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Bank Lending, Risk Taking, and the Transmission of Monetary Policy: New Evidence for Colombia[1]

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Abstract

We study the existence of a monetary policy transmission mechanism through banks in Colombia, using monthly banks' balance sheet data for the period 1996:4 – 2012:12. We obtain results which are consistent with the basic postulates of the bank lending channel (and the risk-taking channel) literature. The impact of short-term interest rates on the growth rate of loans is negative, indicating that increases in these rates lead to reductions in the growth rate of loans. This impact is stronger for consumer loans than for commercial loans. We find important heterogeneity in the monetary policy transmission across banks depending on banks-specific characteristics.

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1. Introduction

Even though there is an open controversy around the primary role a Central Bank must play in an economy, various arguments point out the importance of giving Central Banks a major role in enhancing macroeconomic and financial stability. In this context, there is an ongoing debate on the instruments Central Banks should use to achieve financial stability targets. From a practical perspective, different Central Banks around the world have used short-term interest rates and reserve requirements for roles different than the achievement

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of price stability (their major role). Particularly, these instruments have been largely used as macro-prudential policy tools.

The Central Bank of Colombia (as well as other Central Banks around the world) has explicitly recognized that these two instruments (namely the policy interest rate and reserve requirements) have been used simultaneously looking for price and financial stability. This is a powerful reason for considering interesting studying the effectiveness of the monetary policy transmission through the financial system in Colombia.

Traditionally, the literature describes two basic financial channels for the transmission of monetary policy to the real economy. The first one is known as the broad credit or balance sheet channel. This channel affects more directly financial borrowers rather than banks. According to it, short-term interest rate increases affect primarily debtors (households and firms) in two basic ways: by increasing their debt financial services and by reducing their collateral. The final result of these effects is reflected in a worsening of the debtor´s creditworthiness, which in turn leads some banks to reduce their willingness to extend credit to borrowers.

The second channel is known as the narrow credit channel or bank lending channel. This transmission mechanism is more directly associated with the behavior of banks. According to it a monetary tightening may have an impact on bank lending if the drop in deposits cannot be completely offset by issuing non-reservable liabilities or liquidating some assets. When a bank faces higher reserve requirements (because the Central Bank increases short-term interest rates or, somehow equivalently, legal reserve requirements) it is not always in the capacity to fulfill those higher requirement. Depending on some bank-specific characteristics, some of them will be able to fulfill the new standards but some others won´t. The latter will be forced to reduce their credit supply, and subsequently this will have an impact on reducing investment an aggregate demand in the economy. This means that when the monetary authority imposes a contractive monetary policy (by increasing the reference interest rate, for example), not all banks will react in the same manner, so the effectiveness in the monetary policy transmission varies depending on bank-specific characteristics.

More recently, various authors have identified additional channels through which monetary policy may have an impact on the economy by its effect on banks' behavior (for instance, see Rajan (2005), Borio and Zhu (2008), and Gambacorta and Marques-Ibañez (2011)). They identify and find evidence of the existence of a new monetary policy transmission channel denominated the risk-taking channel, associated to the deregulation of the financial systems around the world and the development of financial innovations[5]. Banks have

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[5] This is particularly important given the increasing number of innovations (higher participation of banks in capital markets and more intense securitization activity) and changes in banks' business models (higher reliance on more volatile non-interest sources of income and establishment of new business models such as

become more interconnected and dependent of financial markets and subsequently more prone to play a major role determining financial stability. These recent studies recognize that monetary policy is not neutral to financial stability.

The existence of a risk-taking channel is generated by the behavior of banks when their costs of funding remain low for long periods of time. Sustained low short-term interest rates induce financial imbalances as a result of a reduction in banks´ risk aversion and a more intensive search for yield. In such an environment there is a disproportionate increase in the demand for riskier assets with higher expected returns. Additionally, low interest rates induce banks to take more risks through their impact on asset valuations, incomes and cash flows.

Several empirical analyses find evidence of the existence of a risk-taking channel (for instance see Jiménez et al. (2009) and Ioannidou et al. (2009) for the cases of Spain and Bolivia). Tenjo et al (2012) use hazard duration models to show that banks operating in the Colombian banking system take on more risks when the level of interest rates is too low.

