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Abstract

This paper tests the impact of the financial structure of banks on the bank lending channel of monetary policy transmission in Colombia. Using a monthly panel of 51 commercial banks for the period 1996:4-2014:8, we find that an increase in the monetary policy interest rate significantly reduces bank loan growth. The magnitude of this effect critically depends on banks' financial structure. Additionally, we identify an asymmetric effect depending on the monetary policy stance. The bank lending channel is stronger in times of monetary contraction than during expansions. We show that this asymmetric behavior is due to the heterogeneous response of banks with different levels of solvency to the monetary policy stance. We discuss the policy implications of our findings.

Keywords: Monetary Policy Transmission, Bank Lending Channel, Bank Financial Structure, Solvency, Heterogeneous Effects, Colombia.

JEL Classification: E5; E52; E59; G21.

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I. Introduction

Three conditions are required for the existence of a bank lending channel (BLC): i) Incomplete and imperfect credit markets; ii) imperfect substitutability between banking credit and other sources of external funding for some firms and households; and, iii) the central bank can affect the supply of bank loans. Under this channel, contractive policies, such as increases in the short-term interest rate, may have an impact on bank lending if the resulting reduction on demand deposits cannot be completely offset by issuing non-reservable liabilities (Bernanke and Blinder, 1992).

Models of the BLC predict that bank-specific characteristics are important in determining the response of loan supply after the occurrence of monetary policy shocks. Empirical studies have identified three most relevant bank characteristics: size, capitalization and liquidity. Using different combinations of these characteristics, several papers have encountered the operation of a bank lending channel in different countries. Some recent examples include, Keks and Sturm (2002), Ehrmann et al. (2003), Gambacorta (2005), Matousek and Sarantis (2009), Fungáčová et al. (2014), García-Posada and Marchetti (2015) and Heryan and Tzeremes (2016).

In this paper, we study this transmission mechanism in Colombia, a middle-income emerging economy sharing similar features with other Latin American economies such as Mexico, Brazil, Peru, Uruguay and Chile. These features include the adoption of an inflation targeting regime in the early 2000s, being a commodity exporter and being a bank-based economy where more than 60% of non-financial firms' external funds are provided by banks.

Available empirical evidence provides substantial support for the view that bank-dependent borrowers are more adversely impacted by a tightening of monetary policy than borrowers with access to financial markets. The evidence also points-out that a BLC can be important in an international context, especially in countries where banks and firms have less direct access to financial markets such as Colombia.

The BLC in Colombia has been insufficiently explored in the literature. Specifically, there are only two studies using bank-level data for this country. Gómez-González and

Grosz (2007) and Reyes et al. (2014) have verified the presence of a BLC of monetary policy transmission using the financial structure of banks as the identification strategy. However, these papers do not consider possible asymmetric effects in the presence of different monetary policy stances.

In this paper, we use a rich dataset comprised of monthly balance-sheet information for over 16 years of all Colombian commercial banks (51 in total) and explore the effect of different sources of heterogeneity (financial, macroeconomic and policy) on the existence and strength of the BLC. We focus in the period comprised between April 1996 and August 2014. The main contribution of the paper is showing that the magnitude of the BLC in Colombia varies depending on the financial structure of individual banks and its interactions with the monetary policy stance.

Our findings point out that an increase in the monetary policy interest rate significantly reduces bank loan growth. However, the magnitude of this effect critically depends on two aspects. First, bank heterogeneity matters. Particularly, the loan supply of better capitalized banks is less sensible to monetary policy shocks. Second, the response of credit supply to shifts in short-term interest rate critically depends on the monetary policy stance. The BLC is stronger in times of monetary contraction than during expansions. Moreover, we show that this asymmetric behavior is due to the heterogeneous response of banks with different levels of solvency to the monetary policy stance.

These findings have significant policy implications. On the one hand, we highlight the importance of bank capitalization in the transmission of monetary policy. Better capitalized banks are more resilient to policy shocks and, hence, they present a more stable loan supply over the business cycle. On the contrary, poorly capitalized banks are significantly affected by changes in short-term interest rates, especially during contractive periods. This implies that the effects of monetary policy contractions are more strongly experienced by firms and households depending on funds supplied by these low-solvency banks. Policies oriented towards macroeconomic stabilization should take this finding into account. This is another reason for which financial supervisors should closely monitor banks' solvency and liquidity, especially during high inflation periods in which central banks tend to increase short-term interest rates.

On the other hand, our results show that central banks must consider both the stage of the business cycle and the composition of banks' balance sheets for formulating monetary policy and assessing its effectiveness. We show that the BLC operates substantially differently during times of monetary contraction than during expansions, and its strength greatly depends on the proper characteristics of banks.

