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Abstract

The recent financial crises brought about a new string of theoretical and empirical studies about the so-called risk-taking channel of monetary policy. There is strong empirical evidence of the channel in terms of local and in terms of the international spillovers of the mechanism. In this paper we contribute to this empirical literature and enhance the range of the analysis by studying which economic sectors are more vulnerable to the channel. We use loan level micro-data for 3019 Colombian firms between 2005:1 and 2014:3. The identification technique used for our estimations is the one developed in Jimenez et al. (2014). Our results show strong evidence of a risk-taking channel for the economy as a whole and a stronger effect in the agriculture and services sectors than in the others. This results are supported in terms not only of ex ante credit risk but also in terms of ex post credit risk. The firms more affected are the less profitable and the less leveraged.

Keywords: Monetary policy, credit risk, supply of credit, bank capital, financial stability.
JEL E44, E51, E52, G10, G20.

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1 Introduction

The recent financial crises of 2007-2009 have been at the heart of a lively debate on the transmissions mechanisms of monetary policy and its spillovers. There is a new approach of this transmission mechanism that gives an important role to the level of the monetary policy interest rates that central banks set. If the level of interest rates is very low, lower than historical norms, it triggers a risk taking behavior in the financial systems. These seems to be the case in years previous to 2007 not only in advanced economies but also in some developing countries.

The so-called risk taking monetary policy transmission mechanism was first coined by Adrian and Shin (2010) and Borio and Zhu (2012). According to them, the risk-taking channel denote how the monetary policy may influence the willingness of market participants to take on risk exposures. They highlight that in conventional models of monetary economics used by central banks the main rigidity is the one of goods and services and that financial intermediaries have no role. They put forward the fact that even though the financial accelerator model by Bernanke et al. (1999) explains how financial frictions affect the real activity, it focus its attention on the side of borrowers while the risk taking channel focus in the financial system itself.

Disyatat (2011) points out that in the risk taking channel monetary policy has an impact on the perception of risk and/or willingness to bear risk by banks via the impact of interest rates on financial buffers or perceived vulnerability of agents. Interest rates have an impact on valuations, incomes, and cash flows. As described by Borio and Zhu (2012) this is one set of the effects of the changes of policy rates that affect risk taking. Lower interest rates, for instance, boost asset and collateral values as well as incomes and profits, which in turn can reduce risk perceptions and/or increase risk tolerance. In addition, there is a procycality between the widespread way in which financial intermediaries measure risk for economic and regulatory purposes (for example Value at Risk) and the perceptions of risk.

A second set of effects in which risk taking may be operative is through the relationship between market rates and target rates of return (Rajan (2005)). This would be the case of the search for yield especially in nominal rates. For example, in 2003-2004

some investors that were trying to meet the nominal returns that they had been able to reach when interest rates were high, shifted from safe low-risk government bonds into higher-yielding but riskier emerging market assets. Other cases in which the financial system have to meet target rates of return is the case of some pension funds or insurance companies that have nominal liabilities at predefined long-term fixed rates (Borio and Zhu (2012)). In this aspect of search for yield, there could exist a component of money illusion where the economic agents do not take into account that the policy rates may be falling as a response of lower inflation rate.

Another important way in which the changes in policy interest rates induce risk taking is trough communication policies of a central bank. For example, if economic agents anticipate that the central bank will ease monetary policy during a downturn of the economic activity they might have a perception of lower risk in the future. This perceived insurance effect constitutes a typical moral hazard problem (Altunbas et al. (2014)).

Finally, there is an important aspect that defines the risk taking channel in the transmission mechanism of monetary policy as addressed by Jimenez et al. (2014). This dimension of the risk taking channel is that the monetary policy may induce a change in the composition between risky and safe assets. In the case of banks, this shifting is due to the fact that they face strong moral hazard problems - especially lowly capitalized banks because they do not fully internalize loan defaults.

In these sense, the supply of credit has been widely analyzed by Stein and Kashyap (2000), Jimenez and Saurina (2006), Khwaja and Mian (2008), among others. It also has been analyzed how the monetary policy may affect credit quality of the pool of borrowers through the firm balance sheet channel, as in Bernanke et al. (1999). However, how monetary policy impact the composition of the supply of credit has been studied just in recent years.