In addition, when a bank must appeal to the financial market to get non-reservable resources by issuing bonds or CDs, for example, some of them may face difficulties depending on investors' perceptions regarding its risk profile. This constraint has also been analyzed by authors such as Opiela (2007), Disyatat (2011), Kishan and Opiela (2012), which consider it an additional mechanism of monetary policy transmissions known as the risk-pricing or market discipline channel. This additional channel is related to the risk-taking channel mentioned above.

All these channels share the common feature of being based on the behavior of banks over the financial cycle. In this document, we study the existence of a monetary policy transmission mechanism through banks in Colombia. For this purpose, we test whether changes in monetary policy instruments have a significant effect on banks' lending supply, and whether this effect differs according to several bank-specific characteristics. For this purpose, and following the relevant literature, we include in the analysis variables such as assets size and capitalization.

A better understanding about how monetary policy has differential effects on the real economy depending on the financial system's structure and on bank-specific characteristics is crucial from a policy maker's perspective. It allows financial authorities and policy makers to identify the most important variables to be considered when designing an

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securitization, which implies an important change from the traditional strategy of "originate and hold" to "originate, repackage and sell"). Specifically referring to securitization activity, there is evidence that it has reduced the influence of monetary policy on credit supply. In normal times (when there is no financial distress) this activity makes the bank lending channel less effective, see Loutskina and Straban (2006).

effective monetary policy. Knowing these variables in the context of the financial Colombian system contributes not only to a better understanding of the effectiveness of monetary policy over time, but also to the design and implementation of more proper policies considering the characteristics of the local financial system.

This document is structured in six sections. The first one is this introduction. The second one presents the literature review. The third section presents a theoretical model with testable implications. The fourth section describes the data and methodology used in the empirical analysis. The fifth section presents and discusses our main results, and the last section concludes.

2. Literature Review

As we mentioned in the introduction, the literature on the transmission of monetary policy through banks' balance sheets can be divided in two different but related groups. The first one is comprised by papers identifying and presenting empirical evidence on the bank lending channel. The second and more recent one is comprised by papers identifying and showing evidence of a risk-taking channel. In this section we briefly survey the main documents of these two strands of the literature.

Regarding the first strand, seminal papers such as Becketti and Morris (1992), Bernanke and Blinder (1992), and Friedman and Kuttner (1993), had difficulties in obtaining evidence supporting the existence of a bank lending channel. However, these studies have the limitation of using aggregate data, making difficult to identify the effect of the heterogeneous response of banks to changes in the monetary policy stance, depending on their individual characteristics. Their conclusions may be driven by the behavior of the larger and well capitalized banks, precisely those which are less responsive to monetary policy.

Kishan and Opiela (2000) find strong evidence of the existence of a bank lending channel in the USA. Using a quarterly data set on the balance sheets of more than 13,000 USA banks during the period 1980:1 to 1995:4, they conclude that small and undercapitalized banks are more responsive to contractionary monetary policy because these banks usually are not able to offset a drain in reservable deposits generated by a contractionary policy. Given this constraint, the credit supply of these banks reduces more noticeably compared to that of larger and well capitalized banks.

In the same line, Hannan and Hanweck (1988) argue that a bank´s capital is an indicator of its financial health and, therefore, an indicator of the bank´s ability to raise alternative funds during periods of contractionary policy. Congruent to this argument, Peek and Rosengren

(1996) emphasize on the role of capital constraints in inhibiting the loan growth of New England's banks during moments of expansionary monetary policy.

Kashyap and Stein (1995) analyze the existence of the bank lending channel splitting their sample by banks' assets size. This variable is taken as a proxy measuring information costs, asset diversification, and potential "too big to fail" issues. They find that banks' loans growth is significantly more responsive for banks in the smallest category than for banks in other asset-size categories. Even though they find support of the existence of a bank lending channel, they conclude that the evidence may not be stringent enough to separate loan supply effects from demand-side shocks.