The rest of the paper is organized as follows. In the next section, a literature review is presented. The third section discusses the methodology used. The fourth section presents the empirical results, while the final section concludes the paper with some policy recommendations.

II. Literature Review

The study of the BLC first appeared in the literature at the beginning of the 1990s. Early papers focused in studying the whole financial system without providing a disaggregated analysis. Bernanke and Blinder (1992), the seminal paper in this literature, show that contractive monetary policies in the US between 1961 and 1989 resulted in a reduction in the total supply of credit in the country. Other early papers obtained similar results. However, given the aggregate nature of these studies, their results offered a rather weak and general evidence for the presence of the BLC. Particularly, all these studies were subject to the critique that using aggregate data it may be impossible to separately identify supply and demand responses to monetary policy shocks.

At the beginning of the 2000s interest in the topic grew and a number of studies that used bank heterogeneity as an identification strategy appeared. Kishan and Opiela (2000) evaluated the existence of a BLC in the US using a panel of 13,042 commercial banks with data for the 1980-1995 period. They find strong evidence of the BLC with a differential effect on banks depending on their size and capitalization. In particular, they noted that lower funding capacity due to financial restrictions imposed by a contractive policy causes smaller banks to reduce loans.

Similar approaches have been employed in recent empirical studies. For example, Xiong (2013) finds evidence of a BLC in China during the period 2000-2011, exhibiting asymmetric effects based on the financial structure of individual banks. Small banks, or banks with lower levels of capitalization react more strongly to contractive monetary policies, while larger banks or banks with more capitalization are more responsive when the policy is expansionary. Similarly, Kishan and Opiela (2006) show that expansionary monetary policies fail to encourage banks with lower capitalization, as opposed to the case of contractive policies whose effect is much more evident in small and poorly capitalized banks.

In the studies described before, deposits are the main catalysts behind the operation of this mechanism. However, another strand of this literature has taken a new direction with respect to the theoretical framework behind the BLC. Indeed, Disyatat (2011) argues that monetary policy is transmitted to the market through changes in the required rate of return[1] (RRR), rather than through the amount of deposits. Thus, when faced with contractive monetary policies, banks have a restriction on the side of capital. Those with a lower capital level suffer from a decline in financial health, which discourages investment and, therefore, does not allow banks to maintain the level of credit that they previously had, thus reducing the supply of loans. This argument is consistent with the results in Gambacorta and Márques-Ibañez (2011) who show a deepening of the role of banks' capital as a buffer (or catalyst if the policy is expansionary) regarding the dynamics of the BLC especially during periods of financial crises.

Other recent literature has studied the BLC and its interaction with other features of the financial sector. For example, using data for several emerging markets, Olivero et al. (2011a, 2011 b) find that financial sectors with lower competition levels or higher number of consolidation processes are less responsive to monetary policy shocks via the BLC. Similar results are encountered in Ghossoub and Reed (2015) who study the optimal size distribution of the banking sector as well as the effect of banking concentration on monetary policy transmission. Aiyar et al. (2016) analyze the interaction of monetary and bank capital-requirement policies for the determination of credit supply in the UK. Their

[1] The required rate of return is the minimum acceptable return for an agent (person or firm) to invest their money in a project.

findings imply that while large banks react only to the capital requirement, small banks' credit supply reacts to both policies.

The BLC has also been studied in relation to other monetary transmission channels. For example, Aysun and Hepp (2013) analyze the interaction between the balance-sheet and the bank-lending channels. Similarly, Aysun (2016) use panel data for US banks and borrowers and show that most macroeconomic shocks are transmitted through large banks' lending and borrowers' balance sheets.[2] In addition, Altunbas et al. (2010) report the presence of a second sub-transmission mechanism related to the BLC, known as the risk taking channel. These authors find a relationship between a slow economic activity (e.g. low interest rates) and the risk-taking by banks where expansionary monetary policies generate a decrease in risk aversion as a result of lower requirements stipulated for offering loans. These riskier positions lead to stronger declines in loans during a monetary policy tightening (Kishan and Opiela, 2012). Ramos-Tallada (2015) studies the BLC and its relation with bank financial indicators in Brazil. His results imply that the external finance premium and bank size are key characteristics that determine the strength of the BLC. In addition, this channel is stronger for banks whose security portfolio includes public bonds with higher market risk.

The BLC in Colombia has been insufficiently explored in the literature. There are only two studies on the BLC for Colombia. Gomez-Gonzalez and Grosz (2007) studied the case of Colombia and Argentina, and report evidence favorable only to the first country, with heterogeneous effects on account of capitalization and liquidity of firms. Reyes et al. (2014) confirm the results of this previous paper and find that this channel is stronger for commercial loans than for consumption loans. However, these papers do not consider possible asymmetric effects in the presence of different monetary policy stances.