At the empirical level there have been many developments in the last decade. The article by Jimenez et al. (2014) uses micro information of the Spanish Credit Register on loan applications and on committed loans and find strong evidence of risk taking behaviors of banks during the period 2002-2009. They use data at the firm-bank level, and to identify bank risk-taking, they make a triple interaction between the changes in

the overnight interest rate with the banks' capital ratio and a measure of firm credit risk. Bank capital is the main theory-based measure of bank agency problems (Holmstrom and Tirole (1997)).

Other studies do not use loan applications due to data limitations but they find some evidence of risk-taking channel. For example Ioannidou et al. (2015) analyze the case of Bolivia during 1999 - 2003. They explore the evidence regarding the risk pricing by banks and their findings are that when the U.S. federal funds rate decreases, bank credit risk increases while loan spreads drop.

Altunbas et al. (2014) use a large panel from listed banks operating in the European Union and the United States for the period 1999-2008. They use as measure of exogenous policy interest rate the gap between the policy rate and the natural interest rate. They relate the Expected Default Frequency with this measure of interest rate gap and some control variables and use the dynamic generalized method of moments (GMM) panel to mitigate endogeneity problems. Their findings are that low interest rates over an extended period of time contributed to an increase in banks' risk. Other empirical works include Gaggl and Valderrama (2010) for Austria; Dell'Ariccia et al. (2013) for the United States; Lopez et al. (2011, 2012) for Colombia; and Apel and Claussen (2012) for Sweden.

Another important contribution to the empirical literature is provided by Bruno and Shin (2015) who address that given that the policy rate is a determinant of the funding cost of banks and that the willingness of banks to take more risk depends of this cost of financing, the role of monetary policy is crucial for the risk-taking behavior of banks. Moreover using VAR estimates their key result is that the banking sector leverage constitutes a channel for the international transmission of monetary policy through its effect on cross-border bank capital flows and the changes in real exchange rates.

In this article, we add to the empirical strand of literature by analyzing the risk taking channel of monetary policy at a sectorial level. As we pointed out before, when interest rates are too low banks are faced with misperceptions of risk because interest rates have an important impact on valuations, incomes and profits. Besides, the way in which financial intermediaries measure risk is pro-cyclical with the perceptions of risk. Here we investigate the degree in which this phenomena is present in each of the particular economic sectors in the economy.

We use the Colombian Credit Register data on loans for a sample of 3019 firms. The data is quarterly since 2005:1 until 2014:3. We also use information on bank and firm characteristics and macroeconomic variables as controls. In order to control for interest rate endogeneity, we use the deviation of the monetary policy interest rate from a Taylor rule based rate.

Our results show first that when interest rates are too low, the supply of credit shifts toward risky borrowers in the economy as a whole. Second, that banks take on more risk in the agricultural and services sectors. This phenomena is also present although in less degree in manufacturing. Third, we find that banks with less capital, that is those affected the most by agency problems, are the ones that take on more risk and that these banks face more default on their granted loans in the future. The results are robust to different horizons of the borrower risk variable and they are also supported by a complementary measure of firm risk that is ex post risk.

The misperceptions in the valuations of incomes and profits make the services sector more vulnerable to risk-taking behavior of banks. We show that in the services sector the firms most affected by the risk taking channel are those that are more vulnerable in terms of the level of firms below the median leverage and the median profitability i.e. the firms more credit constraint. Moroever, the services sector is the one with higher lending interest rate followed by the agricultural sector. In terms of participation in the GDP and the total lending portfolio of banks the fact that the services sector is so affected by the risk taking channel of monetary policy is worrisome.

The rest of the article is organized as follows: Section 2 discusses our identification strategy. Section 3 describes our measure of stance of monetary policy. In section 4 we present the data and descriptive statistics. In section 5 we present the model. Section 6 corresponds to the econometric results and section 7 concludes.

2 Identification

2.1 Firm and bank characteristics

As explained by Jimenez et al. (2014) the main prediction of the risk taking channel of monetary policy is that, given that majority of banks are exposed to moral hazard problems, the monetary policy might induce them to change the composition of lending by giving a higher share to risky lending. However, this prediction is also compatible with demand channels as explained by the financial accelerator mechanism: lower interest rates boost net worth and collateral values of firms which might increase their demand for credit. Hence to control for unobserved heterogeneity in firm loan demand, quality and risk we saturate our specification with firm fixed effects. In Colombia firms mantain multiple bank relationships. Identification in this respect comes from comparing changes in lending by different banks (banks that differ in their capital-to-assets ratio) to the same firm. In this way if a monetary policy shock affects banks differently the observed change in credit will be due to the supply side.