In a related study, Kashyap and Stein (1997) find that banks which hold liquid assets are better able to respond to adverse monetary policy shocks than otherwise identical banks. They also find that the smallest and less liquid banks tend to be more reactive to contractionary monetary policy.

Gómez-González and Grosz (2007) analyze the existence of a bank lending channel for Colombia and Argentina. The authors find evidence of a bank lending channel in these two countries. While in Colombia changes in short-term interest rates affect bank lending both directly and indirectly (through the influence of bank-specific variables), for Argentina they only find evidence of an indirect influence, through the interaction of the policy interest rate with the capitalization and liquidity ratios.

Other studies include additional variables for identifying a bank lending channel. Jayaratne and Morgan (2000) include in their analysis a variable proxying for the degree of dependence of banks' on core deposits, while Opiela (2003) analyzes the role of the absence of full explicit deposit insurance guarantees. In sum, all these empirical studies look for evidence linking the existence of a bank lending channel to banks' balance sheets.

Gunji and Yuan (2010) validate the existence of a bank-lending channel in China. Using balance-sheet data and including two non-conventional variables proxying for profitability (total assets turnover and the ratio of total revenue to total assets) they find evidence that the impact of monetary policy on lending is weaker for larger banks. However, banks´ response to monetary policy does not necessarily vary according to their level of capitalization. Regarding profitability, they find that more profitable banks tend to be less sensitive to tighter monetary policy because these are able to raise alternative funding (besides deposits) more easily.

Some other studies have focused on the differential responses to monetary policy shocks taking into account particular characteristics of banks' portfolios. Some papers argue that commercial and industrial Loans tend to be more reactive to changes in monetary policy given their characteristics of being non-collateralized and of short maturity, which allows banks to make quicker adjustments when changes in the monetary stance are observed.

Although there is not strong evidence supporting this argument, it is worth to say that in most of the cases these type of loans (commercial and industrial) are more important for larger banks.

Ehrmann and Worms (2004), Ashcraft (2006) and Gambacorta (2005) analyze the influence of internal capital markets in bank holding companies concluding that it may also help to isolate exogenous variation in the financial constraints faced by banks' subsidiaries. They show that the loan growth rate of affiliated banks is less sensitive to changes in monetary policy the one of unaffiliated banks. This is because a large holding company can raise external funds more cheaply and downstream funds to its subsidiaries.

Kishan and Opiela (2006) test for the existence of two types of asymmetries in the response given by the banks when there are changes in monetary policy. Testing for the first type of asymmetry, denominated cross-sectional asymmetry, the authors find evidence that small and capital-constrained banks are more reactive to contractionary policy (by reducing their loan supply) relative to larger and unconstrained banks. Testing for the second type of asymmetry, associated to the monetary policy stance (contractionary or expansionary) they find evidence that loan supply of capital-constrained banks seems to respond stronger to contractionary policy than to expansionary policy. Additionally, unconstrained banks do not respond to contractionary policy but increase their loan supply during expansionary monetary policy stances.

A second strand of the literature builds on the traditional bank lending channel and includes more specific risk considerations into the analyses of the effects of monetary policy transmission through banks' balance sheets. Several recent empirical analyses find evidence of the existence of a risk-taking channel (see, for instance, Jiménez et al. (2009) and Ioannidou et al. (2009) for the cases of Spain and Bolivia). According to these studies, a "too accommodative" monetary policy may lead banks to take higher risks in their balance sheets, due to the effect that long periods of loose monetary policy may have on banks' risk aversion. Altunbas et al. (2010) find support for the idea of a significant link between monetary policy looseness and the amount of risk taken by banks operating in the European Union and US right before the beginning of the international financial crisis of 2007-2009.

Gambacorta and Márquez-Ibañez, argue that given that the market for bank debt is not free of frictions, and non-reservable banks' liabilities are typically uninsured, a "lemon's premium" has to be paid to investors. The cost of non-reservable funding (such as bonds or certificates of deposit (CDs)) would therefore be higher for banks with low levels of capitalization if they are perceived as riskier by the market. In contrast, if banks are able to issue unlimited amounts of CDs or bonds not subject to reserve requirements, the "bank lending channel" would not be effective.