In this paper, we use a rich dataset comprised of monthly balance-sheet information for over 16 years of all Colombian commercial banks (51 in total) and explore the effect of different sources of heterogeneity (financial, macroeconomic and policy) on the existence and strength of the BLC. We focus in the period comprised between April 1996 and August 2014. The main contribution of the paper is showing that the magnitude of the BLC in

[2] Relations with respect to the risk-taking channel and the cost channel are studied in Ozsuca and Akbostanci (2016) and Chang et al. (2014), respectively.

Colombia varies depending on the financial structure of individual banks and its interactions with the monetary policy stance.

Other contribution consists in taking into account an important development after 2011 that was not considered in previous studies using Colombian data. It consists of a period in which monetary policy was expansionary both in Colombia and in the major developed economies. International liquidity was abundant and the country received large capital inflows. Thus, credit grew rapidly (Amador-Torres et al, 2016) as well as asset prices, especially in the housing sector (Gomez-Gonzalez et al., 2015). The inclusion of this period of rapid loan growth allows us to compare better the operation of the BLC during periods of contractive and expansionary monetary policy.

III. Data and Methodology

For the empirical analysis we use panel data with monthly records for the period 1996:4-2014:8. We use data for the 51 banks participating in the Colombian financial market during the period. This information comes from the Financial Superintendence of Colombia. Table 1 summarizes the main features of banks in Colombia for the different periods of time, reporting the information according to levels of solvency.

The average ratio of bank solvency presented a very high variation over the period of study. While in April 1996 this ratio was of 16% on average, by the end of the 1990s it sharply diminished due to a major financial crisis that occurred in Colombia. By the beginning of 2002 this ratio was merely above the minimum regulatory level (9% on average), and in the early 2000s it began to increase while the financial system recovered from the crisis. In August 2007 the average solvency ratio was of 11.1%, and it continued increasing until reaching a high of 17.0% in August 2014.

Similar to other emerging market economies, the size of the Colombian financial system increased considerably during the period of study, both in terms of assets and liabilities. This expansion has led to an increased bank concentration as shown by Garcia-

Suaza and Gomez-Gonzalez (2010). Importantly, solvent institutions have gained market share.

Table 1 - Descriptive Statistics of the Sample of Banks by Groups According to Levels of Solvency

	April 1996		August 2007		August 2014	
	Solvency Above Average	Solvency Below Average	Solvency Above Average	Solvency Below Average	Solvency Above Average	Solvency Below Average
Bank Composition (%)	**47.06**	**52.94**	**52.94**	**47.06**	**30.43**	**69.57**
Market Participation (%)						
Assets	2.99	2.88	7.01	4.61	2.32	5.23
Liabilities	2.83	3.02	6.86	4.78	2.16	5.33
Total Portafolio	2.88	3.00	7.22	4.38	2.25	5.27
Credit Characteristics (%)						
Total Portafolio/Assets	58.35	66.47	64.72	61.98	71.04	62.67
Commercial Portafolio/Total Portafolio	67.93	63.23	65.90	48.95	50.76	42.47
Consumer Portafolio/Total Portafolio	31.11	27.65	27.43	37.70	18.44	43.99
Financial Indicators (%)						
Capitalization	9.0	5.0	2.0	3.1	18.0	2.5
Solvency	22.0	10.0	13.5	8.2	29.0	12.0
Liquidity	83.0	62.0	32.7	80.2	27.0	50.0
Average Solvency (%)	**16.0**		**11.1**		**17.0**	
Total Market Assets ($ millions)	**27,889.77**		**150,857.32**		**415,430.00**	
Total Market Liabilities ($ millions)	**24,063.98**		**133,106.49**		**355,560.00**	
Total Market Portafolio ($ millions)	**17,576.50**		**95,672.00**		**257,270.00**	
Total Market Commercial Portafolio ($ millions)	**10,192.08**		**57,811.38**		**150,458.00**	
Total Market Consumer Portafolio ($ millions)	**5,294.83**		**28,313.80**		**75,266.10**	

Solvency is measured by the ratio of total equity of the bank to total assets; capitalization is measured by the ratio of social capital of the bank to total assets. Liquidity is the sum of Cash, Accounts Receivable/CDAT's, CDT's, Repos and Interbank loans.

Source: Own calculations based on the Financial Superintendence of Colombia.

In this study we use the Colombian interbank rate (IR) as a proxy of the intervention interest rate (REPO). These two interest rates are highly correlated (90.1% between 1995:4-2014:8), and the IR presents the advantage of more frequent variations (Figure 1).

