and-distribute banking model was affected when the securitization market froze and the role of banks as broker-dealers changed after adjustments in regulation. Therefore, the GFC had a considerable impact on banks' activity, in particular, how banks are funded, grant credit and respond to monetary policy shocks.

Several studies have highlighted that banking sector can expose the economy to systematically important risks through either excessive credit creation or asset bubbles during credit boom episodes, or excessive cut back in credit during slumps (Bernanke and Blinder, 1988, 1992; Bernanke and Gertler, 1995; Kashyap and Stein, 1997; Holmstrom and Tirole, 1997; Stein, 1998). As a consequence, there has been an increasing literature about testing empirically the effect of supply-side factors on bank credit using credit register data containing information on every business loan given out by the banking sector.

Due to data availability issues, these studies focus mostly on advanced economies (Ehrmann et al., 2001; Jimenez et al., 2012; Juurikkala et al., 2011). In the case of emerging markets such as Peru, the lack of appropriate data makes the analysis more challenging (some exceptions are Alfaro et al. (2005), Rocabado and Gutiérrez (2010), Gómez-González and Grosz (2007), Carrera (2011) and Bernardo et al. (2017)). In this paper we focus on Peruvian's banking system as we overcome the data problems using a unique confidential loan-level data-set containing the characteristics of the borrowing firms and those of the lending banks.

Among emerging economies, Peru is an interesting case of study due to its particular characteristics: (i) unlike advanced economies, Peruvian banks' non-interest income is low and deposits

remain the main source of funding loans; (ii) a still high level of credit dollarization,[1] and (iii) foreign shocks are key determinants of macroeconomic fluctuations.

This paper focuses on the role of bank-specific characteristics in the supply of credit, making a distinction between domestic currency (soles) and foreign currency (dollars), and especially how these characteristics affect the bank's lending channel of monetary policy and the transmission of external shocks. In this regard, the use of detailed credit register data allows a proper identification of both credit supply and demand shifts. The analysis is complemented with detailed firm- and bank-level data, in particular data on individual banks' funding.

To achieve this goal we use an empirical specification based on Khwaja and Mian (2008), Mian (2012), Jimenez et al. (2012) and Gambacorta and Marques-Ibanez (2011). We study how changes in banks' characteristics (i.e. bank size, liquidity, capitalization, funding, revenue, and profitability) may affect the supply of credit. We also analyze how these characteristics affect banks' response to monetary policy shocks, i.e., monetary policy rate changes and reserve requirement adjustments. Finally, we analyze how the link between bank-specific characteristics and the supply of credit is affected by global financial conditions and commodity price shocks.

Using this methodology we found that well-capitalized, high-liquidity, low-risk, more profitable banks tend to grant more credit, particularly in the domestic currency. Moreover, we found that larger banks (in terms of assets) and high-liquidity banks tend to weaken the monetary policy transmission channel. Summing up those results, the empirical evidence shows that strong balance sheets lead to a lower reduction in the loan supply in Peru in the face of monetary tightening. Moreover, the results show that reserve requirements both in domestic and foreign currency are effective in curbing domestic credit in Peru, thereby providing support to the BCRP's active use of reserve requirements as a macroprudential tool to smooth the credit cycle. Finally, we found that the impact of negative commodity price change on bank lending in domestic currency is smaller for banks with additional funding sources.

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[1]Although unconventional monetary policy was implemented to reduce it and mitigate its effects

It is important to highlight which characteristics are more relevant for the transmission of monetary policy shocks and for building resilience against external shocks, so that policy makers can monitor how these factors change over time and anticipate any imbalance or vulnerability which requires a promptly use of policy actions to prevent those vulnerabilities from causing a financial crisis.

The remainder of this paper is organized as follows: Section 2 presents a description of the data data, Section 3 explain the methodology used, Section 4 presents the results for domestic currency credit, Section 5 presents the results for foreign currency lending and Section 6 concludes.

## 2  Data

In this study we use two datasets from Peru's banking supervision agency (Superintendence of Banking and Insurance, SBS). The first one is credit registry data (CRD), which contains information about all the commercial loans from banks to firms between January 2005 and December 2017 on a quarterly basis. This dataset is confidential and is filled in by all regulated financial institutions that grant loans. It contains individual firms' debt outstanding in the financial system, disaggregated by bank (for instance, we can identify the amount of debt outstanding of firm ABC with "bank A", "bank B" and "bank C").

The second dataset is bank's balance sheets and income statements between January 2005 and December 2017 on a monthly basis. This information is provided by each bank to the Central Bank of Peru (BCRP).

Regarding the CRD, we obtain information of the firms that have at least one obligation in the financial system. The dependent variables is the total amount of debt that a firm has in one specific bank. This information was combined with the characteristics of the bank holding the

debt. In the sample we use information from 12 banks for which there is information throughout the study period. On average, each debtor has a debt with 3 financial institutions and 12 as maximum. Likewise, the amount of debt is 2 millions soles on average and 39 million soles as maximum.

Regarding banks' balance sheet and income statements, we calculate several indicators for each bank. We classify the bank-specific characteristics into five categories:

1. **Banks' lending channel standard indicators**: size (median of logarithm of total assets), liquidity ratio (current assets divided by total assets), and bank capital ratio (median of equity divided by total assets).

2. **Risk profile**: risk measures (non-performing loans) and indicator for a bank's securitization activity (if the bank has been involved in the securitization business over the last two years).

3. **Revenue mix**: diversification ratio (percentage of non-credit income relative to total income), and trading activity ratio (percentage of the investment available for sale relative to total assets).