The main prediction of the risk-taking channel of monetary policy may also be compatible with the bank lending channel (Bernanke and Blinder (1988)). According to this last channel the supply of credit will be affected by funds availability as a response of movements in the policy interest rates. The way the empirical literature has overcome this identification problem has been by introducing some bank characteristics in the econometric specifications. We include the size of the bank measured as the logarithm of total assets, non-performing loans, banks profitability measured as ROA and to account for the most specific moral hazard problems the bank capital-to-assets ratio.

2.2 Interaction between the interest rate, bank capital ratio and firm credit risk

As explained above, in the risk taking channel the main problem of banks is one of agency and therefore it is necessary to have a good measure of it. This measure is the capital-to-assets ratio (Holmstrom and Tirole (1997)). A regression with the interaction between the interest rate, the capital-to-assets ratio and a measure of borrowers risk will

help us to identify the risk taking channel. As pointed out by Jimenez et al. (2014) "given the set of fixed effects, identification of the risk-taking channel comes from exploiting the testable prediction that when the monetary policy rate is lower, banks that are subject to more severe agency problems lend more riskily" pag. 473.

Therefore, we use a triple interaction to identify the risk-taking channel. We interact our measure policy interest rate with the capital-to-asstes ratio of each bank and a measure of firm risk. The variable that represents firm risk is a variable that equals 1 if six months previous to the granting of the loan, the borrower was in default and 0 otherwise. Longer horizons of the bad history of the firm are also important, so in a robustness analysis we use longer periods of time (1, 2 and 3 years)[1]

3 The monetary policy stance

One central aspect in the evaluation of the effect of monetary policy on banks risk-taking is the causality between the monetary policy rate and the performance of credit. Sometimes, there is a reverse causality between the policy rate and the supply of credit: The policy rate might react not only to the inflation rate but also to credit growth and in consequence in this cases it ceases to be exogenous.

Therefore it is necessary to have a measure of policy interest rate that is exogenous to the supply of credit. One way to tackle this problem is to use a measure proposed by Altunbas et al. (2014): The deviation of the interest rate from one implied by a Taylor rule. A low level of interest rate would be a level of policy rate below the Taylor rule based rate. In this case the monetary policy shocks will be completely exogenous. The Taylor rule rate is the result of a regression between the interest rate and a constant, the annual GDP growth and the annual inflation rate. The residuals of this regression, restricted to the fulfillment of the Taylor principle, correspond to our measure of the stance of the monetary policy to which we denote $TAYLOR_t$

[1] Default is defined as if three months after the date of maturity, the debt balance remained unpaid.

4 Data and descriptive statistics

The Credit Register of Colombia records detailed information about commercial loans granted to non-financial firms. We analyze a balanced panel of 3,019 firms. The information we use covers quarterly data for the period 2005:1 to 2014:3. Here we can find information about the amount of the loan granted, the date it was granted, the identification of the firm, the interest rates of the loan, the days in delay, counter-cyclical loan provisions, maturity, collateral information, among others.

We match the previous information with two other set of data sources. i) For the firm characteristics, such as size, leverage, profits, the economic sector to which the firm belongs we use annual data from the Colombia's Superintendence of Corporations (Superintendencia de Sociedades), that collects a large amount of data on financial and income statements from private corporations that are not listed in the stock exchange and, the Financial Superintendence (Superintendencia Financiera) that reports information for large firms that are listed in the stock exchange, and ii) complete bank balance-sheet variables with monthly frequency. This information comprises bank size, bank capital-ratio, bank non-performing loans among others. The number of banks in the sample is 19.

The unit of analysis in our econometric model is the pair firm-bank. As explained in Section 2.1 most firms maintain multiple bank relationships. The average number of bank relationships in our sample is two. We aggregate all the different loans between a firm-bank pair during the sample period. Therefore we have a measure of total committed credit exposure between each firm-bank pair. Our main loan variable is the log level of all the loans for each firm-bank pair during the period of analysis, $ln(LOAN_{bft})$.

