

**CREDIT CHANNEL IN DEVELOPING COUNTRIES:
THE CASE OF COLOMBIA**

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RESUMEN

Este documento usa un conjunto de datos de panel que contiene información de los balances generales de 20 bancos comerciales colombianos entre 1995 y 2003. Basado en el proceso de estimación propuesto por Arellano y Bond que aplica técnicas de autocorrelación en datos de panel a través de un estimador de Métodos de Momentos Generalizados (MMG). El modelo incluye características particulares como tamaño, liquidez, capitalización y capital extranjero para determinar la existencia del canal de préstamo bancario. La literatura del canal de préstamo bancario argumenta que diferencias en este tipo de características y la posición inicial de los bancos se reflejan en su habilidad de compensar los efectos de una política monetaria restrictiva. Se prueba entonces que en el caso de Colombia hay una respuesta negativa del crédito a cambios en las tasas de interés, pero los bancos que poseen más activos, o que son más líquidos o más capitalizados son más capaces de mantener el mismo nivel de préstamos cuando enfrentan una restricción monetaria.

PALABRAS CLAVE: Canal de crédito, sistema bancario, economías emergentes, datos de panel.

CLASIFICACIÓN JEL: I20, J20, J31.

ABSTRACT

This paper uses a panel data set containing monthly information from the balance sheets of 20 banks between 1995 and 2003. It follows an estimation procedure proposed by Arellano and Bond which applies autocorrelation into panel data using a Generalized Method of Moments (GMM) estimator. The model includes particular characteristics to determine the existence of a bank lending channel including: size, liquidity, capitalization and foreign capital. The bank lending channel literature argues that differences in the characteristics and initial position of banks are reflected in their ability to offset the effects of a tightening monetary policy. It has been proved that in Colombia there is a negative response of loans to changes in the interest rate, but bigger, liquid or capitalized banks are better able to maintain the same level of loans in the face of a tightening monetary policy.

KEYWORDS: Credit channel, banking, emerging economies, panel data.

JEL CODES: I20, J20, J31.

It is not by augmenting the capital of the country, but by rendering a greater part of that capital active and productive than would otherwise be so, that the most judicious operations of banking can increase the industry of the country.
Adam Smith (1776), Book II Chapter II

1. INTRODUCTION

There is widespread agreement among neoclassical economists that nominal variables have no effect over real variables in the long run (monetary neutrality or super-neutrality). However, there is still discussion about the size and channels of the effect of monetary policy in the short run. The traditional IS-LM explanation about the short run effect of monetary policy links the nominal money supply with the short term interest rates and the cost of capital. An increase in the money supply reduces the cost of capital affecting private decisions of investment and consumption of durable goods. However, this simple theory is rather incomplete: 1. It does not establish a logical link between short term interest rates and long-term decisions and 2. It doesn't say anything about the reaction of other components of expenditures like consumption of nondurables which, as it was found later, can also be affected by a monetary shock.

The “second generation” models, give more importance to the presence of imperfections in the market. These models include informational asymmetries (Lucas, 1972), sticky prices and wages (as in Fischer-Taylor), menu costs (Mankiw, 1985), limited participation (Tobin), and segmented markets (Alvarez, et. al., 2002). These models recognize the existence of rigidities and in this sense they overcome the problems of the IS-LM model described above, but they don't give any role to the financial markets and in particular they don't consider the

conflict between borrowers and lenders in the credit market that arises from information asymmetry.

More recently, there has been a growing interest in what is called the *Credit Channel*. This literature has its origin in the Keynesian analysis about the role that the credit market plays as a link between savings and investment. The explanation provided by the more “modern” Credit Channel literature is based on imperfections and frictions in the credit market and it focuses on the restrictions imposed by the financial position (assets and liabilities) that firms and banks face when a change in monetary policy occurs. The credit channel theory does not neglect the existence of some of the explanations described above; it just provides an additional possible mechanism.

In simple words, the credit channel predicts that a change in monetary policy will affect the value of assets and liabilities of firms and banks. This has a particular effect in the way that firms (borrowers) finance their activities and the amount of loans that banks (lenders) are willing to provide. The reaction of agents in the financial markets depends on their position in terms of assets and liabilities. This implies two distinctions: 1. Agents will assign different value to financial assets (the Modigliani-Miller Theorem is not satisfied) and 2. The reaction of each agent will be different (heterogeneity among borrowers and lenders).

The existence of the credit channel is explained by the effect that monetary policy has over the difference between the cost of internal (generated by the firm, i.e. reinvested utilities) and external funds (searched by the firm in the banking system or financial markets). The credit channel literature assumes that the opportunity cost of these internal funds is the return of the firm, while the costs that have to be assumed by the firm

to obtain a loan are part of what is called the *cost of external funds*. The difference between the cost of external funds and the cost of internal funds is the *external finance premium*. The external finance premium can be defined as the wedge between the expected return received by the lenders and the costs faced by the potential borrowers and it reflects market imperfections, including monitoring costs, information rents and distortion costs over borrower's behavior. If there is an operating credit channel, a tightening monetary policy that increases the lending interest rates will raise this premium and the size of this difference will be an indicator of the effect of monetary policy.

There are two possible linkages between the decisions on monetary policy and the external finance premium covered by the credit channel literature. On the one hand, the *Broad Credit channel* predicts that the external finance premium depends on the effect of monetary policy on the borrower's net worth defined as the amount of liquid assets and marketable collaterals owned by the borrower's. This approach suggests that a change in the Central Bank's policy (i.e. a contractionary policy) will affect the borrower's financial position by changing the short term and floating rate debt and the price of assets. Any variation in the price of assets will change the value of the borrower's collateral. These two effects make more costly to obtain external funds for the firms.

On the other hand, the *Bank Lending channel* focuses on the supply of intermediate credit. This literature assumes that changes in monetary policy affect not only the interest rates on loans received by the banks, but also affects the bank's balance sheets and hence their willingness to provide new loans. In particular, whenever there is a tightening in monetary policy,

the central bank drains deposits from the commercial banks through open market operations sales or increasing the bank's reserve requirements, reducing the availability of resources to supply funds for borrowers. When a bank faces a reduction in its loanable funds, it can either reduce its loans supply or keeping the same level of loans and change its position in other liquid assets (substitution across financial assets), or in less liquid assets. The response is different across banks depending on their assets positions and liquidity. Alternatively, bank's reaction can be reflecting their willingness to lend money.