4. **Stable sources of funding**: share of deposits over total liabilities, and long-term funding.

5. **Additional sources of funding**: wholesale funding and and funding in foreign currency (i.e., dollar funding) over total funding.

6. **Profitability and Efficiency**: Return on equity (ROE), efficiency ratio (operative expenses divided by the total amount of the financial margin plus financial services), number of employees and branches to total assets.

Table 1: **Descriptive Statistics**

This table shows the summary statistics for the variables we use in the regression analysis. the statistics are computed over all firm-bank matches and years. *Size* is the median of logarithm of total assets. *Liquidity ratio* is current assets divided by total assets. *Bank Capital ratio* is the median of equity divided by total assets. *Securitization activity* is an indicator taking a value of 1 if the bank has been involved in the securitization business over the last two years. *Diversification ratio* is the percentage of non-credit income relative to the total income. *trading activity ratio* is the percentage of investment available for sale relative to the total assets. *efficiency ratio* is measured as operative expenses divided by the financial margin plus financial services.

| Variables | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|
| **Main indicators** | | | | |
| Size | 10,4 | 1,0 | 5,5 | 11,7 |
| Liquidity ratio | 69,8 | 25,0 | 32,0 | 957,7 |
| Bank capital ratio | 13,7 | 1,5 | 10,0 | 45,5 |
| **Risk profile** | | | | |
| Non-performing loans | 3,6 | 2,1 | 0,0 | 38,5 |
| Securitization activity | 0,8 | 0,4 | 0,0 | 1,0 |
| **Revenue mix** | | | | |
| Diversification ratio | 40,0 | 10,4 | 2,2 | 143,9 |
| Trading income over total income | 9,1 | 4,6 | -1,5 | 76,1 |
| **Stable sources of funding** | | | | |
| Deposits over liabilites | 72,7 | 6,0 | 46,5 | 96,0 |
| Long-term funding | 57,0 | 8,8 | 8,1 | 93,5 |
| **Sources of funding** | | | | |
| Wholesale funding | 7,4 | 3,0 | 0,0 | 30,5 |
| Foreign currency funding | 12,1 | 4,7 | 0,0 | 50,2 |
| **Profitability and efficiency** | | | | |
| Efficiency ratio | 3,7 | 2,1 | 1,1 | 21,1 |
| Employees to total assets | 22,6 | 16,9 | 1,5 | 190,7 |
| Branches to total assets | 0,8 | 0,6 | 0,0 | 6,9 |

There is a potential limitation in our estimation associated with the proper identification of monetary policy over credit supply, since changes in monetary conditions may impact both loan supply and demand. For example, in the case of a monetary tightening, supply may contract because banks' agency costs may increase, but demand may also fall because firms' net worth is reduced and the cost of financing is higher. This implies that an analysis based only on macro or bank-level data may suffer from an omitted-variables problem. In order to overcome this limitation, we use detailed credit register data which allows proper identification of credit supply and demand shifts. We use a sample with with multiple banking relationships (MBR) firms because it allows better control for loan demand shifts in order to properly identify credit supply movements (Mian, 2012).

## 3 Methodology

The empirical specification is based on Jimenez et al. (2012) and Gambacorta and Marques-Ibanez (2011). We study the relationship between bank-specific characteristics (capitalization, liquidity, size, etc) and the supply of credit using three different specifications. Based in these specifications, we assess (i) the effect of these bank-specific characteristics on the supply of credit; (ii) the role of bank-specific characteristics in strengthening or weakening the monetary policy transmission channel using both the policy rate and reserve requirements; and (iii) the role of banks' characteristics to shelter from global external shocks (in particular, commodity prices).

We estimate four equations using a sample MBR firms. These firms have loans in more than one bank in the Peruvian banking system. Additionally, this sample is matched with associated bank information.

## 3.1 Relationships between bank-specific characteristics and the growth of credit supply

The first question we seek to answer is how certain bank-specific characteristics affect the supply of credit. We address this question using the following equation, which is our baseline model:

$$\Delta Loan_{fbt} = \beta X_{b,t-4} + \alpha_b + firm \times time + \varepsilon_{fbt} \tag{1}$$

Where the dependent variable $\Delta Loan_{fbt}$ represents the logarithm change of outstanding loans by bank b to firm f at time t. $X_{b,t-4}$ is a vector of bank-specific characteristics; $\alpha_b$ corresponds to time invariant bank fixed effects; $firm \times time$ is the time variant firm fixed effect; and $\varepsilon_{fbt}$ is the error term. We estimate these equations using a sample of MBR firms.

## 3.2 Bank Lending Channel

There are several channels though which monetary policy can affect the economy. In particular, the bank lending channel suggests that banks play a special role in the transmission of monetary policy. Changes in the monetary policy rate can affect banks' funding costs differently, depending on bank's ability to manage funding resources, which may include the level of capital, liquidity, bank size, and external funding, among others. This channel is particularly relevant in bad times such as a financial crisis, when funding sources are scarcer.

Therefore, to test the bank lending channel, we seek to answer how monetary shocks affect the supply of credit and determine the role that bank-specific characteristics play in strengthening or softening the monetary policy transmission channel. In order to do so, we extend the model using the following equation:

$$\Delta Loan_{fbt} = \beta X_{b,t-4} + \sum_{j=0}^{4} \delta_j (\Delta W_{t-j} \times X_{b,t-4}) + \alpha_b + firm \times time + \varepsilon_{fbt} \tag{2}$$

In this specification, $\Delta W_t = \{\Delta i_t, \Delta rr_t\}$, where $\Delta i_t$ is the quarterly change in the monetary policy rate and $\Delta rr_t$ is the quarterly change in the reserve requirements rate. We also include

the explanatory variables with lags up to the fourth one to capture persistence in the effect of the explanatory variables.