The descriptive statistics of the dependent and independent variables in the model are presented in Tables 1 and 2. The average loan portfolio of the bank b with the firm f is 2.3 Billions of COP. The percentage of risky borrowers is 10%. The average size of the banks is 18,033 Billions of COP where 7 out of 19 banks concentrate about 50% of the lending portfolio in Colombia. The average capital ratio of the banks is 4.4% with a maximum of 46.8% and a minimum of 0.8%. The average non-performing loans ratio (NPL) is 2.9% with a standard deviation of 1.1%.

The average size of the firms is 24.02 Billions of COP with a standard deviations of 4.11 Billions of COP. The average age of the firms in the financial system is about 15 years. The average profitability of the firms is 5.12%.

In Table 2 we present the descriptive statistics of the firms by economic sectors. It calls the attention the fact that in services there is a high number of firms below the average size; the number of firms is the highest and the lending interest rates charged by banks is also the highest in the sample (16.06%). This makes the firms in this sector the most credit constraint and vulnerable to changes in the economic conditions. This economic sector represent the 59.0% of the GDP and half of the lending portfolio of banks.

The average GDP growth in the sample was 4.7%, the inflation rate had an average of 3.96% (very close to the target rate of 3.0%) and the real exchange rate index was over-valuated during the sample period with an average of 88.04 and standard deviation of 8.38.

5 The model

We estimate a least squared panel data model with firm fixed effects, controlling for bank characteristics and macroeconomic conditions, and we make robust inferences.

Our period of analysis runs from 2005:1 until 2014:3 and includes an important credit boom from 2005:2 until 2008:4 (total real per-capita credit growth was 20% above average in 2006:4). Previous to this credit boom, monetary policy had been very loose since 2004:2 and there existed concerns about the quality of the lending portfolio and the consequences of a probable credit bust. The international financial recession did not affect the Colombian credit growth until 2009:3

The dependent variable of the model regressions in Tables 3 to 6 is $Ln(LOAN_{bft})$ which equals the logarithm of the committed loan amount granted by bank b to firm f in quarter t. The mean value of $Ln(LOAN_{bft})$ is to 2.3 Billions of COP with a standard deviation of 7.5.

Our main inferences on risk-taking (triple interactions) are based on the following panel regression:

$$Ln(LOAN_{bft}) = \alpha_f + \beta I(FIRM\,RISK_{tf}) + \delta TAYLOR_{t-1} * I(FIRM\,RISK_{tf}) +$$

$$+\gamma TAYLOR_{t-1} * I(FIRM\,RISK_{tf}) * (BANK\,CAPITAL_{t-1,b})$$

$$+Bank\,Controls_t + Macroeconomic\,Controls_t + \varepsilon_{bft} \quad (1)$$

Where $I(FIRMRISK_{tf})$ is a variable that equals 1 if six months previous to the granting of the loan, the borrower was in default and 0 otherwise (Default is defined as if three months after the date of maturity, the debt balance remained unpaid), $TAYLOR_{t-1}$ is the deviation of the monetary policy interest rate from a Taylor rule based rate at t-1. $(BANKCAPITAL_{t-1,b})$ is the capital-to-assets ratio of the banks defined as total equity as a share of total assets. Firm risk has a mean of 10%, the interest rate defined by the Taylor rule has a mean of 0.21% and standard deviation of 0.94%, and bank capital has a mean of 4.3% and a standard deviation of 1.96%.

We are interested in the parameters β, δ and γ for the regression that runs the whole sample of firms and for the regressions in each of the economic sectors. This is, the coefficients on the firm risk variable, the interaction between the firm risk and the interest rate and the one of the triple interaction between the firm risk, the interest rate and the bank capital ratio. The specification also takes into account, to control for the bank lending channel, some bank characteristics (bank capital, bank size, bank ROA and bank non-performing loans). Finally, we control for some macroeconomic conditions such as the GDP growth, the real exchange rate and the inflation rate. The specification also presents firm fixed effects represented by α_f to control for the demand channel.

6 Empirical Results

6.1 Preliminary analysis

Before we present our econometric results a preliminary graphic analysis can illustrate the presence of the risk-taking channel of monetary policy in the data. In Figure 1 we plot the deviation of the policy rate from a Taylor rule based interest rate. As explained

earlier, we used this measure to address the question of how low the stance of monetary policy is in the economy in a given moment in time and, its consequences in terms of determining attitudes towards risk-taking of banks. As we can observe, $TAYLOR_t$ was most of the time below zero during 2004:1 and 2009:4 and after then it was well above zero with the exception of 2011. This means that during the first part of the sample monetary policy was more relaxed.