Kishan and Opiela (2012) argue that those banks perceived as more risky will find it harder to get external funding to overpass constrains imposed by a contractionary monetary policy and subsequently are more exposed to reduce their credit supply. Distayat (2011), in turn argues that the most important way through which monetary policy is transmitted is not by a drop or shift in deposits, but rather through variations in the banks´ health in terms of leverage and assets´ quality as well as in perception of risk. According to his view, a broader access of banks to alternative non-reservable funds instead of smoothing the constraints impose by a tighter monetary policy might indeed exacerbate it when banks rely more heavily on financial markets being more sensitive to their changes.

Summing-up recent findings, Central Banks' actions may have an impact on the attitude of banks towards risk. For this reason, Gambacorta and Marques-Ibañez (2011) highlight the importance of improving and complementing traditional measures and indicators used to characterize bank when analyzing the effectiveness of monetary policy transmission (such as size, capitalization and liquidity ratios, among others). They conclude that banks with weaker core capital positions (using Tier 1 instead of the traditional capitalization ratio), greater dependence on market funding and on higher share of non-interest sources of income, presented stronger reductions of their loan supply during the international financial crisis of 2007-2009.

3. A Motivating Model

In this study we are interested in testing whether there is a bank lending channel (understood in a broad sense; in other words, we consider the risk-taking channel a branch of the bank lending channel) operating through Colombian banks. We base our empirical analysis in a theoretical framework which we present in this section.

Kishan and Opiela (2000) provide evidence of the existence of a bank lending channel of monetary policy in the US from 1980 to 1995. Following Kashyap and Stein (1995), they try to identify the bank lending channel by studying cross sectional differences on the response of bank lending to monetary policy. To do so, they develop a model of a representative bank that has three assets, namely required reserves (RR), loans (LN) and securities (SEC); and three liabilities, namely, demand deposits (DD), large time deposits (TD) and capital (K). For simplicity, the bank does not hold excess reserves, so $RR = \alpha DD$, where $\alpha \in [0,1]$ is determined by the central bank.

DD are assumed to be inversely related to the Fed funds rate: $DD = a_0 - a_1 r_{ff}$, where r_{ff} stands for the monetary policy rate.

There is a continuum of identical banks of mass 1, and hence the analysis can be conducted for a representative bank which is assumed to have market power in the TD market as well as in the LN market. Thus, it can rise TD by increasing its rate (r_{TD}) over the mean rate in

the market ($\overline{r_{TD}}$), and can change loans by moving its loan rate (r_{LN}) with respect to the mean rate in the loan market ($\overline{r_{LN}}$):

(1) $TD = b_0 + b_1(r_{TD} - \overline{r_{TD}})$

(2) $LN = d_0 + d_1(r_{LN} - \overline{r_{LN}})$

Capital markets are assumed to be imperfect. This is introduced by assuming that the interest rate sensitivities of TD and LN respectively $(b_1, d_1) > 0$, depend on bank size and capitalization. Specifically, it is assumed that b_1 depends positively on both bank size and capitalization, following the idea that larger and better capitalized banks will find it easier to raise funds by issuing time deposits. This idea is both congruent to the traditional bank lending channel view and with the risk-taking channel hypothesis. Meanwhile, d_1 depends positively on bank size only, reflecting the idea that larger banks tend to give credit to larger firms which have better access to alternative sources of funding. Thus, larger banks have a demand for LN which is more sensible to changes in the interest rate than that of small banks[6].

(3) $b_1 = b_1\left(\overset{+}{\tilde{A}}, \overset{+}{\tilde{K}}\right)$

(4) $d_1 = d_1\left(\overset{+}{\tilde{A}}\right)$

Securities are held as a buffer-stock against liquidity shocks, and the mean market rates of TD, SEC and LN are assumed to be directly related to the policy interest rate with fixed spreads:

(5) $SEC = c_0 + c_1 DD - RR$

(6) $\overline{r_{TD}} = e_0 + \phi r_{ff}$

(7) $\overline{r_{SEC}} = f_0 + \phi r_{ff}$

(8) $\overline{r_{LN}} = g_0 + \phi r_{ff}$

Banks are assumed to choose LN, TD and SEC to maximize profits,

(9) $Profit = (\overline{r_{LN}} - \Phi)LN + \overline{r_{SEC}}SEC - \overline{r_{DD}}DD - \overline{r_{TD}}TD$

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[6] Kishan and Opiela (2000) assume that while large banks can also attend small firms, their major clients are large firms with access to capital markets.