## 3.3 Impact of Global Factors

Finally, we evaluate the impact of external conditions (global factors) on the way banks supply credit. This means that we assess how the bank-specific characteristics shield banks from a group of global factors/external shocks. The model can be written in the following way:

$$\Delta Loan_{fbt} = \beta X_{b,t-4} + \delta(C_t X_{b,t-4}) + \alpha_b + firm \times time + \varepsilon_{fbt} \tag{3}$$

Where $C_t$ corresponds to a global variable that characterizing external conditions. In particular, we consider the effect of commodity prices (measured by a metal price index) since, as explained in the literature for the Peruvian economy, commodity prices shocks are one of the main drivers of Peru's business cycle (Rodríguez et al., 2018; Castillo and Rojas, 2014).

## 4 Results for domestic currency lending

### 4.1 Relationships between bank-specific characteristics and credit growth

Table 2 presents the estimation results based in equation 1, which is used to assess the effect of certain bank-specific characteristics on credit supply. We estimate coefficients, their standard errors, and significance level. This regression is based on national currency variables and we use the 4th lags for the regressors to avoid endogeneity issues.

Table 2: **Effect of bank lending characteristics on credit growth**

This table shows the estimation results for equation (1). ***, **, and * indicate significance at the 1, 5, and 10% level, respectively. The dependent variable ($\Delta Loan_{f,b,t}$) is the log difference between t-1 and t of the total loans outstanding in domestic currency for each firm-bank pair. Includes firm time-variant fixed effects and bank-level time-invariant fixed effects.

|  | Coef. | Std. Err. |  |
|---|---|---|---|
| Total asset index (t-4) | 0,02368 | 0,00798 | *** |
| Capital ratio (t-4) | 0,00429 | 0,00241 | ** |
| Liquidity ratio (t-4) | 0,00329 | 0,00131 | *** |
| NPL/total loans (t-4) | 0,00554 | 0,00225 | *** |
| Diversification ratio (t-4) | -0,00177 | 0,00069 | *** |
| Deposit/total liabilities (t-4) | 0,00025 | 0,00083 |  |
| Funding in foreign currency (t-4) | 0,00426 | 0,00091 | *** |
| Return to equity (t-4) | 0,00457 | 0,00109 | *** |
| Employees to total assets (t-4) | -0,00166 | 0,00054 | *** |
| Observations |  | 1494853 |  |
| Number of banks |  | 12 |  |
| Number of firms |  | 44945 |  |
| R-squared |  | 0,39 |  |

Most theoretical models suggest that the effect on bank lending from standard indicators such as size (total assets index), liquidity ratio (cash and securities over total assets), and bank capital ratio (equity-to-total assets) should be positive. So, this means that large (in terms of assets), well-capitalized, and highly-liquid banks should grant more credit in normal times (Gambacorta and Marques-Ibanez, 2011). Our results in Table 2 show that the effects of liquidity and capital are positive and statistically significant in line with the literature.

Regarding measures of bank risk, the NPL coefficient (as a share of total loans) is positive and statistically significant. This result is consistent with the literature on the effects of bank risk

on the loan supply (Altunbas et al., 2010) and could be understood as risk-taking behavior from banks to remain profitable.

Regarding the indicators for funding composition, the coefficient of the share of funding in foreign currency is positive and significant, which is consistent with the intuition that banks having easy access to foreign funding makes them increase their bank lending operations in both domestic and foreign currency. This effect is of particular interest because in our sample there is a period when the BCRP designed a program to induce credit de-dollarization whereby banks holding dollar loans could access BCRP liquidity in domestic currency to exchange loans from dollars into domestic currency. In this way, banks with important sources of funding in foreign currency could access to FX repo operations to obtain domestic currency funding to increase lending in domestic currency.

With respect to profitability indicators measured by ROE, there is a positive and significant effect of profitability on credit growth, while the number of employees to total assets has a negative and significant effect on credit growth. Overall, these results signal that more profitable and efficient banks tend to grant more credit. Finally, the diversification ratio (non-interest income to total income) and the share of trading income have a negative effect on credit growth, consistent with the fact that banks that are engaged in a non-traditional bank business model grant less loans.

## 4.2 Bank lending channel for interest rate

Table 3 shows the coefficients and the standard errors of the interaction between bank-specific characteristics and policy rate changes, calculated to measure the bank lending channel of monetary policy. We estimate the interactions resulting from the monetary stance (with up to the fourth lag) and the bank-specific characteristics used in the previous section.