With respect to the composition of the lending portfolio between risky and safe borrowers, which can tell us something about risk taking, in Figure 2 we plot the ratio of the loan amount granted to risky versus safe borrowers for the economy as a whole and by economic sectors. The main message here is that until 2011:1 there was a high ratio of lending to risky versus safe borrowers mainly in the services sector. In the other sectors the ratio was increasing until this point in time and later, when the monetary policy stance was more restrictive it dropped.

This is only a suggestive evidence of the risk-taking channel. We need to control for economic factors, bank characteristics, firms characteristics and to do a proper identification of the risk-taking channel in the same lines of Jimenez et al. (2014). The next subsection presents those results.

6.2 Main results

In Tables 3 to 5 we present our main results. Table 6 presents some robustness test regarding the time horizon used to address the measure of firm credit risk. Table 7 presents the regressions with the dependent variable being the future likelihood of loan default. Finally, Tables 8 and 9 present the results according to the leverage of the firms and the ROE of the firms.

In Table 3 we start by estimating the parameter beta, taking into account only firm risk in level. The results shows that risky firms obtain less credit, the parameter β is negative and significant. This is true not only for the economy as a whole but also in each economic sector. In addition, in Table 4 the results show that when the monetary policy is too lax, banks supply more credit to all firms, but especially to risky firms, the coefficients δ in the double interaction $TAYLOR_{t-1} * I(FIRMRISK_t)$ are more

negative than the βs and statistically significant. The impact of a decrease in the policy rate is more important in the agricultural and the services sectors. Notice that according to Table 2, 1649 out of the 3019 firms analyzed here belongs to the services sector. Similarly, the average loan portfolio in this economic sector is the second largest after the manufacturing sector. The average loan portfolio is for the manufacturing sector 7900 billions of COP, for the services sector of 7150 billions of COP while for the agricultural and construction sectors is 631 billions of COP and 1390 billions of COP, respectively.

Finally, as explained earlier, the double interaction of firm risk and the interest rate can capture changes in the composition of credit but not in the composition of the supply of credit. Nonetheless, given the firm fixed effects and the banks controls, the triple interaction of firm risk, interest rate and bank capital identifies the bank risk-taking channel.

In Table 5, we present these triple interactions. "A positive coefficient on this triple interaction importantly implies that when the overnight rates declines, lowly capitalized banks grant larger loan amounts to risky firms, that is, these banks take more risk" Jimenez et al. (2014), pag 493. We find that in the economy as a whole and in all the economic sectors, there is a risk-taking effect of an easy monetary policy. Comparing the double interaction in Table 4 with the triple interaction in Table 5 we can observe that this risk taking effect is more severe in the agricultural sector followed by the services and the manufacturing sectors, respectively. In the construction sector the effect is not significant.

This means that there are more misperceptions of risk in the agricultural and the services sectors. In the Colombian economy the agricultural sector has lost importance as a percentage of the GDP during the las couple of decades, while the services sector represent nearly 59% of GDP. Therefore the results about the services sector adress a financial stability problem in the face of an economic downturn. They suggest that the services sector is more vulnerable to the risk taking channel. The misperceptions of incomes and profits associated to very low interest rates are more severe in this economic sector according to the evidence presented in this document.

6.3 Robustness to time horizons.

Table 6 presents the result changing the time horizon of the risk of the firm. Our benchmark firm risk variable used equals to one if six months previous to the granting of the loan the firm was in default. As robustness check, we analyze the results for a 1 year horizon and for a 2 years horizon. The results are robust to this two specifications. The coefficients on the triple interactions are positive in all economic sectors and higher in agriculture and services. The regressions include the same set of variables as Table 5 but only the triple interaction is reported.

6.4 Future credit defaults

The previous analysis showed that when interest rates are low, lowly capitalized banks take more risk in the economy as a whole and particularly in the agricultural and services sectors analyzing ex ante risky firms. Another important question is how a very loose monetary policy induce to lowly capitalized banks to supply loans to firms that default more ex post which would be complementary measure of risk-taking.

The dependent variable is a dummy variable: I(FUTURE DEFAULT WITH THE BANK$_{tbf}$), that takes the value of 1 when firm f that is granted the loan at time t by bank b defaults two years in the future. In Table 1 we can observe that this measure of risk is also about a 11% as the ex-ante measure.