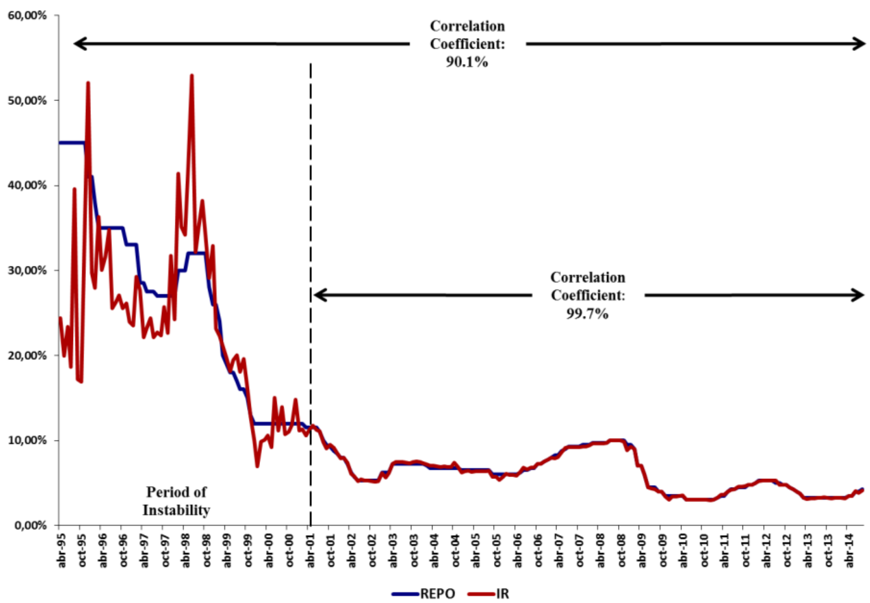
For selecting the periods of contractive and expansionary monetary policy we construct a counterfactual analysis by simulating a Taylor rule and comparing the observed

IR with the resulting interest rate that would have prevailed if the Taylor Rule had been followed. Equation 1 shows our specification according to Taylor (1999):

$$i_t = i^* + 1.5(\pi_t - \pi^*) + 0.5(y_t - y^*) \quad (1)$$

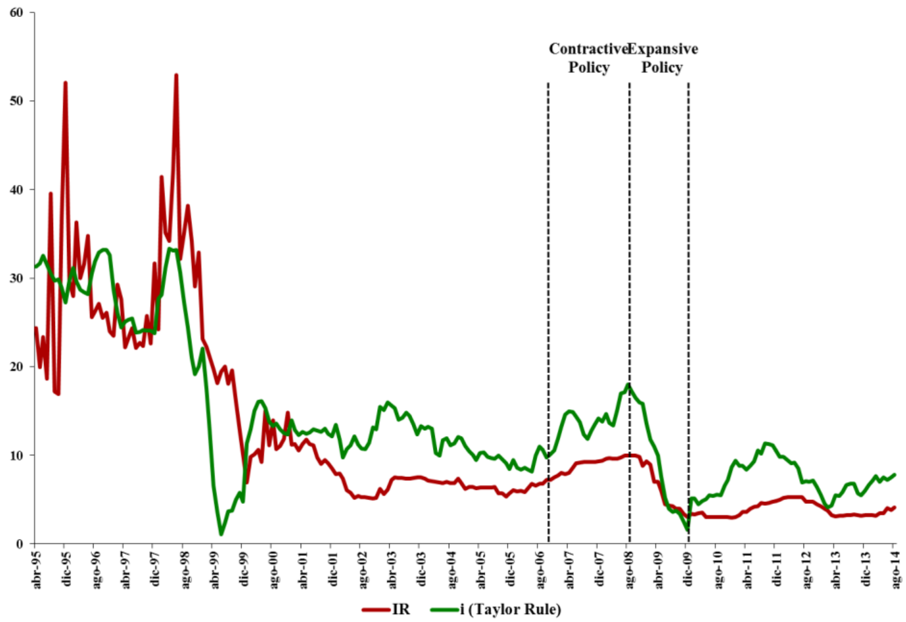
where i_t stands for the nominal interest rate prescribed by the rule, i^* is the natural (nominal) interest rate, $\pi_t - \pi^*$ is the inflation gap, and $y_t - y^*$ represents the output gap. The Hodrick-Prescott filter was used in estimating potential output, y^*. Figure 2 depicts the prescribed interest rate and compares it with the actually observed IR.

Figure 1 – Historical Evolution of the IR vs. REPO



Source: Own calculation based on the Central Bank of Colombia

Figure 2 – Taylor Rule vs. Observed Monetary Policy



Source: Own calculation based on the Central Bank of Colombia, Dane , and *Ultrabursátiles.*

For evaluating the potentially different strength of the bank lending channel during times of monetary policy expansion and contraction, we use information provided by the behavior of these two interest rates (the one prescribed by the rule and IR). Notice that while the prescribed interest rate lies above the IR for almost all of the sample period, both rates tend to co-move closely. Particularly, during some time-periods both of them increase, while during other periods both of them decrease. We use this fact to identify periods of monetary policy expansion and contraction. Periods of monetary policy contraction (expansion) are characterized by moments in which both interest rates increase (decrease). Based on this strategy, we select two different moments of time in which the monetary policy stance can be clearly identified as either expansionary (2008:8-2009:12) or contractive (2006:10-2008:8).