## Table 3: Bank lending channel for interest rate

This table shows the estimation results for equation (1). ***, **, and * indicate significance at the 1, 5, and 10% level, respectively. The dependent variable ($\Delta Loan_{f,b,t}$) is the log difference between t-1 and t of the total loans outstanding in domestic currency for each firm-bank pair. $\Delta i_t$ is the quarterly change in the monetary policy rate. Includes firms' time-variant fixed effects and bank-level time-invariant fixed effects.

| | | Coef. | Std. Err. | |
|---|---|---|---|---|
| Total asset index (t-4) | | 0,02284 | 0,00829 | *** |
| Liquidity ratio (t-4) | | 0,00261 | 0,00142 | *** |
| NPL/total loans (t-4) | | 0,00715 | 0,00262 | *** |
| Funding in foreign currency (t-4) | | 0,00433 | 0,00103 | *** |
| Return on equity (t-4) | | 0,00554 | 0,00128 | *** |
| Employers to total assets (t-4) | | -0,00175 | 0,00061 | *** |
| Total asset index (t-4) $\times$ | $\Delta i_t$ | -0,03350 | 0,01596 | *** |
| | $\Delta i_{t-1}$ | 0,03567 | 0,01611 | *** |
| Capital ratio (t-4) $\times$ | $\Delta i_t$ | 0,01729 | 0,00638 | *** |
| | $\Delta i_{t-2}$ | -0,01465 | 0,00767 | *** |
| | $\Delta i_{t-3}$ | 0,01796 | 0,00708 | *** |
| Liquidity ratio (t-4) $\times$ | $\Delta i_{t-1}$ | -0,00696 | 0,00339 | *** |
| NPL/total loans (t-4) $\times$ | $\Delta i_t$ | -0,01319 | 0,00552 | *** |
| | $\Delta i_{t-4}$ | -0,01601 | 0,00622 | *** |
| Diversification ratio (t-4) $\times$ | $\Delta i_t$ | -0,00274 | 0,00091 | *** |
| | $\Delta i_{t-4}$ | -0,00481 | 0,00112 | *** |
| Deposit/total liabilities (t-4) $\times$ | $\Delta i_{t-2}$ | -0,00370 | 0,00172 | *** |
| Funding in foreign currency (t-4) $\times$ | $\Delta i_{t-3}$ | -0,00243 | 0,00147 | *** |
| Return on equity (t-4) $\times$ | $\Delta i_t$ | 0,00788 | 0,00202 | *** |
| | $\Delta i_{t-4}$ | 0,00460 | 0,00199 | *** |
| Employees to total assets (t-4) $\times$ | $\Delta i_{t-4}$ | -0,00174 | 0,00086 | *** |
| Observations | | 1411475 | | |
| Number of banks | | 12 | | |
| Number of firms | | 44945 | | |
| R-squared | | 0,39 | | |

The results show that larger (in terms of assets), more capitalized and more profitable banks mitigate the monetary transmission channel through bank lending. These findings are consistent with the literature on the bank lending channel (Altunbas et al., 2012; Kishan and Opiela, 2000). However, there is a counter-intuitive result regarding the interaction between the changes in the policy rate and liquidity. The results show that more liquid banks reinforce the effect of monetary policy changes. In connection with this finding, Lucchetta (2007) suggests that, since the policy rate is translated into the economy through interbank markets, a tightening of monetary policy rises the interbank market rate, thereby inducing banks with excess liquidity to lend to banks needing funds to make loans. Therefore, an increase in the policy rate can results in higher loans for banks with low liquidity. We also find that banks with riskier loans, measured by the NPL share, are less able to insulate their loan supply from monetary policy changes. This results is consistent with the literature (Altunbas et al., 2012).

Additionally, we find that banks with a higher share of non-interest income to total income are more affected by changes in the monetary policy rate. Regarding the interaction between funding composition indicators and the change in the monetary policy rate, the results show that banks with higher funding in foreign currency over total funding reinforces changes in policy rate. Finally, more efficient banks (lower number of employees to total assets) are better insulated against changes in the policy rate.

As a results, in general terms, these findings show that, in Peru, strong balance sheets lead to a lower reduction in the loan supply in the face of a monetary tightening (an increase in the monetary policy rate).

## 4.3 Bank Lending and reserve requirements (RRs)

Regarding the effect of an increase in domestic currency RRs, Table 4 shows that more capitalized, profitable and efficient banks can mitigate the effects from increasing RRs on credit growth. Additionally, if banks have access to funding in foreign currency, they can reduce the

effect of an RR increase on lending. Moreover, banks involved in other activities besides lending find it more difficult to soften the effect on lending after an RR increase. Finally, we found an oddly result that banks with riskier loans are able to insulate their lending after an RR increase.

Table 4: Bank lending channel for reserve requirement

This table shows the estimation results for equation (1). ***, **, and * indicate significance at the 1, 5, and 10% level, respectively. The dependent variable ($\Delta Loan_{f,b,t}$) is the log difference between t-1 and t of the total loans outstanding in domestic currency for each firm-bank pair. $\Delta rr_t$ is quarterly change in RRs. Includes firm time-variant fixed effects and bank-level time-invariant fixed effects.

|  |  | Coef. | Std. Err. |  |
|---|---|---|---|---|
| Total asset index (t-4) |  | 0,02110 | 0,00834 | *** |
| Capital ratio (t-4) |  | 0,00540 | 0,00261 | *** |
| Liquidity ratio (t-4) |  | 0,00268 | 0,00149 | ** |
| Diversification ratio (t-4) |  | -0,00168 | 0,00075 | *** |
| Funding in foreign currency (t-4) |  | 0,00336 | 0,00103 | *** |
| Return on equity (t-4) |  | 0,00359 | 0,00130 | *** |
| Employers to total assets (t-4) |  | -0,00148 | 0,00058 | *** |
| Capital ratio (t-4) × | $\Delta rr_{t-1}$ | 0,00689 | 0,00353 | ** |
| Liquidity ratio (t-4) × | $\Delta rr_{t-3}$ | -0,00370 | 0,00164 | *** |
|  | $\Delta rr_{t-4}$ | 0,00236 | 0,00127 | ** |
| NPL/total loans (t-4) × | $\Delta rr_{t-3}$ | 0,01030 | 0,00429 | *** |
|  | $\Delta rr_{t-4}$ | -0,00963 | 0,00329 | *** |
| Diversification ratio (t-4) × | $\Delta rr_{t-1}$ | -0,00194 | 0,00065 | *** |
| Deposit/total liabilities (t-4) × | $\Delta rr_t$ | 0,00170 | 0,00090 | ** |
| Funding in foreign currency (t-4) × | $\Delta rr_{t-1}$ | 0,00226 | 0,00099 | *** |
|  | $\Delta rr_{t-2}$ | -0,00176 | 0,00098 | ** |
| Return on equity (t-4) × | $\Delta rr_{t-1}$ | 0,00460 | 0,00116 | *** |
| Employers to total assets (t-4) × | $\Delta rr_{t-2}$ | -0,00101 | 0,00048 | *** |
| Observations |  | 1411475 |  |  |
| Number of banks |  | 12 |  |  |
| Number of firms |  | 44945 |  |  |
| R-squared |  | 0,39 |  |  |