Table 7 present the results. The double interaction of the interest rate and the capital ratio of the bank is positive and significant. This indicate that when the policy interest rate decreases lowly capitalized banks grant more loans to firms with higher future defaults. And in the same direction as ex-ante risk, ex-post risk also increases more in the agricultural and services sectors.

6.5 Which firms are affectred the most?

The vulnerability of the economic system at the firm level is also of great interest. We divide the sample into lowly leveraged and highly leveraged firms according to the median leverage. We also split the sample into less profitable and more profitable firms according

to the median.

In terms of leverage, Table 8 shows that the firms under the median leverage in the services sector are the most affected by the risk taking channel.

Changing our attention to profitability, the firms in the services sector with ROE below the median are the most affected according to the results presented in Table 9.

The results presented above are of great interest because these firms are the most credit constraint and the most vulnerable in the economy.

We can make a parallel between this findings and the ones by Lopez et al. (2012) where the hazard function of comercial loans and consumers loans are compared and the results are that in the consumers loans banks take more risk. This is, more credit constraint units of analysis are more vulnerable and when interest rates are too low, banks shifts their supply of credit towards risky borrowers.

7 Final remarks

The risk-taking channel of monetary policy is a new channel that has been recently studied and documented. In this paper we found solid evidence of the presence of this channel in the Colombian economy for the period 2005.1-2014:3. The identification strategy used to assess the channel allows us to conclude that lowly capitalized banks supply more credit when monetary policy is too loose.

Moreover, in our paper we find that this phenomena is stronger in the agriculture and the services sectors and that given the high participation of the services sector in the GDP, near 60%, and in the lending portfolio of banks, near 42%, this monetary policy channel should not be overlooked in the monetary policy decisions making process.

Our results are robust in terms of the time horizon used to define our variable of firm risk and they address the same results when we analyze ex post defaults instead of ex ante risk. That is the agricultural and the services sectors are the more vulnerable sectors when we analyze the behavior of firms in the future.

Finally, we also find that in terms of leverage, in the services sector the less leveraged firms are the most affected, and in terms of the profitability the less profitable ones are also the most affected (that is the most credit constraint).

Tab. 1: **Total Sample Summary Statistics**[a]

Dependent variables	Description	Mean	Minimun	Maximum	St. Dev.
$I\left(FIRM\ RISK\right)_{ft}$	Equals 1 if in period t the firm f had commited default in the six previous months to t. Equals 0 otherwise.	0.10	0	1	-
$LOAN_{fbt}$	Loan portfolio in billions of COP from firm f with bank b at t.	2.28	0	366.64	7.45
$I\left(FUTURE\ DEFAULT_{ft}\right)$	Equals 1 when a loan is granted to firm f in t and defaults at some point between $t+1$ and $t+8$. Equals 0 otherwise.	0.11	0	1	-
Independent Variables					
Macroeconomic Variables					
$INTEREST\ RATE_t$	Interbank policy rate in t (%).	5.62	3.02	9.93	2.24
$TAYLOR_t$	Policy rate deviation from a taylor base rule (%).	0.21	-1.43	2.09	0.94
$\triangle GDP_t$	Quarterly GDP anual growth rate (%).	4.792	1.010	7.416	1.621
$\triangle CPI_t$	Quarterly CPI annual growth rate (%).	3.96	1.83	7.67	1.61
$RERI$	Quarterly real exchange rate index.	88.036	76.08	110.32	8.38
Bank Variables					
$BANK\ CAPITAL_{bt}$	Total equity as a share of total assets of bank b at t (%).	4.38	0.75	46.83	1.96
$BANK\ SIZE_{bt}$	Ln of total assets of bank b at t.	9.862	4.853	11.421	0.741
$BANK\ NPL_{bt}$	Fractions of loans from bank b at t that are in default as a fraction of assets (%).	2.93	1.19	18.76	1.08
$BANK\ ROA_{bt}$	Net profits/assets (%).	1.3	-4.94	8.32	0.67
Firm Variables					
$FIRM\ AGE_{ft}$	Number of quarters a firm has been in the financial system.	63.469	0.000	208.000	24.558
$FIRM\ LEVERAGE_{ft}$	Registered relation between liabilities and assets from firm f at t (%)	0.512	0.000	7.544	0.222
$FIRM\ SIZE_{ft}$	Ln of total assets of firm f at t.	3.179	-2.460	9.398	1.463
$FIRM\ ROE$	Return on Equity	0.053	-250.4	130.8	1.63

[a] Summary statistics report for the entire sample consisting of 305,691 observations for the period 2005:1 - 2014:3.