The empirical methodology follows the model formulated by Kishan et al. (2000) and related studies. Concretely, we estimate the following equation by Feasible Generalized Least Squares (FGLS):

$$y_{i,t} = \sum_{j=1}^{6} X_{t-j}\beta_j + \sum_{j=1}^{6} Z_{t-j}\gamma_j + \sum_{j=1}^{6} x_{t-j}\delta_j + \sum_{j=1}^{6} x_{t-j}\, I_2' \odot Z_{i,t-j}\emptyset_j + u_{i,t} \tag{2}$$

where $y_{i,t}$ corresponds to the real growth rate of loans of bank i in month t; x_{t-j} is the interbank interest rate at time $t-j$; $X_{i,t-1}$ is a matrix of macroeconomic variables at time $t-j$, including the real exchange rate and real GDP growth; $Z_{i,t-j}$ is an array of bank specific variables (size and solvency) at time $t-j$; $\odot$ represents the *Hadamard* product; I_2' is a matrix of ones of size 2x1 (i.e. a row of ones); and $u_{i,t}$ corresponds to the residual of the model, for which we assume a AR(1) structure which is specific for each bank.

We do not use a dynamic structure in our panel due to both theoretical and empirical reasons. From a theoretical point of view, there is no reason to justify that the current growth rate of loans depends on its past realizations. From an empirical perspective, our panel consists of a large number of periods and a relatively small number of banks. Concretely, under the general specification the number of periods is larger than the number of banks. It is well known that in this case traditional panel data techniques are not suitable for estimation purposes as coefficients are not consistently estimated. In this case, it is common practice to follow a FGLS estimation, (Beck, 2006).

We perform different panel unit-root tests and verify all variables are covariance stationary. Concretely, we apply the test developed by Im et al (2003), which accounts for heterogeneous panels.

IV. Empirical Results

Table 2 shows empirical results using the full sample. These results confirm the existence of a BLC in the Colombian economy. Accordingly, the coefficient corresponding to the interbank interest is negative and significant. The direct effect of a 100 basis-point (bp) increase in the policy rate is a 45 bp reduction in the growth rate of total loans. An identical result holds for the growth rate of commercial loans.

In order to calculate the total effect of an increase in the policy rate on credit growth it is necessary to consider also the interactions of this rate with bank-specific variables. Notice that the marginal effect of a change in the policy rate on credit growth is given by

$$\frac{\partial y}{\partial x} = \beta_{IR} + \beta_{IR*solv} * Solvency + \beta_{IR*size} * Size \quad (3)$$

Given the values of the estimated parameters the total effect is:

$$\frac{\partial y}{\partial x} = (-0.45) + (0.38) * Solvency$$

Table 2. Results of the General Model (1996:4-2014:8) - Solvency

	Total Credit (# Observations: 5065)		**Commercial Credit** (# Observations: 5037)	
	Coefficient	**Significance**	**Coefficient**	**Significance**
Constant	0.216	***	0.255	***
	(0.038)		*(0.046)*	
Size	-0.167	n.s.	-0.371	n.s.
	(0.465)		*(0.567)*	
Solvency	-0.901	***	-0.841	***
	(0.160)		*(0.193)*	
Control Variables				
IPI	-0.022	n.s.	-0.011	n.s.
	(0.044)		*(0.053)*	
RERI	0.078	n.s.	0.072	n.s.
	(0.069)		*(0.083)*	
Long Term Variables				
TIB	-0.449	***	-0.451	***
	(0.048)		*(0.058)*	
TIB*Size	0.071	n.s.	0.077	n.s.
	(0.069)		*(0.083)*	
TIB*Solvency	0.382	***	0.376	***
	(0.023)		*(0.028)*	

Standard errors in parenthesis

***, ** & * imply significance at 1%, 5% & 10%, respectively

n.s. - Not significant

TIB: Interbank rate

IPI: Industrial Production Index (Proxy of GDP)

