

Evaluating the impact of macroprudential policies on credit growth in Colombia

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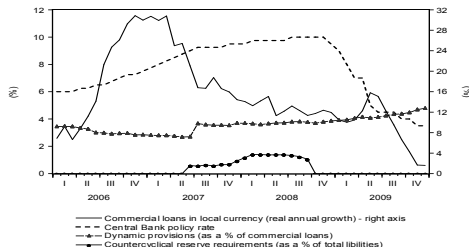
Introduction and Motivation

- During 2006-2009 Colombia's economy presented certain imbalances:
 - i. Excessive capital inflows → current account deficit rose from 1.8% to 3.6% of GDP between the second half of 2006 and the first half of 2007.
 - ii. High credit growth → real credit growth went from 11.8% in December 2005 to 27.3% twelve months later.
 - iii. Robust housing price dynamics.
- In response the Central Bank increased the intervention rate gradually (400 bps between April 2006 and July 2008)...
- ...but transmission was sluggish and there was a limited reaction of credit dynamics.
- In this context, a marginal reserve requirement was implemented → attenuate high loan growth and leverage of private agents.
- In addition, to prevent possible arbitrages and to limit substitution from local to external borrowing, a reserve requirement for short-term external borrowing was reactivated → simultaneously, the Ministry of Finance established a deposit on FX portfolio flows and, a year later, a minimum holding period for FDI was imposed.
- Finally, the Financial Superintendency designed a new system of countercyclical provisions.

Introduction and Motivation

- The conjunction of this policies seems to have been effective...
- ...giving the Central Bank enough space for acting in a countercyclical fashion when the external shock hit in 2008.

Figure: Credit Dynamics, Macroprudential Policies and Central Bank Policy Rate



Source: Superintendencia Financiera de Colombia and Banco de la República; authors' calculations.

Introduction and Motivation

- Though this would point to the effectiveness of the MPP tools in place, it is difficult to discern between the individual impact of each as well as to isolate these from the effects of the global financial crisis.
 - Bottom-line: little is known about the real impact of these tools on the supply of credit and on banks' risk-taking.
 - Yet, the experience of Colombia in the 2006-2009 period is especially rich and unexplored → simultaneous use of tools for increasing resilience and containing build-up of risks.
- i. Dynamic provisions
 - ii. Countercyclical reserve requirements

Related Literature

- There is not a wide literature about the effectiveness of macroprudential policies and their interaction with monetary policy using microdata.
 - Macroprudential policy toolkit is comprised of a variety of tools and targets various objectives, which are difficult to disentangle in practice: this analysis should take in consideration the time and cross-sectional dimensions of systemic risk.
 - Cumulative experience and information required for performing proper evaluations is not particularly rich.
- The state-of-the-art in the evaluation of the impact of macroprudential policies on diverse economic variables of interest can be differentiated depending on the information used:
 - I. Aggregate information at the country level (most of the papers in the literature).
 - II. Bank level data.
 - III. Information at the bank-debtor relationship level or credit registry data.

Related Literature

I. Aggregate country level data

- Bakker et al. (2012): macroprudential policies can reduce the impact of a bust, diminishing the impact on the real economy.
- Bruno et al. (2015), Cerutti et al. (2015) and Akinci & Olmstead-Rumsey (2015): tightening is associated with lower bank credit growth and housing prices.
 - a. Bruno et al. (2015): macroprudential policies are more successful when they complement monetary policy by reinforcing monetary tightening, than when they act in opposite directions.
 - b. Cerutti et al. (2015): the effects appear to be smaller in more financially developed and open economies.
- Tovar et al. (2012) and Agénor & Pereira da Silva (2016): reserve requirements had transitory effects on credit growth and played a complementary role to monetary policy.
- Vargas et al. (2010): in Colombia, reserve requirements are important long-run determinants of business loan interest rates and have been effective in strengthening the pass-through from policy to deposit and lending interest rates.