The effect of bank's decisions differs across borrowers. It will be stronger for firms that do not have access to financial substitutes (i.e. access to financial markets) and are more bank-dependent borrowers (i.e. small firms). In developing countries this mechanism can be particularly important. There are certain structural features that increase the effects of monetary policy through the mechanisms described by the bank lending channel. 1. There is a less developed financial market, implying the existence of fewer alternative sources for loans for firms, and therefore bank loans become more important as a source of funds (that is, a higher proportion of firms are bank-dependent borrowers). 2. There is a riskier environment for projects, so the external finance premium should be higher and therefore there is a relatively higher excess demand for loans.

The monetary policy regime can play an important role in the credit channel affecting the response of the agents and the exogeneity of the variables. In the case of Colombia, the monetary policy regime has changed several times in the last 15 years. Before 1991, the central bank used a crawling peg system, where monetary policy was set in response to the slow

devaluation of the peso. The exchange rate was exogenous and money supply was the endogenous variable. This system was replaced by an exchange rate band where the price of the dollar could fluctuate inside the limits, but it was fixed in the floor and the roof of the band. In this system, the exchange rate is exogenous at the limits, and is somewhat endogenous inside the band, while the money supply is exogenous in the middle and endogenous in the extremes.

The incentives for a speculative attack created by the band system and aggravated by the *sudden stop* in capital inflows after the Russian and Brazilian crises led the central bank to adopt a “dirty” floating exchange rate system in September 1999. In this system the central bank determines the monetary policy exogenously, but it tries to reduce the variance of the exchange rate. The importance of the exchange rate in developing countries is not only reflected in the monetary policy of the central bank, it is also one of the most important variables in the credit market, since an important proportion of the assets held by banks and firms are foreign assets.

This paper uses a panel data set containing monthly information from the balance sheets of 20 banks (commercial banks) between 1995 and 2003. Particular characteristics used to determine the existence of a bank lending channel include: size, liquidity, capitalization and foreign capital. The idea is to see if there are differences across banks in their ability to offset the effects of a tightening monetary policy based on these characteristics. For instance, it is expected that bigger banks (banks with more assets) will be better able to maintain the same level of loans in the face of tightening monetary policy. In this paper a Bank Lending channel has been found only when size (in terms of assets) is considered, while banks with more

capital or liquidity provide less loans when higher interest rates are faced.

This paper follows a variation of a model initially developed by Kashyap and Stein (2000) and has been used in empirical studies by De Haan (2001) for the Netherlands, Marques (2002) for Portugal, Kaufman et. al. (2003) for Austria, Worms (2001) for Germany, Hernando et. al. (2001) for Spain and Loupias (2001) for France¹. There are some differences in the model and in the measures for the variables included in this paper with respect to the papers mentioned above. One of the main contributions is the use of this type of analysis for developing countries; most of this literature on the bank lending channel has been used in developed countries. Another contribution is the inclusion of additional variables like the exchange rate and risk to explain loans. The results are also surprising, since there is no confirmation of the existence of a bank lending channel. This seems to be showing a substitution between domestic and foreign assets when there is a change in monetary policy.

This paper includes this introduction. In section II there is a review of the literature. Section III contains some stylized facts about the performance of the Colombian economy between 1995 and 2003 and some important facts about the Colombian banking system are described. Section IV is a description of the model and the variables used in it. Section V presents the econometric estimations and comments over the results obtained, and section VI concludes.

¹ All these papers were presented at the European Central Bank at a conference called "The Monetary Policy Transmission in the Euro Area", Dec 18-19, 2001 and can be found in the European Central Bank webpage. <http://www.ecb.int/events/conf/other/mtn/mtn.html>

2. REVIEW OF THE LITERATURE

There is a large literature on the effects of changes in monetary policy on the real sector and a variety of explanations have been offered to explain this phenomenon. Economic science has proposed different ideas about the impact of nominal variables over real variables². At the initial stages, the answer was provided based on the *IS-LM* model, in which monetary policy has an impact on output through a change in investment, specifically by increasing the cost of capital. However, the increasing importance given to micro foundations in macro models brought a renewed interest in the transmission mechanisms.

The main explanation for the short run effects of monetary policy built in this period were based on market imperfections. Lucas (1972)³ relies on informational imperfections (signal extraction problem), where suppliers form expectations about the behavior of nominal variables based on imperfect information. The impossibility to determine whether a shock was produced by a change in monetary policy or just a change in preferences for its product causes a partial response in output. Other models like Taylor (1979)⁴ look at the time structure of contracts, arguing that some prices are determined by contracts or they are costly to adjust. For instance, wages can be considered sticky compared with other prices. This

² For an early view see Friedman, Milton (1968) "The Role of Monetary Policy" *American Economic Review*, 58 (1), Mar.

³ Lucas, Robert (1972). "Expectations and the neutrality of Money". *Journal of Economic Theory*, 4(2), Apr 1972, 103-124.

⁴ See Taylor, J.B. (1979) "Staggered Wage Setting in a Macro Model" *American Economic Review*, 69 (2), May

fact makes monetary policy effective by increasing demand. Mankiw's (1985) explanation considers the existence of market imperfections like monopolistic competition and menu costs, where prices are determined before monetary shocks can be observed⁵.

More recently, market segmentation and limited participation models have acquired more importance. The presence of some form of market segmentation in the financial markets generates heterogeneity among agents (see Alvarez et. al., 2002⁶). This is an idea that comes from the previous literature of limited participation in which some cost for agents to access the financial market is considered (Tobin, 1952). This cost is assumed to reduce the participation in the financial market. The most important contribution of this literature is the recognition of a liquidity effect that affects output.

Another branch of the literature that has grown in the last two decades is what is known as the credit channel. The credit channel lies on the existence of imperfections in the market for funds and the conflict that these restrictions have over the relation between borrowers and lenders. The risks and characteristics of the banking activity create an additional link between monetary policy and output. Information asymmetry about the financial situation of the borrowers creates a series of risks for the lenders. This is represented by what is called the external funding premium, that is, the difference between

⁵ See Mankiw, Gregory (1985) "Small Menu Costs and Large Business Cycles: A Macroeconomic Model of Monopoly". *Quarterly Journal of Economics*, 101 (2), May 1985, 529-537.