## 4.4 Interaction between bank-specific characteristics and global factors

Table 5 presents the results of the interaction between bank-specific characteristics and global factors/conditions, and considering that Peru is characterized as a small open commodity-exporting economy, we highlight the effects of changes in commodity prices on bank lending. This external shock is relevant because Peru's main exports revenues come from commodities (especially, copper and gold); and the mining industry is one of the main drivers of economic activity.

The only significant interaction between banks' characteristics and changes in commodity prices are funding in foreign currency and efficiency. First, we found that funding in foreign currency mitigates the effect of a negative commodity shock on bank lending, which can signal that whenever there is a negative commodity shock (interpreted as a negative income shock on the Peruvian economy), the resulting slowdown may potentially reduce bank lending. However banks with additional funding sources can be less affected by commodity shocks. With respect to the efficiency indicator, we find that for less efficient banks the effect of a negative commodity shock on bank lending is stronger.

## Table 5: External conditions (commodities) and bank lending

This table shows the estimation results for equation (1). ***, **, and * indicate significance at the 1, 5, and 10% level, respectively. The dependent variable ($\Delta Loan_{f,b,t}$) is the log difference between $t-1$ and $t$ of total loans outstanding in domestic currency for each firm-bank pair. $\Delta pc$ is the quartely change in the commodity price index. Includes firm time-variant fixed effects and bank-level time-invariant fixed effects.

|  |  | Coef. | Std. Err. |  |
|---|---|---|---|---|
| Total asset index (t-4) |  | 0,02447 | 0,00834 | *** |
| Capital ratio (t-4) |  | 0,00266 | 0,00250 |  |
| Liquidity ratio (t-4) |  | 0,00362 | 0,00141 | *** |
| NPL/total loans (t-4) |  | 0,00386 | 0,00282 |  |
| Diversification ratio (t-4) |  | -0,00200 | 0,00073 | *** |
| Deposit/total liabilities (t-4) |  | 0,00033 | 0,00092 |  |
| Funding in foreign currency (t-4) |  | 0,00453 | 0,00100 | *** |
| Return on equity (t-4) |  | 0,00414 | 0,00120 | *** |
| Employers to total assets (t-4) |  | -0,00097 | 0,00060 |  |
| Total asset index (t-4) $\times$ | $\Delta pc$ | -0,00043 | 0,00034 |  |
| Capital ratio (t-4) $\times$ | $\Delta pc$ | 0,00017 | 0,00014 |  |
| Liquidity ratio (t-4) $\times$ | $\Delta pc$ | -0,00011 | 0,00008 |  |
| NPL/total loans (t-4) $\times$ | $\Delta pc$ | 0,00009 | 0,00008 |  |
| Diversification ratio (t-4) $\times$ | $\Delta pc$ | 0,00000 | 0,00002 |  |
| Deposit/total liabilities (t-4) $\times$ | $\Delta pc$ | 0,00005 | 0,00003 |  |
| Funding in foreign currency (t-4) $\times$ | $\Delta pc$ | -0,00007 | 0,00003 | *** |
| Return on equity (t-4) $\times$ | $\Delta pc$ | -0,00001 | 0,00004 |  |
| Employees to total assets (t-4) $\times$ | $\Delta pc$ | -0,00005 | 0,00001 | *** |
| Observations |  | 1411475 |  |  |
| Number of banks |  | 12 |  |  |
| Number of firms |  | 44945 |  |  |
| R-squared |  | 0,39 |  |  |

# 5    Results for foreign currency lending

Since partial financial dollarization is an important feature of Peru's economy, we also need to take into consideration the dynamics of foreign currency credit and how bank lending in foreign currency responds to banks' characteristics. Therefore, in this section we present the previous analysis but considering now the credit growth in foreign currency as the dependent variable. In order to implement this approach we need to introduce a few changes. For instance, as capital variable we use an indicator equal to 1 if the level of capital is above the median and zero if it is below. We made this change because it improves the fit in the base equation, which seems to suggest that, when analyzing foreign currency, the funds that can be raised by banks depends more on the relative position of the bank in terms of its capital level instead of its capital ratio [2]. Aditionally, as monetary policy variable we use the Fed fund shadow rate calculated by Wu and Xia (2016) and as the reserve requirement variable we use the RRs in foreign currency set by the BCRP.