Subject to the balance sheet constraint $(LN + SEC + RR = DD + TD + K)$ and the equations given above. ΦLN represents loan losses.

The first order conditions of this maximization problem yield the optimal portfolio for the bank (i.e. LN, SEC, TD). Taking derivatives of LN, SEC and TD with respect to the Fed funds rate generates some testable implications. In particular, assuming $c_1 < 1$, the model predicts that an increase in this rate should increase TD, decrease LN, and have an ambiguous effect on SEC (the sign of the partial derivative will depend on the values of the parameters, thus becoming an empirical issue).

(10) $\qquad \frac{\partial LN}{\partial r_{ff}} = -\frac{a_1 d_1 (1 - c_1)}{b_1 + d_1} < 0$

(11) $\qquad \frac{\partial TD}{\partial r_{ff}} = \frac{a_1 b_1 (1 - c_1)}{b_1 + d_1} > 0$

(12) $\qquad \frac{\partial SEC}{\partial r_{ff}} = -a_1 (c_1 - \alpha) \lessgtr 0$

More interesting testable implications, however, derive from the introduction of the dependence of interest rate sensitivities of LN and TD on bank size and capitalization:

(13) $\qquad \frac{\partial \left(\frac{\partial LN}{\partial r_{ff}} \right)}{\partial A} = \frac{\partial \left(\frac{\partial TD}{\partial r_{ff}} \right)}{\partial A} = \frac{a_1 (1 - c_1) \left(b_1 \frac{\partial d_1}{\partial A} - d_1 \frac{\partial b_1}{\partial A} \right)}{(b_1 + d_1)^2} \lessgtr 0$

(14) $\qquad \frac{\partial \left(\frac{\partial LN}{\partial r_{ff}} \right)}{\partial K} = \frac{\partial \left(\frac{\partial TD}{\partial r_{ff}} \right)}{\partial K} = \frac{a_1 d_1 (1 - c_1) \frac{\partial b_1}{\partial K}}{(b_1 + d_1)^2} > 0$

First, the net effect of asset size on the sensitivity of LN to r_{ff} is undetermined and depends on parameter values. This reflects the idea that two factors play an important role for big banks: maybe they may face less asymmetries of information than smaller banks, and therefore they can obtain easier alternative sources of funds (TD) when a contractionary monetary policy reduces DD; but, their clients are also bigger firms which tend to be more sensitive to interest rates, so if big banks increase r_{LN} due to higher costs of funding, they will loose more demand for loans than smaller banks. Similarly, it is unclear the effect of bank size on the sensitivity of TD to the Fed funds rate.

Furthermore, the sensitivity of LN to r_{ff} is lower for better capitalized banks; that is, better capitalized banks experience a lower reduction in loans than less well capitalized banks do. Similarly, better capitalized banks will increase more TD in times of monetary policy tightening.

Thus, capitalization and bank size appear to matter for lending. In Section 5 we test the predictions for bank lending that derive from this model for Colombia.

4. Description of the Data and Empirical Methodology

Our empirical analysis is conducted using a very rich monthly dataset on individual banks´ balance sheet information provided by the financial supervisory authority of Colombia, the Superintendencia Financiera de Colombia, for the period 1996:4 to 2012:12.

Table 1 summarizes the main features of Colombian banks by the end of 2012, segmented into four groups according to size (proxied by total assets) and capitalization (proxied by the ratio of capital to assets).