Related Literature

II. Bank-level data

- Claessens et al. (2013): DTI and LTV ratios seem to be comparatively more effective than capital requirements as tools for containing credit growth. Limits on foreign currency lending are effective in reducing bank leverage during booms.
- Wang & Sun (2013): reserve requirements and housing related policies in China can be useful to reduce procyclicality, but are not enough to reduce systemic risks.
- Aiyar et al. (2014): generation of spill-over effects → banks tend to reduce lending when capital ratios increase, but non-UK regulated banks (resident foreign branches) increased lending in response to tighter capital requirements on regulated banks.

III. Bank-debtor relationship level data or credit registry data

- Jiménez et al. (2016): countercyclical provisions in Spain were successful in reducing the effects of a credit crunch, but they were not as successful in curbing the pre-crisis credit boom.
- Dassatti, Tous & Peydró (2016): reserve requirements for foreign deposits in Uruguay reduced credit supply, more affected banks increased their exposure to riskier firms and larger banks were less affected by this regulation.
- López et al. (2014): countercyclical provisions in Colombia effectively helped reduce the amplitude of credit cycles.
- Basten and Koch (2015): activation of the Basel III countercyclical capital buffers on risk-weighted domestic residential mortgages in Switzerland seems to have had little impact on credit extension, although it had some effect on mortgage pricing.

Data

- Quarterly dataset containing microdata on the loan-by-loan operations of firms in the commercial portfolio of banking institutions between 2006Q1 and 2009Q4.
 - * Commercial loans averaged 61.3% of total loans in the financial system.
 - * Firm's commercial loans with banks represented roughly 72% of the total commercial portfolio.
- Time horizon: the year prior to the adoption of the macroprudential policies to be evaluated as well as the year following their elimination (countercyclical reserve) or last modification (dynamic provisions).

General characteristics of the firms-only sample

Total Observations	1,953,520
Banks	22
Debtors	152,862
Bank-debtor relations	272,306

Source: Superintendencia Financiera de Colombia; authors' calculations.

Data

- Close to 44% of the outstanding debt amount corresponded to short term loans.
- Loans of a larger amount have lower levels of risk materialization and of collateralization.

	Debt amount	# relationships
Maturity < 1 year	44.3%	33.67%
Non-Performing loans	2.11%	10.73%
Collateralized loans	27.17%	28.35%

Source: Superintendencia Financiera de Colombia; authors' calculations.

- The mean amount of loans granted in the sample reached USD197,463 with a median time-to maturity of 1.42 years and an annual interest rate of 21%.

Measure	Debt amount (USD)	Loan rate (%)	Maturity (years)
Central tendency	197,463.25	20.95	1.42
Dispersion	1,648,786	5.56	1.04

Source: Superintendencia Financiera de Colombia; authors' calculations.

Methodology

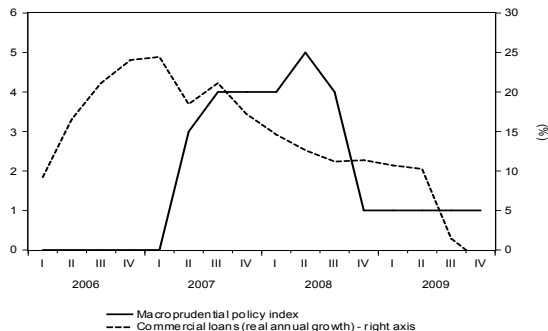
- To estimate the effects of the macroprudential tools on lending a loan-by-loan database is employed, where only credit granted in COP is considered.
- To perform the estimations distinct types of control variables are used: Macroeconomic indicators, banks financial ratios, and bank-debtor relationship characteristics.
- Different equations are estimated to check whether the macroprudential tools' effect on lending varies depending on different conditions, such as the business or financial cycle, the monetary policy stance and banks' and firms' riskiness.
- To perform the estimations a panel methodology using fixed effects is employed.
- Results are further confirmed using a Diff-in-Diff analysis

Methodology - Variables' Description

- The dependent variable is the quarterly growth of the actual value of loans ($\Delta \text{Log Credit}_{br,t}$).
- The specification used for the two macroprudential policies mentioned is: i) the ratio between the total amount of dynamic provisions and total commercial loans ($DP_{br,t}$); and ii) the amount of the countercyclical reserve requirement to total liabilities ratio ($CRR_{br,t}$).
- As the macroprudential tools were active at the same time, an aggregate variable is used to estimate the joint effect of the tools ($MPP\ index_t$). This index captures the aggregate macroprudential policy stance of the country, and is defined as the sum of the individual policies' dummy variables (dummies that take the value of 1 if the policy is in place and 0 otherwise).