## 5.1    Bank-specific characteristics and foreign currency lending

In the baseline model showed in Table 6, it is worth noticing that total assets and the liquidity ratio does not affect the credit supply. Instead, as mentioned above, it seems that the only variable relevant for these loans is the capital index. Additionally, with respect to the NPL ratio, the sign is the same as for domestic currency, but the size of the coefficient is much larger in foreign currency. This is because foreign currency loans carry not only credit risk but also currency mismatch risks (while loans on domestic currency are not affected) and therefore riskier banks are involved in this business.

The diversification ratio has a positive sign unlike the model in domestic currency. This happens because some banks used to grant foreign currency loans along with other services, such as hedging against exchange rate fluctuations. These additional services were important in 2015

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[2]Also, After 1998 banking crisis banks have kept solvency ratios well above the mandatory level as precautionary motive

when the domestic currency depreciated against the dollar by about 15%.

The fact that funding in foreign currency is not as significant as for domestic currency loans is associated with the de-dollarization process (since 2013) as a result of which most funding in foreign currency ended up financing the domestic currency loans through BCRP's special REPO facilities. In addition, the return on equity is still relevant in this specification, but the size of the coefficient is smaller than that for domestic currency loans.

Table 6: Effect of bank lending characteristics on credit growth in dollars

This table shows the estimation results for equation (1). ***, **, and * indicate significance at the 1, 5, and 10% level, respectively. The dependent variable ($\Delta Loan_{f,b,t}$) is the log difference between $t-1$ and $t$ of the total loans outstanding in foreign currency for each firm-bank pair. The capital ratio index is an indicator equal to 1 if the level of capital is above the median and zero if it is below. Includes firm time-variant fixed effects and bank-level time-invariant fixed effects.

|                                   | Coef.    | Std. Err. |     |
|-----------------------------------|----------|-----------|-----|
| Total asset index (t-4)           | -0,00441 | 0,00720   |     |
| Capital ratio index (t-4)         | 0,01351  | 0,00431   | *** |
| Liquidity ratio (t-4)             | -0,00046 | 0,00132   |     |
| NPL/total loans (t-4)             | 0,00815  | 0,00172   | *** |
| Diversification ratio (t-4)       | 0,00160  | 0,00057   | *** |
| Deposit/total liabilities (t-4)   | 0,00222  | 0,00068   | *** |
| Funding in foreign currency (t-4) | 0,00099  | 0,00079   |     |
| Return on equity (t-4)            | 0,00389  | 0,00095   | *** |
| Employers to total assets (t-4)   | 0,00003  | 0,00044   |     |
| Observations                      |          | 1094204   |     |
| Number of banks                   |          | 12        |     |
| Number of firms                   |          | 35593     |     |
| R-squared                         |          | 0,393     |     |

## 5.2 Effect of US monetary policy on foreign currency lending

This section documents the impact of US monetary policy on domestic bank lending, in line with Miranda-Agrippino and Rey (2015). However, we show some evidence that US monetary policy also impact domestic credit conditions. In order to do that, We measure the effect of US monetary policy changes on growth rate of loans in foreign currency, using the shadow rate from Wu and Xia (2016) as the monetary policy rate. The results from Table 7 show that, similar to the equation in domestic currency, bigger banks weaken the spillover from US monetary policy, although is not the case with the liquidity indicator. This is because banks have kept a high ratio of foreign currency liquidity since the beginning of the 2000 and without making any significant change during most of the sample period.

Having a higher share of liabilities in the form of deposits reduces the effects of US monetary policy on domestic lending in foreign currency because still an important share of these deposits comes from households' savings denominated in dollars. These agents does not have a strong reaction to changes in foreign monetary policy, and instead they react more to income shocks. This also shows the role of dollarization of deposits to stabilize foreign funding shocks (Dalgic, 2018).

The diversification ratio and funding in foreign currency reinforces the negative effect of US monetary policy on credit growth in foreign currency, but these effects are of small magnitude. Since foreign institutions provide the additional funding in foreign currency (not coming from foreign currency deposits) and most banks have pre-approved credit lines with these institutions, then after an expansionary US monetary policy, banks would have plenty of funding available to make loans in foreign currency.

Table 7: Effects of US monetary policy on credit growth in foreign currency

This table shows the estimation results for equation (1). \*\*\*, \*\*, and \* indicate significance at the 1, 5, and 10% level, respectively. The dependent variable ($\Delta Loan_{f,b,t}$) is the log difference between $t-1$ and $t$ of the total loans outstanding in foreign currency for each firm-bank pair. $\Delta i_t^*$ is the quarterly change in the Fed funds shadow rate calculated by Wu and Xia (2016). The capital ratio index is an indicator equal to 1 if the level of capital is above the median and "0" if it is below. Includes firm time-variant fixed effects and bank-level time-invariant fixed effects.