At December 2012, the total number of banks operating in Colombia was of 23. Along with these banks, other financial intermediaries operate in Colombia's financial system, namely: *Financial Companies*, which are mainly specialized on issuing consumption loans; *Financial Corporations* specialized on investment businesses; and *Financial Cooperatives* which are smaller financial intermediaries specialized on issuing consumption and mortgage loans. Even though most of the financial regulation and supervision is transversal to all financial intermediaries, there are important differences between banks and the rest of financial intermediaries operating in Colombia, such as the legal capital requirements to operate, which is higher for banks, as well as the authorization to issue current accounts which is restricted to banks. Therefore, in this document we use only information on the 23 commercial banks.

Table 1: Characterization of Colombian Banks by Groups

Total number of banks at Dic-2012: 23

Assets Median in 2012: COP $7,82 billions or US Dollars $4,35 millions

Capitalization Ratio Median in 2012: 14%

Characteristic	Group 1: Banks with total assets and capitalization above the median	Group 2: Banks with total assets above the median and capitalization bellow the median	Group 3: Banks with total assets bellow the median and capitalization above the median	Group 4: Banks with total assets and capitalization bellow the median
Market Share (%)				
Total Assets	58,2%	38,5%	2,0%	1,3%
Total Loans	58,8%	37,5%	2,4%	1,4%
Total Securities	72,6%	21,8%	2,9%	2,7%
Total Deposits	57,2%	40,2%	1,3%	1,2%
Main Ratios (%)				
Loans to Assets	68,9%	66,2%	79,4%	77,0%
Average Loans Composition in 2012				
Commercial	62,3%	51,2%	34,6%	34,6%
Consumption	33,5%	32,8%	34,9%	51,0%
Mortgage	3,9%	9,9%	0,1%	14,4%
Microcredit	0,3%	61,0%	30,4%	0,0%
Securities to Assets	9,4%	4,5%	9,9%	14,1%
Capital to Assets (Capitalization Ratio)	16,3%	10,3%	22,8%	8,8%
Deposits to Liabilities	73,3%	74,7%	44,5%	62,2%
Real values at Dic-2012 in billions of COP of Dic-2008				
Total Assets	$ 32,24	$ 12,32	$ 0,846	$ 1,96
Total Loans	$ 22,22	$ 8,15	$ 0,672	$ 1,51
Total Securities	$ 3,04	$ 0,551	$ 0,084	$ 0,276
Total Deposits	$ 19,71	$ 8,12	$ 0,320	$ 1,10
Total Assets of the Banks´ System at Dec-2012	**$ 301,89**			
Total Loans of the Banks´ System at Dec-2012	**$ 206,59**			
Total Securities of the Banks´ System at Dec-2012	**$ 23,27**			
Total Deposits of the Banks´ system at Dec-2012	**$ 193,49**			

Source: Superintendencia Financiera de Colombia. Calculations are done by the authors.

From Table 1, there are some interesting features to be highlighted. First, the Colombian banking system is characterized for being highly concentrated. More than 50% of total assets, loans and deposits are concentrated in the Group 1, compounded by the 5 largest banks operating in Colombia. Additionally, about 75% of securities issued by Colombian banks belong to the same Group.

Second, loans account for the largest share of total assets among all Colombian banks, representing about 70% of total assets. This proportion is larger for smaller banks.

Third, when looking at the composition of the loans portfolio, commercial loans represent the highest share of the total portfolio for larger banks. These types of loans account for more than 50% of total loans in Groups 1 and 2. Consumption loans represent about 30% of

total loans for most of the Colombian banks. However, for the smallest banks, these type of loans represent more than 50% of total loans.

Fourth, mortgage and microcredit loans represent a very low share of total loans for most banks, except for some particular banks specially designed to serve these segments of the market.

Fifth, Colombian banks depend primarily of traditional sources of funding, namely time and demand deposits. These represent more than 50% of total liabilities for most of the banks, proportion which can reach almost 75% in larger banks. Even though securities have increased their importance as a source of funding in recent years, this alternative is still of little importance; by the end of 2012, it represents about 10% of total assets.

Finally, the capital to assets ratio, or capitalization ratio, for most of the Colombian banks is above 10%. Recall the minimum capital requirement established for Colombian banks is of 9%. However, the way of measuring capital and the way of establishing the minimum legal requirement differs from the way suggested by the Basel Accord[7]. Therefore, in this study we use the ratio of capital to total assets as a proxy of the capitalization ratio in order to avoid improper comparisons to results from other studies.