Methodology - Variables' Description

Figure: Aggregate Macroprudential Policy Index and Commercial Loans Growth - 2006Q1-2009Q4



Source: Superintendencia Financiera de Colombia and Banco de la República; authors' calculations.

Methodology - Estimating the effects on Credit Growth

A fixed effects panel methodology is implemented, where the two dimensions of the panel are time (t) and the bank-debtor relationship (br). Equation (1) is estimated to assess the effect of the macroprudential tools on lending dynamics.

$$\Delta \text{Log Credit}_{br,t} = \delta_{br} + \sum_{j=1}^2 \beta_j \text{Macro Tool}_{br,t}^j + \sum_{j=1}^5 \text{Macro Controls}_{t-1}^j + \sum_{j=1}^5 \text{Bank Controls}_{br,t-1}^j + \text{quarter}_t + \varepsilon_{br,t} \quad (1)$$

Likewise, to confirm whether the effect of the business cycle over credit growth is altered by the stance of the macroprudential policies, equation (2) is estimated.

$$\Delta \text{Log Credit}_{br,t} = \delta_{br} + \sum_{j=1}^2 \beta_j \text{Macro Tool}_{br,t}^j + \sum_{j=1}^5 \text{Macro Controls}_{t-1}^j + \sum_{j=1}^5 \text{Bank Controls}_{br,t-1}^j + \gamma \Delta \text{MPP index}_t * \Delta \text{Log GDP}_{t-1} + \text{quarter}_t + \varepsilon_{br,t} \quad (2)$$

Methodology - Estimating the effects on Credit Growth

Using equation (3) the intention is to test if a strong stance of the macroprudential policies reinforces the negative impact that increases in the monetary policy rate should have on lending dynamics (credit channel).

$$\Delta \text{Log Credit}_{br,t} = \delta_{br} + \sum_{j=1}^2 \beta_j \text{Macro Tool}_{br,t}^j + \sum_{j=1}^5 \text{Macro Controls}_{t-1}^j + \sum_{j=1}^5 \text{Bank Controls}_{br,t-1}^j + \theta \Delta \text{MPP index}_t * \Delta \text{MP rate}_t + \text{quarter}_t + \varepsilon_{br,t} \quad (3)$$

Equation (4), evaluates if the macroprudential policies affect the selection of debtors depending on their risk profile (i.e. risk-taking channel), and if its effects depend on the financial health of banking institutions.

$$\Delta \text{Log Credit}_{br,t} = \delta_{br} + \sum_{j=1}^2 \beta_j \text{Macro Tool}_{br,t}^j + \sum_{j=1}^5 \text{Macro Controls}_{t-1}^j + \sum_{j=1}^5 \text{Bank Controls}_{br,t-1}^j + \alpha \Delta \text{MPP index}_t * \text{Bank Risk}_{br,t} + \rho \Delta \text{MPP index}_t * \text{Firm Risk}_{br,t} + \text{quarter}_t + \varepsilon_{br,t} \quad (4)$$

Methodology - Estimating the effects on Credit Growth

To complement the previous analysis, equation (1) is re-estimated using the aggregate macroprudential index ($MPP\ index_t$) instead of the individual *Macro Tool* variables ((5)).

$$\begin{aligned} \Delta \text{Log Credit}_{br,t} = & \delta_{br} + \beta \Delta MPP\ index_t + \sum_{j=1}^5 \text{Macro Controls}_{t-1}^j \\ & + \sum_{j=1}^5 \text{Bank Controls}_{br,t-1}^j + \text{quarter}_t + \varepsilon_{br,t} \end{aligned} \quad (5)$$

In this case β represents the marginal effects on credit growth of the macroprudential policy stance, and is expected to have a negative sign.