⁶ Alvarez, Fernando, Patrick Kehoe and Andrew Atkeson (2002) "Money, Interest Rates and Exchange Rates in Endogenously Segmented Markets". *Journal of Political Economy*. Vol. 110, No. 1, pp. 73-112.

the cost of financing activity with internal sources and through some external agents, specifically, the financial market.

The theoretical bases of the credit channel were built some years before with the papers on credit rationing. For instance, Stiglitz and Weiss (1981) argue by using a moral hazard environment, that an increase in interest rates can attract investors to riskier projects so banks prefer to keep interest rates at their initial level and decrease the amount (or the number) of loans; Jaffee and Russell (1976) assuming adverse selection find that lenders consider unprofitable to increase the interest rates if they don't know the type of borrower that is obtaining the loan. Bernanke and Gertler (1989) suppose the existence of agency costs between the lender and the borrower. In particular, the lender has to pay some fee in order to observe the outcome of the borrower's investment project.

The papers mentioned above are the microeconomic foundations of the credit channel. Based on this literature other authors have developed the macroeconomic implications of credit rationing. The role of the financial system in the transmission of monetary policy is an idea that has been extensively discussed. For instance, Romer and Romer (1990) found very weak evidence of a bank lending channel for the US. However, Bernanke and Blinder (1992) found that a monetary contraction was followed by a reduction in loans and Bernanke and Gertler (1995) developed a VAR model to look at the effects of monetary policy on loans and some components of GDP and confirmed that there could be some relationship between bank loans and output when there was a change in the Fed funds rate. Kashyap, Stein and Wilcox (1995) looked at the composition between bank and non-bank funds and also found evidence of a bank lending channel for the US.

More recently, Kashyap and Stein (2000) have developed a model looking at a panel data including more than 14,000 banks during almost 20 years to determine the existence of a bank lending channel for the US. They built a model similar to the one used in this paper, to determine the effect that size and liquidity have over the response to a change in monetary policy. They found support to the hypothesis of a bank lending channel by using a two step regression approach.

In developing countries, and more specifically, in Latin America, the presence of a bank lending channel has not been analyzed very extensively. However, there is a large number of papers that have analyzed the financial market, the behavior of the banking system and the response of the private sector. Barajas and Steiner (2001), analyze the variables that affected the market for loans, determining a demand and supply functions for Mexico, Argentina, Colombia and Peru. Galindo and Izquierdo (2002) summarize a set of papers that were part of a project developed by the Inter-American Development Bank called "Determinants and Consequences of Financial Constraints Facing Firms in Latin America and the Caribbean". These analyses focused on the existence of a Balance sheet channel looking at firms in six countries in the area.

An area that has been more explored is the presence of a broad credit channel and the presence of the balance sheet effects of the exchange rate. Authors like Calvo, Izquierdo and Mejia (2004) and Caballero and Krishnamurthy (2004) have contributed to this literature that links the presence of sudden stops with banking crises. They show how the instability of foreign capital inflows in emerging economies reduces the alternatives for funding investment and output. However, this literature focuses on the effects of these crises over the ability

of firms to borrow while the bank lending channel studies the willingness of banks to lend.

To determine the presence of some form of credit channel, the creation of databases of banks and/or firms observed through many years has been very helpful. These databases have allowed the use of panel data techniques. In December 2001, the European Central Bank organized a conference where a series of papers with these characteristics were presented. De Haan (2001) for example, determines the existence of a bank lending channel for the Netherlands. Similar techniques are used by Marques (2002) for Portugal and Kaufman et. al. (2003) for Austria, Worms (2001) for Germany, Hernando et. al. (2001) for Spain and Loupias (2001) for France.

3. SOME STYLIZED FACTS AND CHARACTERISTICS OF THE COLOMBIAN BANKING SYSTEM

Between 1995 and 2003 the Colombian economy showed its worst behavior since 1930. In 1999, the country experienced the first negative growth year in more than 60 years. The Colombian economy has been historically recognized as one of the most stable in Latin America, however during the period mentioned above, a set of events including a more unstable political situation, a credit crunch due to the sudden stop in capital inflows after the Russian crisis that affected most countries in the region and the deterioration in the external and fiscal deficits, were among the main causes of the fall in output, employment and investment.

Between 1995 and 1999 the growth rate decreased from 5.20% to a negative rate of 4.20%. During this period, the Central Bank tightened monetary policy in order to maintain

the credibility of the exchange rate band, increasing the interest rates to unexpected levels. In June 1998, the real interest rate of the Central Bank reached a level of more than 50%. This generated a profound crisis in the banking system in the following months: with just a few exceptions, the financial sector showed a negative growth, with a slight recovery during 2002 and 2003. Additionally, there was a higher risk in the financial business and a reduction in liquidity due to a higher rate of past due loans and defaults. This produced a tough situation for banks and the amount of loans decreased substantially.

In spite of the crisis, the Colombian banking system has grown during the last two decades. A more flexible regulation in terms of operation and restriction over positions on foreign assets was established during the nineties⁷. This regulation reform included: less restrictions on foreign investment in the sector, the reduction in reserve requirements and norms that made the trade in bank's assets and liabilities easier (for instance merges and acquisitions).

This increased competition in the sector and allowed entry of new participants. The Colombian banking system includes commercial banks, financial corporations, and finance companies including leasing companies. They are regulated by four governmental institutions, including: Banco de la Republica (the central bank), Banking Superintendence (bank's regulation office), Fogafin (the Financial Institutions Guarantee Fund) and the Ministry of Finance. In this paper, the focus will be on commercial banks. They represent more than 80% of

⁷ For further information see "Colombian Financial system" in www.superbancaria.gov.co

the financial market, but regulations allow them only to lend money, not to invest directly in the private sector.