Regarding our empirical approximation, we follow cross-sectional time-series techniques instead of the most commonly used panel data models. In our data the number of cross-sectional units is relatively small, while the number of time periods is relatively large. Moreover, it is expected that the time dimension of the panel grows faster than the cross-sectional dimension. In this context, and contrary to traditional panel data settings, it appears reasonable to specify a common conditional mean function across the units, with heterogeneity taking the form of different variances rather than shifts in the means. The asymptotic theory here is in respect to time going to infinity, while the number of cross-sectional units is fixed.

Another difference with a traditional panel data set is that units in the context of this study are quite large. Therefore, correlations across units become important in the specification, while in a traditional panel data setting these correlations are always assumed to be zero.

Our empirical specification is represented by the following equation:

$$y_{it} = \sum_{j=1}^{6} x_{i,t-j}\beta_j + \sum_{j=1}^{6} x_{2,t-j}I_2' \odot z_{i,t-1}\phi_j + R_{i,t-1}' + u_{it} \quad (15)$$

Where y_{it} represents the growth rate of total loans for bank i at time t, X is a matrix of variables including banks' capitalization and size, and the policy instrument, which is the interbank interest rate denoted by x_{2i}. Z is a matrix of bank specific variables, namely,

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[7] Currently Colombia is intending to adjust to the Basel Accord's recommendations. However, there are still some challenges remaining before such standard can be met.

capitalization and size. R stands for some control variables included in the regressions. I_2' is a 2x1 row vector of ones, and $\odot$ stands for the Hadamard product. The error term, u_{it}, was assumed identically and independently distributed as well as to account for bank specific AR(1) structure.

Another two regressions are considered, namely, one for commercial loans and one for consumption loans.

The estimated empirical specification is:

$$\begin{bmatrix} y_1 \\ \vdots \\ y_m \end{bmatrix} = \begin{bmatrix} x_1^* \\ \vdots \\ x_m^* \end{bmatrix} \delta + \begin{bmatrix} u_1 \\ \vdots \\ u_m \end{bmatrix} \quad (16)$$

Where $1, \dots, m$ are the banks, and X^* are the regressors included in the empirical model. The variance-covariance matrix has the following structure:

$$E(uu') = \begin{bmatrix} \sigma_{11}\Omega_{11} & \cdots & \sigma_{1m}\Omega_{1m} \\ \vdots & \ddots & \vdots \\ \sigma_{m1}\Omega_{m1} & \cdots & \sigma_{mm}\Omega_{mm} \end{bmatrix} \quad (17)$$

As a robustness test, the variance structure of the errors was also specified to account for autocorrelation of order 1 specific to each panel.[8]

5. Results

Table 2 shows results of the estimation of equation 1 by Feasible Generalized Least Squares (FGLS). Results are reported for three different specifications. Model 1 presents results for real growth rate of total loans as the dependent variable, Model 2 for real growth rate of commercial loans, and Model 3 for real growth rate of consumption loans.

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[8] Some studies have used dynamic panel data models to look for evidence of a bank lending channel. However, since the endogenous variable is the growth rate of loans, it is not clear why the growth rate of loans of today depends on its previous realizations. The current period growth rate of loans might depend on past periods realizations through demand side influences, but these should be captured by the bank specific variables.

Table 2: Cross-Sectional Time Series Estimations Results						
VARIABLE	**MODEL**					
	1: Total loans real growth rate		**2: Commercial loans real growth rate**		**3: Consumption loans real growth rate**	
LONG-RUN TIB	-0,152	***	-0,078	***	-0,154	***
	(0,017)		(0,018)		(0,019)	
TARGET MARKET COM	-0,083	***	-0,079	***	-0,408	***
	(0,023)		(0,026)		(0,031)	
GROUP1	5,784	***	11,022	***	0,024	Not significant
	(1,632)		(1,909)		(2,195)	
CORE DEPOSITS	-0,286	***	0,095	**	-0,016	Not significant
	(0,038)		(0,039)		(0,047)	
CONSTANT	85,330	***	65,995	***	115,989	***
	(3,191)		(3,252)		4,542	
INTERACTIONS						
LONG-RUN TIB * SIZE	2,155	**	0,776	Not significant	6,841	***
	(0,898)		(1,049)		(1,199)	
LONG-RUN TIB * CAP	1,080	*	1,594	**	-3,165	***
	(0,596)		(0,718)		(0,741)	
WALD-CHI(24)	**400,04**		**174,00**		**507,19**	
PROB > x²	**0,000**		**0,000**		**0,000**	