| | | | Coef. | Std. Err. | |
|---|---|---|---|---|---|
| Capital ratio index (t-4) | | | 0,01201 | 0,00493 | \*\*\* |
| NPL/total loans (t-4) | | | 0,01103 | 0,00390 | \*\*\* |
| Diversification ratio (t-4) | | | 0,00147 | 0,00066 | \*\*\* |
| Deposit/total liabilities (t-4) | | | 0,00215 | 0,00080 | \*\*\* |
| Return on equity (t-4) | | | 0,00438 | 0,00121 | \*\*\* |
| Employers to total assets (t-4) | | | -0,00178 | 0,00073 | \*\*\* |
| Total asset index (t-4) | $\times$ | $\Delta i_{t-2}^*$ | 0,04487 | 0,02542 | \*\* |
| Diversification ratio (t-4) | $\times$ | $\Delta i_{t-3}^*$ | -0,00305 | 0,00137 | \*\*\* |
| | | $\Delta i_{t-4}^*$ | 0,00182 | 0,00093 | \*\* |
| Deposit/total liabilities (t-4) | $\times$ | $\Delta i_{t-2}^*$ | 0,00717 | 0,00332 | \*\*\* |
| | | $\Delta i_{t-3}^*$ | -0,01118 | 0,00299 | \*\*\* |
| | | $\Delta i_{t-4}^*$ | 0,00605 | 0,00173 | \*\*\* |
| Funding in foreign currency (t-4) | $\times$ | $\Delta i_{t-3}^*$ | -0,00515 | 0,00271 | \*\* |
| | | $\Delta i_{t-4}^*$ | 0,00279 | 0,00162 | \*\* |
| Employers to total assets (t-4) | $\times$ | $\Delta i_{t-1}^*$ | 0,00241 | 0,00130 | \*\* |
| | | $\Delta i_{t-3}^*$ | -0,00488 | 0,00144 | \*\*\* |
| | | $\Delta i_{t-4}^*$ | 0,00299 | 0,00083 | \*\*\* |
| Observations | | | 1094204 | | |
| Number of banks | | | 12 | | |
| Number of firms | | | 35593 | | |
| R-squared | | | 0,393 | | |

## 5.3 Effects of FX reserve requirement on foreign currency lending

Table 8 shows how the interaction between bank-specific characteristics and RRs in foreign currency affect credit growth in foreign currency. Neither the assets, capital nor liquidity are able to mitigate the effects of FX RRs. Instead, banks' assets have a negative sign, meaning that banks with more assets would reinforce the effect of the reserves requirement. This happens because bigger banks have more liabilities that are subject to the reserve regulation, so that if the requirement is raised, the bigger banks would have to store more cash that the rest. This finding is interesting since comparing with credit in domestic currency where some of the characteristics that make banks to cushion lending from RR increases, those characteristics cannot soften the effect of reserve requirements in foreign currency on dollar credit growth. Therefore, RR in foreign currency are effective in curbing bank lending, in line with other studies for the Peruvian economy (Armas et al., 2014; Pérez-Forero and Vega, 2014).

The interaction with the NPL ratio has a negative sign, which is also consistent with Altunbas et al. (2010), who explain that this variable is related to "market discipline", which affects banks' capacity to issue riskier uninsured funds. The interaction with the deposits-to-liabilities ratio has also a negative sign, since deposits are a liability that is directly affected by RRs.

In the case of the interaction with the employees-to-total assets ratio, the effect is negative. Since this variable is a market indicator, this results shows that the more inefficient banks would find it more difficult to issue more loans in the case of a RR increase.

## Table 8: Effect of reserve requirement in dollars on foreign currency lending

This table shows the estimation results for equation (1). ***, **, and * indicate significance at the 1, 5, and 10% level, respectively. The dependent variable ($\Delta Loan_{f,b,t}$) is the log difference between $t-1$ and $t$ of the total loans outstanding in foreign currency for each firm-bank pair. $\Delta rr_t$ is the quarterly change in reserve requirements inf foreign currency. The capital ratio index is an indicator equal to 1 if the level of capital is above the median and zero if it is below. Includes firm time-variant fixed effects and bank-level time-invariant fixed effects.

|  |  | Coef. | Std. Err. |  |
|---|---|---|---|---|
| Capital ratio index (t-4) |  | 0,01006 | 0,00459 | *** |
| NPL/total loans (t-4) |  | 0,00647 | 0,00182 | *** |
| Diversification ratio (t-4) |  | 0,00141 | 0,00062 | *** |
| Deposit/total liabilities (t-4) |  | 0,00267 | 0,00074 | *** |
| Return on equity (t-4) |  | 0,00467 | 0,00112 | *** |
| Total asset index (t-4) $\times$ | $\Delta rr_t$ | -0,00822 | 0,00393 | *** |
|  | $\Delta rr_{t-4}$ | -0,01537 | 0,00376 | *** |
| Capital ratio index (t-4)$\times$ | $\Delta rr_{t-2}$ | -0,00904 | 0,00353 | *** |
| Liquidity ratio (t-4) $\times$ | $\Delta rr_t$ | 0,00140 | 0,00061 | *** |
|  | $\Delta rr_{t-2}$ | -0,00181 | 0,00063 | *** |
|  | $\Delta rr_{t-3}$ | 0,00145 | 0,00074 | ** |
|  | $\Delta rr_{t-4}$ | -0,00153 | 0,00076 | *** |
| NPL/total loans (t-4) $\times$ | $\Delta rr_{t-4}$ | -0,00447 | 0,00216 | *** |
| Deposit/total liabilities (t-4) $\times$ | $\Delta rr_t$ | -0,00184 | 0,00051 | *** |
|  | $\Delta rr_{t-4}$ | -0,00072 | 0,00043 | ** |
| Return on equity (t-4) $\times$ | $\Delta rr_t$ | -0,00252 | 0,00053 | *** |
| Employers to total assets (t-4) $\times$ | $\Delta rr_t$ | -0,00119 | 0,00022 | *** |
|  | $\Delta rr_{t-1}$ | -0,00052 | 0,00023 | *** |
|  | $\Delta rr_{t-3}$ | -0,00051 | 0,00024 | *** |
|  | $\Delta rr_{t-4}$ | -0,00041 | 0,00023 | ** |
| Observations |  | 1094204 |  |  |
| Number of banks |  | 12 |  |  |
| Number of firms |  | 35593 |  |  |
| R-squared |  | 0,393 |  |  |

## 5.4 Interaction between bank-specific characteristics and global factors

Regarding the equation with variables interacting with commodity price variations, only two of them are statistically significant: the liquidity and employees-to-total assets ratios.