Tab. 2: **Sectors Summary Statistics**[a]

No. of firms: 3,019					
No. of banks: 19					
Agriculture[b]		Mean	Minimun	Maximum	St. Dev.
No. of firms: 259	259				
No. of observations: 16,905	16,905.0				
Average loan portfolio Billions COP	631				
$I\,(FIRM\,RISK)$		0.11	0	1	-
$FIRM\ SIZE$		3.068	-0.283	6.317	1.259
$FIRM\ AGE$		57.106	0	113	18.948
$FIRM\ LEVERAGE$		0.413	0.001	3.638	0.227
$FIRM\ ROE$		0.013	-6.303	6.278	0.366
Average Interest Rate	0.159				
Share in GDP	0.036				
Manufacturing					
No. of firms: 863	863				
No. of observations: 108,973	108,973.0				
Average loan portfolio Billions COP	7,900.0				
$I\,(FIRM\,RISK)$		0.104	0	1	-
$FIRM\ SIZE$		3.451	-1.064	8.392	1.458
$FIRM\ AGE$		66.61	0	207	24.685
$FIRM\ LEVERAGE$		0.474	0	4.447	0.195
$FIRM\ ROE$		0.033	-82.062	12.728	1.225
Average Interest Rate	0.143				
Share in GDP	0.11				
Services					
No. of firms: 1,649	1,649				
No. of observations: 146,824	146,824.0				
Average loan portfolio Billions COP	7,150.0				
$I\,(FIRM\,RISK)$		0.104	0	1	-
$FIRM\ SIZE$		2.912	-2.46	9.397	1.397
$FIRM\ AGE$		62.527	0	208	25.248
$FIRM\ LEVERAGE$		0.543	0	7.543	0.233
$FIRM\ ROE$		0.061	-12.566	1.162	0.404
Average Interest Rate	0.160				
Share in GDP	0.592				
Construction					
No. of firms: 248	248				
No. of observations: 20,947	20,947.0				
Average loan portfolio Billions COP	1,390.0				
$I\,(FIRM\,RISK)$		0.101	0	1	-
$FIRM\ SIZE$		3.369	-1.09	7.307	1.599
$FIRM\ AGE$		60.553	0	147	21.863
$FIRM\ LEVERAGE$		0.571	0.001	1.021	0.197
$FIRM\ ROE$		0.083	-12.566	1.162	0.404
Average Interest Rate	0.149				
Share in GDP	0.074				

[a] This table reports summary statistics for firm variables specifying by economic sector.
[b] Firms were classified according to ISIC rev. 3

Tab. 3: **Benchmark**[a]

Dependent Variable: $LN(LOAN_{fbt})$					
Independent Variables:	**Total**	**Agriculture**	**Manufacturing**	**Services**	**Construction**[b]
$I\left(FIRM\ RISK_{ft}\right)$	-0.1***	-0.176**	-0.135***	-0.023	-0.406***
	(0.017)	(0.079)	(0.027)	(0.024)	(0.075)
$BANK\ SIZE_{bt}$	0.379***	0.39***	0.36***	0.356***	0.611***
	(0.006)	(0.029)	(0.01)	(0.009)	(0.027)
$BANK\ NPL_{bt}$	-4.419***	-2.194	-1.958***	-7.012***	0.594
	(0.437)	(1.862)	(0.725)	(0.609)	(1.702)
$BANK\ ROA_{bt}$	4.468***	2.216	9.702***	1.283	0.602
	(0.659)	(2.779)	(1.065)	(0.927)	(2.73)
$\triangle GDP_t$	-0.008***	0	-0.004	-0.017***	0.03**
	(0.003)	(0.014)	(0.005)	(0.004)	(0.013)
$\triangle CPI_t$	1.042***	-4.985***	2.602***	0.885*	-1.479
	(0.357)	(1.498)	(0.585)	(0.499)	(1.458)
$RERI_t$	-0.014***	-0.02***	-0.007***	-0.018***	-0.02***
	(0.00)	(0.002)	(0.001)	(0.00)	(0.002)
No. of groups:	3,019	259	863	1,649	248
No. of observations:	285,365	16,564	105,595	142,654	20,552
R^2	0.417	0.413	0.396	0.426	0.419