Between 1990 and 1995, the banking system experienced a boom explained by the increase in capital inflows and the deregulation of the financial system; however, after 1996 the reduction in capital flows due to the Mexican and Argentinean crisis, as well as the reduction in the growth rate of the economy pressured the exchange rates. In order to defend the exchange rate band, the central bank increases the interest rates putting the debtors in difficulties, increasing the percentage of non-performing loans and reducing the liquidity of the system. Consequently, the price of assets, especially housing prices, decreased during these years. Some decisions, including governmental transfers to the financial sector, a credit line for capitalizations, and the privatization of banks owned by the public sector, allowed some improvement that was observable from the second half of the year 2000.

The sample considered in this paper contains 20 commercial banks, including only those that were created before April 1995 in order to avoid the use of an unbalanced panel (since then, only three new institutions have been created). The data has the information contained in the monthly balance sheets for these banks from April 1995 to June 2003. There are 7 foreign banks and 13 domestic banks. Among the foreign banks there are two American banks (Citibank, Boston), two British banks (Banco Anglo Colombiano owned by Lloyds Bank, Standard Chartered), two banks from Spain (Banco Ganadero, owned by the BBVA and Banco Santander), one from Peru (Banco Tequendama), and one from France and Italy (Banco Sudameris). The country with highest participation in terms of assets is Spain, followed by the United States.

In Table 1 there are some descriptive statistics comparing the participation of foreign and domestic banks in April-95 and July-2003. The participation of foreign banks in the commercial banking system in terms of assets decreased from 41.12% in 1995 to 31.60% in 2003. The same reduction is observed by looking at other variables like disposable assets, loans and deposits. Foreign banks have two characteristics: low profitability (10% for the national banks and 4% for the foreign banks) and a lower risk (the past due loans ratio is 9.5% for the national banks and 3.0% for foreign banks). The higher risk of domestic banks is explained by the bigger percentage of mortgage loans provided by them.

In Table 1b some additional variables describing the way that banks run their business can be observed. The percentage of loans over assets provided by foreign banks increased from 53.54% to 58.15% in 2003. For domestic banks, this participation decreased from 64.16% to 57.46%. The change in this proportion can be explained by the increase in the participation of mortgage loans, mostly provided by the domestic banks. The percentage of commercial loans

Table 1a. (Composition)
Colombian Banking System

	April 1995		July 2003	
	Foreign	Domestic	Foreign	Domestic
Assets	41,12%	58,88%	31,60%	68,40%
Disposable assets	45,99%	54,01%	35,60%	64,40%
Loans	40,84%	59,16%	33,27%	66,73%
Deposits	37,55%	62,45%	30,83%	69,17%

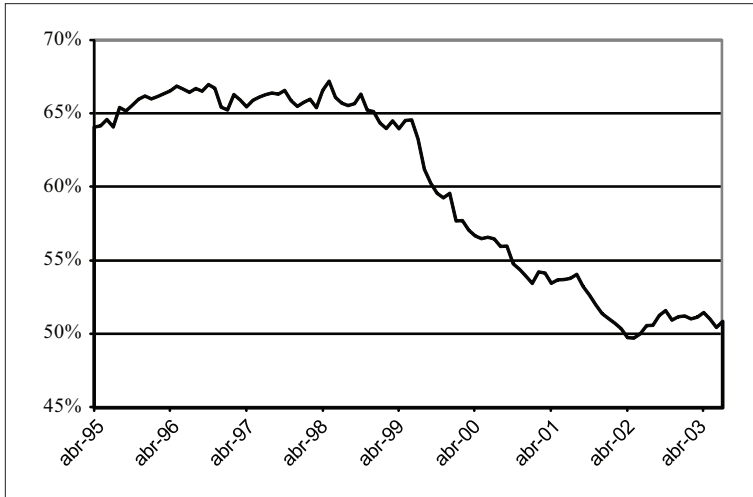
Table 1b. (Proportions)

	April 1995		July 2003	
	Foreign	Domestic	Foreign	Domestic
Loans/Assets (Only Banks)	53,54%	64,16%	58,15%	57,46%
Comercial Loans/ Assets	36,39%	25,37%	52,43%	30,49%
Liquidity	14,89%	11,82%	7,89%	6,33%
Capitalization	26,69%	12,71%	14,66%	10,99%

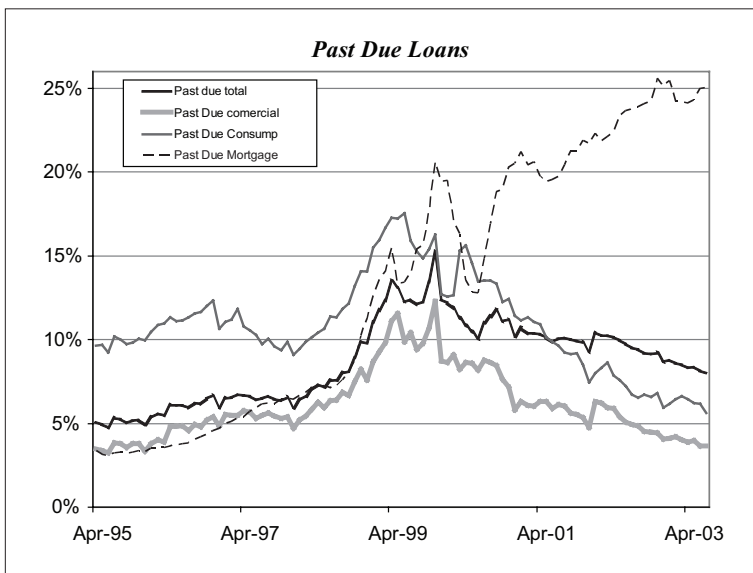
over assets is much higher in foreign banks (36.39%) than in domestic banks (25.37%). This percentage increased for both of them, however the commercial loans represent more than 80% of foreign bank's loans.

Liquidity and capitalization decreased in the whole system, especially in foreign banks. However, they are still more liquid and have more capital than domestic banks. The percentage of disposable assets changed substantially in terms of its composition between national and foreign banks. This can be explained by the change in the participation in deposits observed above.