Results on loan growth

Relevant Exogenous variables	Equations				
	(1)	(2)	(3)	(4)	(5)
$DP_{br,t}$	-0.514***	-0.614***	-0.509***	-0.398***	
$CRR_{br,t}$	-0.668**	-0.642***	-0.731***	-0.649***	
$\Delta MPP\ index_t$					-0.008***
$\Delta MPP\ index_t * \Delta^A GDP_{t-1}$		-0.135***			
$\Delta MPP\ index_t * \Delta^A MP\ rate_t$			-0.083		
$\Delta MPP\ index_t * Firm\ Risk_t$				-0.003**	
$Firm\ Risk_t$				-0.065***	
$\Delta MPP\ index_t * DZ\ score_t$				-0.005***	
$DZ\ score_t$				0.003*	
$\Delta^A Log\ GDP_{t-1}$	0.402**	0.380***	0.474**	0.305***	0.530***
$\Delta^A MP\ rate_t$	-0.517***	-0.426	-0.493***	-0.266*	-0.423***
$EBR_{br,t}$	0.162	0.192	0.090	0.111	
$ORR_{br,t}$	0.083	0.019	0.089	0.057	0.040
<i>Observations</i>	1,614,534	1,614,534	1,614,534	1,614,534	1,614,534
<i>Hausman Test p-value</i>	0.000	0.000	0.000	0.0000	0.000
<i>F Test p-value</i>	0.000	0.000	0.000	0.0000	0.000

Results on loan growth

Results for the different specifications using individual controls (equations (1) - (4)):

- MPP associated with provisions and reserve requirements have a (-) effect on credit growth
→ expected, as both imply an increase in the cost of intermediating funds.

Results using the aggregate measure of macroprudential policy (equation (5)):

- The change in the MPP index, which captures the aggregate stance of prudential policy, also has a (-) sign.

Results on loan growth

Macroeconomic controls have the expected effects as well (equations (2) and (3)):

- Higher growth leads to higher loan growth.
- The policy rate has the expected (-) sign, highlighting the countercyclical nature of monetary policy → complementarity between both types of policies.
- Interaction between MPP index and GDP shows the stabilizing nature of said policies.
- Interaction with the policy rate has the expected (-) sign, though not statistically significant.

Equation (4) provides some interesting results on bank risk-taking:

- Firms and banks with a higher risk profile are associated with lower loan growth.
- When MPP are in place, access to credit of riskier debtors further reduced (risk-taking channel).
- The credit supply of less stable financial institutions is more severely affected (lending channel).

Cross-sectional Analysis

Relevant Exogenous variables	
$DP_{br,t}$	-0.917***
$CRR_{br,t}$	-3.210***
$DP_{br,t} * DummyCapital_{br,t}$	0.245***
$DP_{br,t} * DummySize_{br,t}$	0.264***
$DP_{br,t} * DummyFunding_{br,t}$	0.443***
$CCR_{br,t} * DummyLiquidity_{br,t}$	0.959***
$CCR_{br,t} * DummySize_{br,t}$	-1.031***
$CCR_{br,t} * DummyFunding_{br,t}$	-0.892***
Observations	1,459,331
Hausman Test p-value	0.000
F Test p-value	0.000

* Statistically significant at the 10% level.

** Statistically significant at the 5% level.

*** Statistically significant at the 1% level.

Results on loan growth: Cross-sectional analysis

- Consistent with equations (1) - (5), results confirm the negative effect of the MPP evaluated on loan growth
- The effect of dynamic provisions on loan growth is moderated for banks with:
 - i. Higher levels of capital
 - ii. Larger value of assets
 - iii. More traditional funding

This result seems to suggest that bigger, more capitalized banks could exhibit more prudent behavior in their loan portfolio → would be consistent with a more traditional funding structure.

- The effect of the countercyclical reserve requirement on loan growth is moderated for banks with higher levels of liquidity (expected), but is intensified for those with:
 - i. Larger value of assets
 - ii. More traditional funding

The result for size could be associated with bigger banks holding larger shares of demand deposits, which in turn have higher requirements.

Results on loan growth: Diff-in-Diff Analysis

- A significant effect on credit growth in a specific moment in time could be related to other events happening during the specific period and not necessarily due to the effects of the MPP in place.
- Identification of a causal relationship is clearer using a counter-factual and performing a diff-in-diff analysis (usual in policy evaluation exercises).
- In defining the counter-factual, we used information from a period in which the policies were not yet employed (in particular, one year before)
 - i. We calculated the level of provisions (reserve requirements) that banks would have had if the policies had been implemented the year before.
 - ii. Jimenez et al. (2016) use a similar approach for evaluating the impact of dynamic provisioning in Spain.