***, ** and *; denote significance at the 1%, 5% and 10%, respectively

TIB: Interbank Interest Rate

TARGET MARKET COM: Ratio of commercial loans to total loans

GROUP1: Defined in section 4

CORE DEPOSITS: Time and demand deposits

SIZE: According to total assets

CAP: Ratio of capital to total assets

The findings reported in Table 2 agree with the basic ideas of the bank lending channel. The impact of the short-term interest rate on the growth rate of loans is negative, indicating that increases in the interbank interest rate lead to reductions in the growth rate of loans. This result holds true under the three different specifications of the empirical model. Interestingly, the direct impact of changes in short-term interest rates over loans' growth appears to be considerably stronger for consumer loans (-0.15) than for commercial loans (-0.08).

Another interesting feature is that the impact of changes in interest rates is not the same across banks; large banks are less sensible to these changes, as well as highly capitalized banks. This suggests that these bank specific variables, capitalization and size, affect lending decisions done by banks, and also the ability that they have to obtain alternative sources of funding when a monetary policy shock affects the amount of core deposits in the economy.

Regarding our control variables, we find some interesting results. Particularly, we included a dummy variable taking on the value 1 for the first group of banks (according to the

definition of groups presented in section 4), and obtained a positive and statistically significant coefficient for its parameter in Models 1 and 2. In Model 3 the sign remained positive but it is not significantly different from zero at standard significance levels. This result implies that the group of the largest and better capitalized banks exhibits a lower loan rate growth. This result appears to be consistent with the finding that better capitalized and larger banks are less responsive to monetary policy shocks. Specifically, their loan growth rate varies less along the monetary policy cycle.

Following the recent literature, we include the share of commercial loans on total loans as an explanatory variable, and find in all three models a negative and statistically significant coefficient for the corresponding parameter. This result implies that banks whose loan portfolio is compounded of a higher share of commercial loans tend to exhibit less credit-growth variation over the monetary policy cycle. This result, which is in line with the bank lending channel postulates, may be explained by the fact that generally speaking banks with a higher commercial loan share are those which have more stable relationships with large firms (see Gómez-González and Reyes (2011)).

6. Conclusions

In this document, we study the existence of a monetary policy transmission mechanism through banks in Colombia. For this purpose, we test whether changes in monetary policy instruments have a significant effect on banks' lending supply, and whether this effect is heterogeneous across banks depending on several bank-specific characteristics. We present a theoretical model that has testable implications for identifying the role of banks' balance sheets in the transmission of monetary policy through the financial system.

Given the characteristics of our dataset, we follow cross-sectional time-series estimation techniques and estimate an empirical model which is specified according to our theoretical framework. Following the traditional literature on the bank lending channel, we include in our empirical analysis variables such as assets size and bank capitalization. Furthermore, following the recent literature that has identified a monetary transmission mechanism which derives from the bank lending channel, namely the risk-taking channel, we also include additional control variables such as proxies for the composition of liabilities and the composition of banks' loan portfolio.

We obtain results which are consistent with the basic postulates of the bank lending channel (and the risk-taking channel) literature. The impact of the short-term interest rate on the growth rate of loans is negative, indicating that increases in the interbank interest rate lead to reductions in the growth rate of loans. This result holds true under the three different specifications of the empirical model. Interestingly, the direct impact of changes in short-

term interest rates over loans' growth appears to be considerably stronger for consumer loans than for commercial loans.

We find that the effect of changes in interest rates is not the same across banks; large, well, capitalized banks are less sensible to monetary policy shocks. Bank specific variables, such as capitalization and size, affect banks' lending decisions.

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