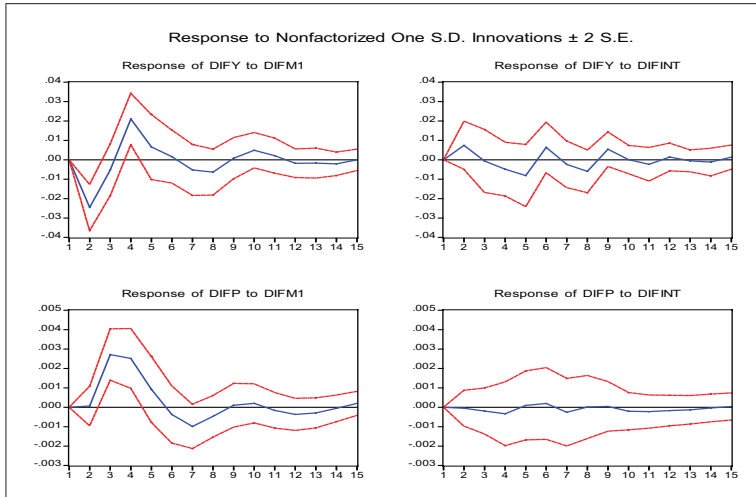
This period was characterized by a profound crisis that affected almost all macro variables. Graph 1 describes the behavior of the growth in loans. It can be seen that during this period, this variable had what appears to be a permanent decrease, with a slight recovery after 2001. The combination of political disturbances and a tightening of monetary policy created a negative environment with a simultaneous decrease in the price of assets and an impressive increase in the interest rates. This was particularly bad for agents with mortgages, whose assets lost up to half of their value.



Graph 1. Loans/assets (Banks+other Fin Inst)



Graph 2. Past Due Loans



Graph 3. VAR Model Output and Prices

This situation created more risk in bank's loans. As it can be seen in graph 2, the past due index (amount of non-performing loans over total loans) increased during the whole period for mortgages and for most of the time in other types of loans. In 2003, around 25% of the mortgage loans are not paid to the banking system. All the other types of loans also became more risky for the suppliers of funds up to the end of the 1990's, but then started a gradual decline.

The graphs included in Graph 3 describe the aggregate variables used corresponding to this period. All the series are in logarithms except for the interest rates. These graphs show the reduction in total loans, in particular in consumption and mortgage loans, as well as the drastic change in monetary policy, reflected in the reduction in the interest rates after the band system was abolished and the decrease in the devaluation rate. These are the original series. However, in order to use stationary variables, the Hodrick-Presscott filter is applied

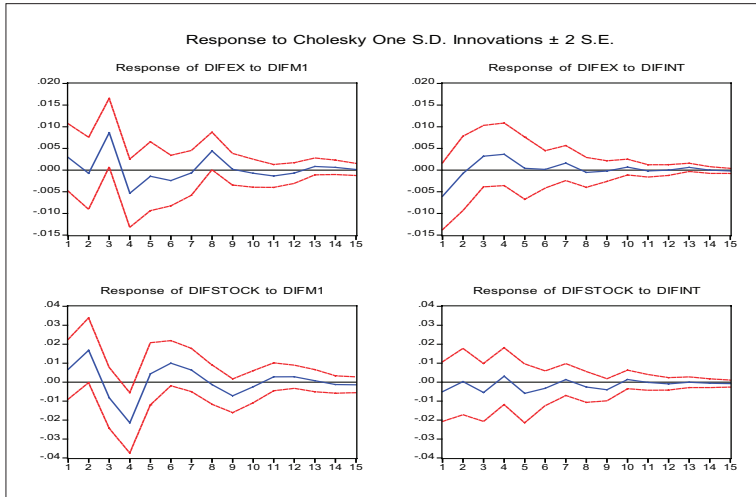
to all of them, using a smoothing parameter (λ) of 10,000⁸. The census x-12 procedure was also used to avoid seasonality in some of these series.

The first method that will be used to determine the existence of a bank lending channel is a VAR model using a Cholesky decomposition estimated using aggregate monthly data for Colombia between 1995 and 2003 and then use the impulse response functions. This initial framework follows what Bernanke and Gertler (1994) did for the US. The first model (see graph 3) describes the effect of monetary policy, M1 and interest rates, over prices and output. The response of output to a monetary shock is positive and significant, however there is a one quarter lag in which output decreases and then it oscillates around its long run level. However, the effect of a change in interest rate is not significant (although, it has an inverse effect over output). The price level follows the expected behavior, it increases when M1 goes up and has a negative, but insignificant response when interest rates have a positive shock.

The second model (described in Graph 4) looks at the effect of monetary policy on the stock index and the exchange rate⁹. As it is expected, there is a negative and almost instantaneous effect over the exchange rate. When M1 goes up, the exchange

⁸ Other alternatives could have been used, like differentiation; however, due to the changes occurred after September 1999, I decided to use the difference between the actual data and the smoothed series. A dummy variable can also be used to control for these huge changes in the level of the variables. A second draft of this paper will contain some of these alternatives.

⁹The definition of the stock index changed recently. This is the percentual change of its value. Before July 2001, the two big stock markets (Bogota and Medellin) had separate indexes, but from that date there is only one index called the IGBC (Colombian Stock Market General Index).



Graph 4. VAR Model Exchange Rate and Stock Index

rate also increases, and an increase in the interest rate implies a lower exchange rate. The effect of a monetary shock on the stock index is higher, but it has the same direction. The effects of the interest rate on these variables are consistent with this story, however they are not very significant.

The third VAR model describes the effect of a monetary shock on different types of loans (consumption, commercial and mortgage). The results in this case seem to be contradictory. In particular, the response of all of them to an increase in M1 is the same as the response to a shock in interest rates. For commercial loans this response is positive, while in the case of loans for consumption and mortgages the effect is negative.

The VAR model is not very conclusive about the effect of monetary policy over loans and provides contradictory conclusions. It does not distinct the demand factors and the supply factors behind the responses of loans, it is not clear about

the size, timing, significance and direction of the responses and it does not take into account the characteristics of banks. In order to look at some alternative approach to determine the existence of a bank lending channel, a model using the panel data mentioned above is described in the next section.¹⁰

4. MODEL

In this chapter an alternative model based on panel data techniques will be introduced to analyze the effect of changes in monetary policy on the behavior of banks, and more specifically, on the supply of loans. This model is based on the heterogeneity of banks in certain characteristics (size, liquidity and capitalization) and how these differences affect the response of loans to changes in interest rates.