Results on loan growth: Cross-sectional analysis

- We estimated the following equation:

$$\begin{aligned} \Delta \text{LogCredit}_{bf}(\text{Impactperiod}) = & \delta_f + \beta \text{Macrotool}(\text{counterfactual})_b \\ & + \text{controls}_{bf} + \varepsilon_{bf} \end{aligned} \quad (6)$$

where $\Delta \text{LogCredit}_{bf}(\text{Impactperiod})$ refers to the change in log of credit from bank b to firm f in the window of time *after* the implementation of each MPP.

- We considered a one-year window after the macroprudential tool was assumed to be in place. δ_f are firm fixed effects and controls_{bf} are the same variables at the bank level that are employed in previous equations.
- β can be interpreted as the additional annual change in credit growth with respect to the reference group (i.e. counter-factual); in other words, β is interpreted as a semi-elasticity (the change in credit growth to the average firm in response to a one unit increase in the macroprudential requirement).

Results on loan growth: Cross-sectional analysis

- Results suggest that an increase of 1 percentage point (pp) in the provisioning to commercial loans ratio (for the period it would be an increase from 3.7% to 4.7% on average) corresponds to a decrease of 0.97 pp in credit growth.
- In the case of the marginal reserve requirement, an increase of 10 basis points (bp) in the reserve requirement to total liabilities ratio (for the period it would be an increase from 0.4% to 0.5% on average) corresponds to a decrease of 80 bp in credit growth.

Concluding Remarks

- Following the Global Financial Crisis of 2007-2008, considerable interest has been centered on the relevance and virtues of MPP as a complement to microprudential and monetary policy.
- Developing countries have been very active in their use → analyzing their experience can shed light on these tools' effectiveness.
- Using a micro dataset containing close to 2 million observations between 2006-2009, this paper analyzes the effect of two distinct MPP tools on credit growth.
- Results show that dynamic provisions and countercyclical reserve requirements had a negative effect on loan growth.

Concluding Remarks

- Macroprudential policies have been used in a countercyclical way with respect to business cycles, thereby helping to reduce the procyclicality of credit.
- Thus, MPP seem to be an effective tool to dampen credit cycles → allowing to reduce systemic vulnerabilities and the build-up of risks.
- MPP seem to influence risk-taking behavior: a tightening of the MPP index is shown to reduce credit access to riskier debtors, and to have a stronger adverse effect on the credit supply of less stable financial institutions.

Annex 1

Variables' Description

Annex 1 - Variables' Description

The control variables are divided in four groups:

- Macroeconomic controls: Real GDP growth ($\Delta \text{Log } GDP_t$), the change in the interbank rate as a proxy of the monetary policy stance ($\Delta \text{MP rate}_t$), the real growth in the exchange rate ($\Delta \text{Log } EX \text{ rate}_t$), and the real growth in the current account deficit ($\Delta \text{Log } CA \text{ deficit}_t$).
- Bank controls: the liquidity ratio ($\text{Bank Liquidity}_{br,t}$), return on assets ($\text{Bank ROA}_{br,t}$), bank size ($\text{Bank Size}_{br,t}$), the deposits to total liabilities ratio ($\text{Bank Fund Composition}_{br,t}$), and an indicator signalling whether a bank is close to the regulatory minimum capital ratio is included ($\text{Bank Signalling}_{br,t}$). Additionally, to measure bank riskiness, a dummy variable that takes the value of 1 if the bank's Z-score indicator is below the quarterly average of the banking system is used ($Zscore_{br,t}$). This indicator is defined as the ratio between the sum of the capital ratio and the mean of the ROA and the standard deviation of the ROA.
- Bank-debtor relationship controls: A dummy variable to distinguish if the loans have an acceptable collateral ($\text{Collateralized Loans}_{br,t}$) and a proxy for debtor riskiness, which is a dummy variable based on the number of days a loan has been past due (Firm Risk_t).