RERI: Real Exchange Rate Index

Size: Bank assets as a proportion of the total market assets

Solvency: Equity as a proportion of assets

Table 3 - Results of the General Model (1996:4-2014:8) – Inverse Leverage Ratio

	Total Credit (#. Observations: 5065)		Commercial Credit (#. Observations: 5037)	
	Coefficient	**Significance**	**Coefficient**	**Significance**
Constant	0.195	***	0.208	***
	(0.031)		*(0.040)*	
Size	-0.950	**	-0.880	n.s.
	(0.440)		*(0.567)*	
Capitalization	-1.452	***	-1.004	***
	(0.200)		*(0.251)*	
Control Variables				
IPI	0.030	n.s.	0.041	n.s.
	(0.042)		*(0.051)*	
RERI	-0.061	n.s.	-0.066	n.s.
	(0.066)		*(0.079)*	
Long Term Variables				
TIB	-0.500	***	-0.461	***
	(0.041)		*(0.051)*	
TIB*Size	0.534	***	0.491	***
	(0.069)		*(0.086)*	
TIB*Capitalization	0.763	***	0.703	***
	(0.034)		*(0.042)*	

Standard errors in parenthesis

***, ** & * imply significance at 1%, 5% & 10%, respectively

n.s. - Not significant

TIB: Interbank rate

IPI: Industrial Production Index (Proxy of GDP)

RERI: Real Exchange Rate Index

Size: Bank assets as a proportion of the total market assets

Capitalization: Social capital as a proportion of assets

Hence, there are asymmetric effects of changes in the policy rate on banks’ loan growth rate depending on solvency. This effect is lower for more solvent banks. Particularly, banks with capitalization ratio above 11.8% experience an increase in the growth rate of their loans after the policy rate increases. The BLC operates for banks with capitalization ratios below this threshold level. Notice that the interaction between size and the policy rate is statistically insignificant at conventional levels. Therefore, banks of different sizes do not respond differently to monetary policy shocks. Similar results hold when commercial loans are considered instead of total loans.

Table 4 – Results from selected sample periods - Solvency

	Contractive Policy (2006:10-2008:8)				Expansive Policy (2008:8-2009:12)			
	High Solvency (# Observations: 172)		***Low Solvency*** (# Observations: 207)		***High Solvency*** (# Observations: 128)		***Low Solvency*** (# Observations: 153)	
Long Term Variables	**Coeff**	**Signif**	**Coeff**	**Signif**	**Coeff**	**Signif**	**Coeff**	**Signif**
TIB	-0.132	***	-0.134	***	-0.106	**	-0.032	n.s.
	(0.047)		*(0.038)*		*(0.053)*		*(0.054)*	
TIB*Size	0.008	n.s.	0.156	***	0.009	n.s.	0.133	***
	(0.009)		*(0.025)*		*(0.026)*		*(0.034)*	
TIB*Solvency	-0.045	n.s.	0.308	n.s.	0.606	**	0.225	n.s.
	(0.203)		*(0.273)*		*(0.269)*		*(0.601)*	

Standard errors in parenthesis

***, ** & * imply significance at 1%, 5% & 10%, respectively

n.s. - Not significant

TIB: Interbank rate

Size: Bank assets as a proportion of the total market assets

Solvency: Equity as a % of assets

Results in Table 2 show that the only control that directly affects credit growth is solvency. On average more solvent banks exhibit lower credit growth. Size and macroeconomic controls have no statistically significant effects on bank loan growth.

For robustness purposes, we perform the same estimation reported above but using an inverse leverage ratio instead of the capitalization ratio[3]. Results are qualitatively very similar than those reported above. A BLC exists and bank heterogeneity matters, see Table

[3] It is difficult to compare solvency ratios for countries not covered by the Basel accord with usual benchmarks, because Tier 1 and Tier 2 capital sometimes are measured differently, as well as risk-weighted assets. Thus, we present results using a simple ratio of total equity over total loans (inverse leverage ratio or unweighted capital ratio) to confirm the robustness of our results.

3. The only important difference is that size and its interaction with the policy rate are relevant when the inverse leverage ratio is included.

Table 5 -Results for selected sample periods – Inverse Leverage Ratio

	Contractive Policy (2006:10-2008:8)				Expansive Policy (2008:8-2009:12)			
	High Solvency (# Observ: 172)		***Low Solvency*** (# Observ: 207)		***High Solvency*** (# Observ: 43)		***Low Solvency*** (# Observ: 238)	
	Coeff	**Signif**	**Coeff**	**Signif**	**Coeff**	**Signif**	**Coeff**	**Signif**
Long Term Variables								
TIB	-1.3216	***	-1.3403	***	-0.4557	n.s.	0.3862	n.s.
	(0.4672)		*(0.3825)*		*(0.9956)*		*(0.3329)*	
TIB*Size	0.077	n.s.	1.564	***	0.549	n.s.	0.296	*
	(0.089)		*(0.255)*		*(1.453)*		*(0.173)*	
TIB*Solvency	-0.045	n.s.	0.308	n.s.	0.192	n.s.	-0.124	n.s.
	(0.203)		*(0.273)*		*(0.413)*		*(0.310)*	

Standard errors in parenthesis

***, ** & * imply significance at 1%, 5% & 10%, respectively

n.s. - Not significant

TIB: Interbank rate

Size: Bank assets as a proportion of the total market assets

Solvency: Equity as a proportion of assets

We test for possible asymmetric effects of the BLC during times of monetary policy contraction and expansion, estimating Equation 2 for two different sub-periods: i) 2006:10-2008:8 (contraction); and, ii) 2008:8-2009:12 (expansion). Results are shown in tables 4 and 5. In both tables banks are divided into two categories, depending on whether their capitalization ratio is lower or higher than the median of the financial system.