Each of these characteristics has a specific impact in the way that banks react when they face a change in monetary policy: 1. Small banks can find more difficult to get non-deposit funds since they have a more restricted access to financial markets than larger banks; 2. Banks with a higher level of liquidity can compensate a reduction in available funds by using some cash or disposable assets in order to keep the amount of loans constant. A similar effect is expected in the case of capitalization; 3. Banks that are poorly capitalized should have a lower access to additional funds and therefore they have to adjust their loans when a monetary policy change is faced.

In emerging economies, exchange rates can also play an important role in the willingness of banks to provide loans.

¹⁰ A VAR model including all these variables was estimated, however the model was not significant.

As it was seen above in the VAR model, a positive shock to the money supply can increase the exchange rate and this will have a positive effect on the availability of funds for those banks with higher foreign participation. This is one of the contributions of this paper to this literature. For the same reason, the stock market index is considered.

The model tries to explain loans, which is the left hand side variable. On the right hand side we have: the short term interest rates are used as an indicator for changes in the monetary policy; prices and production are used as controls to avoid the effects of nominal and real variables; the past due loans index is used to control the risk faced by each bank; In addition, the exchange rate and the stock index are included, as well as the combined effects of bank's characteristics with prices, production and interest rates:

$$\begin{aligned} \Delta_{12} \log m_{it} = & \sum_{j=1}^L \alpha_j \Delta_{12} \log m_{it-j} + \sum_{j=1}^L \beta_j \Delta_{12} r_{t-j} + \sum_{j=1}^L \gamma_j X_{it-j} \Delta_{12} r_{t-j} + \sum_{j=1}^L \lambda_j X_{it-j} \\ & + \sum_{j=1}^L \mu_j \Delta_{12} \log pc_{t-j} + \sum_{j=1}^L \delta_j \Delta_{12} \log y_{t-j} + \sum_{j=1}^L \phi_j \Delta_{12} PD_{it-j} + \sum_{j=1}^L \rho_j X_{it-j} \Delta_{12} pc_{t-j} \\ & + \sum_{j=1}^L \sigma_j X_{it-j} \Delta_{12} \log y_{t-j} + \sum_{j=1}^L \eta_j \Delta_{12} \log S_{t-j} + \sum_{j=1}^L \varphi_j \Delta_{12} \log K_{t-j} + \nu_i + \varepsilon_{it} \end{aligned}$$

Where:

Δ_{12} Lag-12 seasonal difference, that is: $\Delta_{12} X_t = X_t - X_{t-12}$

log Logarithm

m Loans

it Subscripts denoting bank i and quarter t, respectively, $i=1, \dots, N$ and $t=1, \dots, T$

- r Monetary policy indicator, in this case is the interest rate on loans
- pc Consumer price index, used to control for the influence of inflation
- y Production index, to control for the influence of real growth
- PD Past due index. That is past due loans over total outstanding loans
- S Exchange Rate
- K Capital Stock index
- v_i Individual bank effects
- ε_{it} Error Term
- $\alpha, \beta, \gamma, \lambda, \mu, \delta, \phi, \rho, \sigma, \eta, \varphi$ Parameters to be estimated
- X Bank Characteristic variable, respectively: size, liquidity and Capitalization

$$\text{Size } Size_{it} = \log A_{it} - \frac{\sum_i \log A_{it}}{N}$$

$$\text{Liquidity } Liq_{it} = \frac{L_{it}}{A_{it}} - \left(\frac{\sum_i \frac{L_{it}}{A_{it}}}{N} \right) / T$$

$$\text{Capitalization } Cap_{it} = \frac{C_{it}}{A_{it}} - \left(\frac{\sum_i \frac{C_{it}}{A_{it}}}{N} \right) / T$$

The bank size is measured by using the amount of assets A_{it} owned by each bank at every period of time. Liquidity is defined as the difference between the ratio of liquid assets (disposable assets, which includes short run assets and cash) for each bank and the average for all banks at all periods. Capitalization is also the difference between bank's capital and reserves and the average across units and time. These three criteria should sum up zero over all the observations, hence the variable that creates the interaction between these characteristics and the interest rates should also average zero. This is just to allow that the whole effect of a change monetary policy can be reflected in b_j . For the size measurement, this approach removes the existence of some trend over time.

The parameters used to analyze the presence of a Bank Lending Channel are b_j and g_j . The first one is the pure effect of a tightening in the monetary policy over the bank's loans regardless of the characteristics of the bank (total effect) and it is expected to be positive. The second one reflects the interaction between the interest rates and each of the characteristics mentioned above. This parameter captures the difference in the response of banks to changes in interest rates depending on their size, liquidity and capitalization. Big banks are expected to be more able to keep the same level of loans; hence g_j is expected to be positive. The assumption behind this is that the loan demand faced by banks will be the same regardless of their characteristics.

One of the differences between this paper and the paper by De Haan, is the presence of some additional variables. For instance risk, which is measured as the past due index; the exchange rate between pesos and dollars, which affects the substitution of domestic assets for foreign assets, and the stock

index. Interest rates and the exchange rate go in opposite directions. When there is a tightening monetary policy banks will be able to substitute domestic for foreign assets at a lower cost. This is an advantage for those banks that have acquired some negative asset position (for instance banks with foreign capital).

The influence of the exchange rate reduces the Bank Lending Channel: when interest rates go up, banks are willing to provide more loans, however the reduction in the value of foreign assets reduces the availability of funds. Based on this hypothesis, it is expected a stronger bank lending channel on domestic banks, with a lower share of foreign assets than on foreign banks. This can also be explained by the higher ability of foreign banks to hedge against the exchange rate risk. The exchange rate could also affect the composition of credits. Mortgages and consumption loans are more likely to react to increases in the money supply compared with commercial loans due to the type of goods that are financed with these funds.

5. ECONOMETRIC ESTIMATIONS AND RESULTS

The data used in this paper includes the information of the balance sheets of 20 commercial banks for the period between April-1995 and July-2003, this is monthly data published by the Superintendencia Bancaria, the entity in charge of regulating the financial system in Colombia. Some variables were obtained from the Banco de la Republica (Colombian Central Bank) and the Departamento de Planeacion Nacional (National Planning Department).