The interaction of the variable relating to bank inefficiency has an effect in the same direction as the equation in domestic currency, but the magnitude of the effect is lower. This implies that banks that are more efficient, a market indicator, would reinforce the positive effect of an increase in commodity prices.

On the other hand, the liquidity ratio has a negative effect, which implies that more liquid banks will contain the effect of an increase in commodity prices. The reason is that Peruvian banks have maintained a relatively stable FX liquidity ratio through the last decades (because of regulatory and prudential norms). When metal prices rises and banks are able to grant more credits, the most liquid banks must maintain some funds as liquid assets to keep their liquidity ratio at adequate levels.

## Table 9: External conditions (commodities) and bank lending in foreign currency

This table shows the estimation results for equation (1). ***, **, and * indicate significance at the 1, 5, and 10% level, respectively. The dependent variable ($\Delta Loan_{f,b,t}$) is the log difference between $t-1$ and $t$ of the total loans outstanding in foreign currency for each firm-bank pair. $\Delta pc$ is the quartely change in the commodity price index. The capital ratio index is an indicator equal to 1 if the level of capital is above the median and zero if it is below. Includes firm time-variant fixed effects and bank-level time-invariant fixed effects.

|  | | Coef. | Std. Err. | |
|---|---|---|---|---|
| Total asset index (t-4) | | -0,00380 | 0,00733 | |
| Capital ratio index (t-4) | | 0,00942 | 0,00460 | *** |
| Liquidity ratio (t-4) | | -0,00084 | 0,00136 | |
| NPL/total loans (t-4) | | 0,00931 | 0,00215 | *** |
| Diversification ratio (t-4) | | 0,00158 | 0,00059 | *** |
| Deposit/total liabilities (t-4) | | 0,00191 | 0,00073 | *** |
| Funding in foreign currency (t-4) | | 0,00159 | 0,00083 | ** |
| Return on equity (t-4) | | 0,00463 | 0,00099 | *** |
| Employees per total assets (t-4) | | 0,00060 | 0,00049 | |
| Total asset index (t-4) $\times$ | $\Delta pc$ | 0,00015 | 0,00027 | |
| Capital ratio index (t-4) $\times$ | $\Delta pc$ | 0,00004 | 0,00022 | |
| Liquidity ratio (t-4) $\times$ | $\Delta pc$ | -0,00015 | 0,00006 | *** |
| NPL/total loans (t-4) $\times$ | $\Delta pc$ | -0,00002 | 0,00006 | |
| Diversification ratio (t-4) $\times$ | $\Delta pc$ | -0,00003 | 0,00002 | |
| Deposit/total liabilities (t-4) $\times$ | $\Delta pc$ | 0,00004 | 0,00003 | |
| Funding in foreign currency (t-4) $\times$ | $\Delta pc$ | -0,00003 | 0,00003 | |
| Return on equity (t-4) $\times$ | $\Delta pc$ | -0,00001 | 0,00003 | |
| Employees per total assets (t-4) $\times$ | $\Delta pc$ | -0,00003 | 0,00001 | *** |
| Observations | | 1094204 | | |
| Number of banks | | 12 | | |
| Number of firms | | 35593 | | |
| R-squared | | 0,393 | | |

# 6  Conclusions

Nowadays it is well known that macroeconomic stability is not a sufficient condition to ensure financial stability. The global financial crisis (GFC) in 2008-2009 was proof that the macroeconomic stability achieved in previous years due to low and stable inflation and to low output volatility was insufficient to preserve stability in the financial system. Also, there is a consensus that in order to maintain financial stability, it is necessary to ensure a stable and sound banking system. These basic conditions are needed to maintain an effective the transmission of monetary policy to the rest of the economy.

We evaluate the effect of bank-specific characteristics on the credit supply, the role of bank-specific characteristics in strengthening or softening the monetary policy transmission channel, and the role of these characteristics in sheltering banks from external shocks. Since the Peruvian economy is characterized as a commodity-exporting small open economy with a partially dollarized financial system, we need to take into account these characteristics in our analysis. Therefore, our results are divided by currency, and the main external shock comprises a commodity price shock. Moreover, since Peru's central bank has been active in using reserve requirements as a tool to smooth the credit cycle, we also evaluate how banks characteristics strengthen or soften reserve requirement changes.

For credit in domestic currency, our results show that well-capitalized, high-liquidity, low-risk, more profitable banks tend to grant more credit. Also, we find bigger banks (in terms of assets) and higher bank liquidity weaken the monetary policy transmission channel. This means that strong balance sheets lead to a lower reduction in the loan supply in domestic currency when there is a monetary policy tightening. Moreover, we find that a higher share of funding from foreign sources builds resilience against negative commodity price shocks. Last, we found that well-capitalized, profitable and efficient banks can reduce the effect of an increase in reserve requirements on credit.

For credit in foreign currency, we found that well-capitalized and profitable banks are more inclined to grant more FX loans because banks need to be compensated for risks related to foreign currency lending. Moreover, our results show that bank size matters for softening the spillovers of US monetary policy on domestic lending in foreign currency. We also found some evidence on the role of deposit dollarization to stabilize foreign financial shocks. Interestingly, we found evidence on the effectiveness of FX reserve requirements as a tool to smooth credit growth in foreign currency.

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