An interesting asymmetry appears. According to the results, the BLC is stronger during contractive phases of monetary policy, presenting a slightly greater effect on banks with low solvency levels. As expected, due to minimum capital regulations, solvent banks can maintain the level of their loan portfolios easier than poorly capitalized using internal funds. However, during periods of monetary expansion, the BLC is more noticeable for highly solvent banks. Similar results are obtained when the inverse leverage ratio is used instead of the capitalization ratio (Table 5).

V. Conclusions and Policy Implications

In this paper we study the existence of a bank lending channel in Colombia, emphasizing on its heterogeneous nature depending on bank-specific financial characteristics. We use a rich dataset comprised of monthly balance-sheet information for over 16 years of all Colombian commercial banks and explore the effect of different sources of heterogeneity (financial, macroeconomic and policy) on the existence and strength of the bank lending channel.

Our findings show the existence of a bank lending channel in Colombia. Its magnitude critically depends on two aspects. Firstly on bank heterogeneity, as better capitalized banks are less sensible to monetary policy shocks. Their loan supply is less responsive to monetary policy decisions than the one of less solvent banks. Secondly, the response of credit supply to shifts in short-term interest rates critically depends on the monetary policy stance. The BLC is stronger in times of monetary contraction than during expansions. Hence, the central banks have a greater control of credit supply during times of contraction. This fact goes in line with the observed difficulties that central banks have when trying to stimulate loan growth in the aftermath of a financial crisis.

Moreover, bank heterogeneity presents interesting interactions with the monetary policy stance. While well capitalized banks are more responsive to central bank stimuli during expansionary monetary policies, the bank lending channel operated more strongly for poorly capitalized banks during contractive periods.

Our findings have significant policy implications. On the one hand, we highlight the importance of bank capitalization in the transmission of monetary policy. Better capitalized banks are more resilient to policy shocks and, hence, they present a more stable loan supply over the business cycle. On the contrary, poorly capitalized banks are significantly affected by changes in short-term interest rates, especially during contractive periods. This implies that the effects of monetary policy contractions are more strongly experienced by firms and households depending on funds supplied by these low-solvency banks. Policies oriented towards macroeconomic stabilization should take this finding into account. This is another reason for which financial supervisors should closely monitor banks' solvency and liquidity, especially during high inflation periods in which central banks tend to increase short-term interest rates.

On the other hand, our results show that central banks must consider both the stage of the business cycle and the composition of banks' balance sheets for formulating monetary policy and assessing its effectiveness. We show that the BLC operates substantially differently during times of monetary contraction than during expansions, and its strength greatly depends on the proper characteristics of banks.

References

Altunbas, Y., Gambacorta, L. and Marquez-Ibañez, D., (2010), "Does monetary policy affect bank risk-taking?" *European Central Bank, Working paper 1166.*

Aiyar, S., C. W. Calomiris, and T. Wieladek, (2016). "How does credit supply respond to monetary policy and bank minimum capital requirements?" *European Economic Review*, 82, pp. 142-165.

Amador-Torres, J., J. Gómez González, J. Ojeda-Joya, O. Jaulin-Mendez, and F. Tenjo-Galarza. (2016). "Mind the Gap: Computing Finance-Neutral Output Gaps in Latin-American Economies," *Economic Systems*, 40(3), p.444-452.

Aysun, U. (2016). "Bank size and macroeconomic shock transmission: Does the credit channel operate through large or small banks?" *Journal of International Money and Finance*, 65, pp. 117-139.

Aysun, U., and R. Hepp, (2013). "Identifying the balance sheet and the lending channels of monetary transmission: A loan-level analysis," *Journal of Banking and Finance*, 37, pp. 2812-2822.

Beck, N., (2006), "Time-Series-Cross-Section Methods", manuscript, Department of Politics, New York University.

Bernanke, B., and Blinder, A.S., (1992), “The federal funds rate and the channels of monetary transmission”, *American Economic Review* 82: 901-22.

Chang, J.D., C. Huang, and I. Chien, (2014). "Cost Channel of Monetary Policy: Financial Frictions and External Shocks," *Emerging Markets Finance and Trade,* 50(2), pp. 138-152.