This data set contains monthly data from bank's balance sheets with two dimensions (a panel data set). Variables change through

time and observation units (banks). The data set includes 20 banks so $i=1, \dots, 20$ and one hundred time periods so $t=1, \dots, 100$. In order to get balanced panel data set, only information of existing banks during the entire period was considered.

Panel data techniques take into account the differences in individual specific effects. In contrast, the OLS estimator assumes that all the units (banks), have the same error regardless of the size, liquidity, capitalization or any other particular characteristic. This assumption of the OLS estimator creates some correlation between the error and the exogenous variables and generates an omitted variable bias. With panel data, the error from each bank is considered separately, avoiding the correlation between errors and the characteristics of the banks. The OLS estimator can be biased even with no fixed effects and the variance covariance matrix can change when heteroskedasticity is not considered.

The main two procedures in panel data are the Least Squares Dummy variable Estimator and the Generalized Least Squares Estimator. The first one treats the individual effect error as fixed by using a dummy variable and then by taking the average for each observation unit across time and subtracting it from the data, it derives the fixed effects estimator or LSDV estimator which gets rid of the fixed characteristics of the observational units. The second procedure consists in building a transformation such that we can get rid of heteroskedasticity. It is also known as the random effects estimator. One additional estimator reported below is the between effects estimator, which only uses the variation across observational units, eliminating the changes that can occur in each of them through time. In order to control for the endogeneity and randomness of the variables, these three estimators are calculated and

Table 2. Results of Regressions by Characterization, Method, Type of Bank and Loans

		Size		
Gamma		Fixed Effects	Random Effects	Between Effects
Total Loans	All Banks	0,2740%	0,5194%	0,1778%
	National Banks	-0,0466%	0,8065%	-0,7158%
	Foreign Banks	0,8300%	0,4797%	0,5634%
Commercial	All Banks	0,5329%	0,6168%	0,1247%
	National Banks	-0,1648%	-0,0106%	0,0997%
	Foreign Banks	0,5441%	0,2473%	0,4402%
Other Variables		Exch Rate	Int Rate	Stock Index
Total Loans	All Banks	2,5526%	0,7351%	-0,4014%
	National Banks	1,9633%	0,6780%	-0,0133%
	Foreign Banks	3,6099%	1,2971%	-1,1188%
Commercial	All Banks	0,5784%	0,3509%	-0,4235%
	National Banks	1,0610%	0,6968%	-0,6615%
	Foreign Banks	0,3614%	0,3365%	-1,1295%

Table 3. Results of Regressions by Liquidity, Method, Type of Bank and Loans

		Liquidity		
Gamma		Fixed Effects	Random Effects	Between Effects
Total Loans	All Banks	-9,0738%	-8,9672%	2,1652%
	National Banks	-2,4063%	-1,2607%	3,9459%
	Foreign Banks	-11,4479%	-9,6500%	n.a.
Commercial	All Banks	-3,0041%	-9,9126%	-4,9903%
	National Banks	-3,3616%	-1,6160%	-0,2053%
	Foreign Banks	-3,0936%	-3,4459%	-5,9980%
Other Variables		Exch Rate	Int Rate	Stock Index
Total Loans	All Banks	2,6682%	0,4845%	-0,4568%
	National Banks	1,8000%	0,3773%	-0,1676%
	Foreign Banks	4,1263%	1,0674%	-1,0237%
Commercial	All Banks	0,2367%	0,2791%	-0,4369%
	National Banks	0,2345%	0,2347%	-0,3724%
	Foreign Banks	0,3369%	0,4156%	-0,6340%

Table 4. Results of Regressions by Capitalization, Method, Type of Bank and Loans

Capitalization				
Gamma		Fixed Effects	Random Effects	Between Effects
Total Loans	All Banks	-12,3447%	-12,6329%	0,2693%
	National Banks	-4,1089%	-8,4276%	-0,7444%
	Foreign Banks	-20,2929%	-15,8640%	n.a.
Commercial	All Banks	-0,9847%	-0,6117%	0,0678%
	National Banks	-0,4577%	-0,0331%	0,2745%
	Foreign Banks	-2,2434%	-1,2694%	n.a.
Other Variables		Exch Rate	Int Rate	Stock Index
Total Loans	All Banks	2,6372%	0,2791%	-0,4420%
	National Banks	1,9514%	0,0197%	-0,2797%
	Foreign Banks	3,9986%	0,4446%	-0,8935%
Commercial	All Banks	0,7024%	0,2188%	-0,4750%
	National Banks	0,2464%	0,2278%	-0,3830%
	Foreign Banks	0,4851%	0,2704%	-0,6387%

reported in tables 2, 3 and 4. A Hausman test can be used to select the best estimator (Fixed or random effects). However, all the estimates are reported in order to identify the within (time series) and between (cross sectional) effects.

On the other hand, this model is dynamic, the dependent variable is included among the independent variables, but the fixed effects estimator is still consistent since the number of banks is lower than the number of periods. More recently Arellano and Bond, developed a GMM estimator for cases where $N > T$ that eliminates any correlation between the independent and the dependent estimator. However, it can not be used for this model, since $T > N$. Although, there is discussion about the consistency of the fixed effects estimator when $T > N$, it has been shown that a higher number of periods reduces the potential bias of the estimator.

By using these techniques, the following group of parameters will be estimated.

$$\gamma = \left(\frac{\partial \text{loans}_{it}}{\partial r} \right) / \partial X_{it}$$

$$\beta = \left(\frac{\partial \text{loans}_{it}}{\partial r_t} \right)$$

$$\eta = \left(\frac{\partial \text{loans}_{it}}{\partial S_t} \right)$$

$$\varphi = \left(\frac{\partial \text{loans}_{it}}{\partial K_t} \right)$$

Tables 2, 3 and 4 describe the main results obtained. The first part of the table describes the estimates of the parameter γ , which is the parameter that measures the existence of a bank lending channel. The table shows the three different methods used in the estimation of this parameter (fixed, random and between effects). It also distinguishes between total and only commercial loans, as well as banks with foreign capital and domestic banks. The second part of the table is organized in the same form (making a distinction between types of loans and banks), but it contains the estimates for β , η , and φ , which are the parameters for the interest rates, the exchange rate and the stock index, respectively.