Disyatat, P., (2011). "The Bank Lending Channel Revisited," *Journal of Money, Credit and Banking*, 43(4), pp. 711-734.

Ehrmann, M., L. Gambacorta, J. Martinez-Pages, P. Sevestre and A. Worms, (2003). "The Effects of Monetary Policy in the Euro Area," *Oxford Review of Economic Policy*, 19(1), pages 58-72.

Fungáčová, Z., L. Solanko, and L. Weill, (2014). “Does competition influence the bank lending channel in the euro area?”, *Journal of Banking and Finance*, 49, 356–366

Garcia-Posada, M., and M. Marchetti, (2015). “The Bank Lending Channel of Unconventional Monetary Policy: The Impact of the VlLTROs on Credit Supply in Spain,” *Banco de Espana Working Paper* No. 1512.

Gambacorta, L., (2005). "Inside the bank lending channel," *European Economic Review*, 49(7), pp. 1737-1759.

Gambacorta, L., and Márques-Ibañez, D., (2011). “The bank lending channel: Lessons from the crisis,” *Economic Policy*, 26 (66), pp. 135-182.

García-Suaza, A., and J. Gómez-González, (2010). "The competing risks of acquiring and being acquired: Evidence from Colombia's financial sector," *Economic Systems*, 34(4), pp. 437-449.

Ghossoub, E.A., and R.R. Reed, (2015). “The size distribution of the banking sector and the effects of monetary policy,” *European Economic Review*, 75, pp. 156-176.

Gomez-Gonzalez, J., and Grosz, F., (2007), “Evidence of a bank lending channel for Argentina and Colombia”. *Cuadernos De Economía* 44:109-26.

Gomez-González, J., J. Ojeda-Joya, J. Franco and J. Torres. (2016). “Asset-Price Bubbles, Existence, Persistence and Migration,” *South African Journal of Economics*, In Press, doi: 10.1111/saje.12108

Heryan, T., and P. G. Tzeremes, (2016). “The bank lending channel of monetary policy in EU countries during the global financial crisis,” *Economic Modelling*, In Press.

Im, Pesaran and Shin (2003), "Testing for Unit Roots in Heterogeneous Panels", *Journal of Econometrics*, 115, 53-74

Keks, J., and Sturm, J.E., (2002). “Monetary policy and bank lending: evidence from German banking groups,” *Journal of Banking and Finance*, 26, 2077–2092.

Kishan, R.P., and Opiela, T., (2000), “Bank size, bank capital, and the bank lending channel”. *Journal of Money, Credit and Banking*, 32(1), pp. 121-141.

Kishan, R.P., and Opiela, T., (2006), “Bank capital and loan asymmetry in the transmission of monetary policy,” *Journal of Banking and Finance,* 30(1), pp. 259-285. .

Kishan, R.P., and Opiela, T., (2012), “Monetary policy, bank lending and the risk-pricing channel,” *Journal of Money, Credit and Banking*, 44(4), pp. 573-602.

Matousek, R., and N. Sarantis, (2009). “The bank lending channel and monetary transmission in central and eastern European countries,” *Journal of. Comparative Economics*, 37 (2), 321–334

Olivero, M., Y. Li, and B. N. Jeon, (2011a). “Competition in Banking and the Lending Channel: Evidence from Bank-Level Data in Asia and Latin America,” *Journal of Banking and Finance*, 35, pp. 560-571.

Olivero, M., Y. Li, and B. N. Jeon, (2011). “Consolidation in Banking and the Lending Channel of Monetary Transmission: Evidence from Asia and Latin America,” *Journal of International Money and Finance*, 30, pp. 1034-1054.

Ozsuca, E. A., and E. Akbostancı, (2016). "An Empirical Analysis of the Risk-Taking Channel of Monetary Policy in Turkey," *Emerging Markets Finance and Trade*, 52(3), pp. 589-609.

Ramos-Tallada, J., (2015). "Bank risks, monetary shocks and the credit channel in Brazil: Identification and evidence from panel data," *Journal of International Money and Finance*, 55, pp. 135-161.

Reyes, N., Gómez-González, J., and Ojeda-Joya, J., (2014), "Bank lending, risk taking, and the transmission of monetary policy: New evidence for an emerging economy". *Macroeconomics and Finance in Emerging Market Economies* 8:1-2,67-80.

Taylor, J., (1999), "A Historical Analysis of Monetary Policy Rules". En "Monetary Policy Rules", *National Bureau of Economic Research.* Cambridge, MA.

Xiong, Q., (2013), "The role of the bank lending channel and impacts on stricter capital requirements on the Chinese banking industry". *BOFIT Discussion Papers*, No. 7.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