Table 2 includes the results where size is used as the observable characteristic. The main result derived from the results in the first part of this table (regarding γ) is that almost all the parameters estimated when size is used as characteristic, are positive (except for domestic banks).

Banks are more willing to provide loans when they observe a higher interest rate ($\beta_j > 0$). However, the reaction of banks with more assets is stronger ($\beta_j > 0$). This is explained by the availability of funds that they can use to lend when they face this situation.

Additionally, commercial loans are more affected by changes in money supply and if we consider the foreign participation a stronger response in banks with a higher share of foreign capital can be noticed. This reflects the importance of the foreign assets in the reaction of the lenders: the presence of foreign assets allows banks to hedge against risks and provides an additional alternative source of funds. This is precisely what the bank lending channel predicts, banks that have additional sources of funds will be able to react faster and stronger to monetary shocks.

Whenever banks observe that the interest rate is above its average, the willingness to lend increases in both big and small banks. However, this willingness to lend will imply more loans only if these banks have alternative sources of funds. It is expected that large banks will be able to get additional funds by substituting liquid assets for loans. The argument behind these results is that the existence of a permanent disequilibrium in the loans market will create some room for increases in the interest rates that will reduce the excess demand. Therefore, it is assumed that the interest rate that prevails in the market is not the equilibrium interest rate.

In the second part of the table the positive effect of the exchange rate on loans can be seen. When we look at total loans and foreign banks, this effect is higher, which confirms the results described above. The interest rate has a positive effect on loans and the stock index (negatively correlated

with interest rates) has a negative effect on the provision of loans and has a stronger effect on commercial loans and foreign banks. Although it is not reported in the tables, it is important to mention that the past due index has a negative coefficient in all the estimations (regardless the type of loans or banks). This result confirms the fear of risk foresight by the credit rationing literature.

In table 3 we look at the effect of liquidity: A negative gamma is obtained, which means that the response of more liquid banks is weaker than the response of banks with less liquidity. When a higher interest rate is faced, banks with more disposable assets will increase their loans less. This response is even weaker for total loans and banks with foreign capital. From these results we get that banks with liquidity excess will react less. Two possible explanations can be behind this result: 1. Higher interest rates open more profitable alternatives for the banks than just lending (especially for banks with more liquidity) and 2. A higher interest rate implies a reduction in the exchange rate which reduces the value of foreign assets and available funds. The effect is especially important for banks with higher shares of foreign assets, which confirms the role of the exchange rate and the interest rate, as well as the substitution of financial assets and loans commented above.

The second part of table 3 reflects the effect of the interaction between the exchange rate and the interest rate. Although, in general there is a negative correlation between the interest rate and the exchange rate, the positive parameters related to both exchange rates and interest rates can be explained by the response of monetary policy when the exchange rate goes up. It can also be observed the substitution between the financial market (stock index) and the banking system (loans).

Similarly, when capitalization is the observable characteristic of banks, the lending response is stronger in banks with a lower proportion of capital (see table 4). Banks with a large proportion of foreign investment are more responsive to monetary shocks and the response of commercial loans is weaker. This confirms the conclusions extracted from the results of table 3. In particular, the active role of the exchange rate due to the presence of foreign assets is a pattern which is also observed in these results. Moreover, the effects of the exchange rate, interest rates and the stock index are the same.

These results indicate that banks with more capital are able to transfer funds to increase their loans. It also confirms that a higher exchange rate increases the availability of funds. The positive effect is specially strong in foreign banks (with more access to foreign assets whose value in pesos increase when the exchange rate goes up). The stock index has a negative parameter as in the previous tables and the past due index (a proxy for risk) has also a negative effect on loans. Total loans (which include mortgage and consumption loans) are more sensible than commercial loans. Comparing the set of estimators used (fixed effects, random effects and between effects), it can be observed that the cross sectional effects (between effects) are weaker than the time series.

Behind these results the main conclusion that arises is the importance of the exchange rate in the transmission mechanisms. This variable causes a reduction in the funds for loans allocated by commercial banks and creates an additional reason for credit rationing. Additionally, this creates a link between sudden stops in capital flows and credit access in emerging economies. These results also provide some lights about the regulations and incentives necessary to increase

loans and how to stimulate certain economic activities through the financial sector.

6. CONCLUSIONS

Despite of the increase in interest in the credit channel, the literature on the Bank Lending Channel for less developed countries is very limited. This paper has explored the case of Colombia by using microdata from the balance sheets of 20 banks published by the Superintendencia Bancaria, the office in charge of banking regulation in this country. The idea is to look at the response of banks when they face a change in monetary policy and how this response is affected by certain particularities in the banks as size, liquidity and capitalization.

This paper intends to give an answer to the debate that is taking place in Colombia and other developing countries about the effect of a more flexible monetary policy in the middle of a credit crunch and a negative economic environment. It was found that the existence of a bank lending channel is affected by the presence of substitute assets for the banks, in particular foreign assets.

Banks with liquidity excess response less when they face a change in interest rates. A change in interest rates affects the exchange rate and the availability of loanable funds. This is particularly important for banks with foreign assets. Additionally, foreign banks are more exposed to the exchange rate risk, and they are more sensible to any change in monetary policy and react less to changes in interest rates. It has also been found that commercial loans are less sensitive to changes in monetary policy than other types of loans.

These conclusions can have consequences on monetary policy. The response of banks to changes in interest rates has an important effect over the transmission mechanism and economic policy. Regulations and incentives on the banking system in emerging economies should be adjusted depending on circumstances that affect variables like capital inflows, booms in the stock market or changes in the exchange rate.

This paper opens the door to further research in monetary theory and policy. Theoretically, it can be the starting point for a broader research about the credit channel and the necessary conditions for this mechanism. In this sense, it would be interesting to look at the difference across developing countries in order to find a pattern that can give us some light about the determinants of a bank lending channel. Empirically, a larger sample containing more banks could allow us to use a more consistent estimator. On the other hand, this paper only includes the interaction between interest rates and the characteristics mentioned before, so it would be interesting to look at the interactions with other variables as exchange rate. Some additional tests about the randomness and importance of some of these variables could also be included.

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