[a] This tables report estimates for the loan benchmark between riskier and non-riskier borrowers. Estimation results are presented using OLS with firm fixed effects. The dependent variable is $Ln(LOAN_{ft})$ which accounts the total loan amount a firm f has with a bank b in period t. The definition of the independent variables can be found in Table 1. First row of each variables represent the coefficient, second row the standard errors clustered at the firm level. ***, ** and * represent significance at the p<0.01, p<0.05 and p<0.01 percent level respectively.

[b] Firms were classified according to ISIC rev. 3

Tab. 4: **Double interaction**[a]

Dependent Variable: $LN(LOAN_{fbt})$

Independent Variables:	**Total**	**Agriculture**	**Manufacturing**	**Services**	**Construction**[b]
$I\left(FIRM\ RISK_{ft}\right)$	-0.337***	-0.661***	-0.328***	-0.305***	-0.412*
	(0.048)	(0.203)	(0.079)	(0.066)	(0.214)
$TAYLOR_{t-1}$	1.283***	-0.534	1.628**	1.031	3.125*
	(0.455)	(1.934)	(0.744)	(0.636)	(1.862)
$TAYLOR_{t-1} * I\left(FIRM\ RISK_{ft}\right)$	-4.028***	-8.214**	-3.692**	-4.541***	0.478
	(0.931)	(3.802)	(1.518)	(1.295)	(4.119)
$BANK\ SIZE_{bt}$	0.304***	0.23***	0.337***	0.257***	0.521***
	(0.007)	(0.033)	(0.012)	(0.01)	(0.03)
$BANK\ NPL_{bt}$	-6.741***	-5.103**	-3.272***	-10.339***	0.398
	(0.51)	(2.099)	(0.855)	(0.71)	(1.979)
$BANK\ ROA_{bt}$	6.531***	6.686**	10.144***	3.918***	4.559
	(0.672)	(2.823)	(1.088)	(0.944)	(2.779)
$\triangle GDP_t$	-0.008**	-0.001	-0.004	-0.017***	0.034**
	(0.003)	(0.014)	(0.005)	(0.004)	(0.013)
$\triangle CPI_t$	1.6***	-5.95***	3.399***	1.248*	0.539
	(0.457)	(1.904)	(0.748)	(0.638)	(1.865)
$RERI_t$	-0.014***	-0.02***	-0.007***	-0.018***	-0.019***
	(0.00)	(0.002)	(0.001)	(0.00)	(0.002)
No. of groups:	3,019	259	863	1,649	248
No. of observations:	285,365	16,564	105,595	142,654	20,552
R^2	0.418	0.413	0.396	0.426	0.419

[a] This tables report estimates for the risk-taking channel by sector. Regressions explain the loan benchmark between riskier and non-riskier borrowers, and the risk-taking channel using a double interaction between $TAYLOR_{t-1}$ and $FIRM\ RISK_{ft}$. Estimation results are presented using OLS with firm fixed effects. The dependent variable is $Ln(LOAN_{ft})$ which accounts the total loan amount a firm f has with a bank b in period t. The definition of the independent variables can be found in Table 1. First row of each variables represent the coefficient, second row the standard errors clustered at the firm level. ***, ** and * represent significance at the p<0.01, p<0.05 and p<0.01 percent level respectively.

[b] Firms were classified according to ISIC rev. 3

Tab. 5: **Triple interaction**[a]

Dependent Variable: $LN(LOAN_{fbt})$					
Independent Variables:	**Total**	**Agriculture**	**Manufacturing**	**Services**	**Construction**[b]
$I\left(FIRM\ RISK_{ft}\right)$	-0.336***	-0.645***	-0.318***	-0.312***	-0.393*
	(0.048)	(0.202)	(0.078)	(0.066)	(0.214)
$TAYLOR_{t-1}$	1.054**	-1.165	1.336*	0.882	2.849
	(0.455)	(1.926)	(0.743)	(0.635)	(1.861)
$TAYLOR_{t-1} * I\left(FIRM\ RISK_{ft}\right)$	-9.25***	-21.114***	-7.013***	-10.334***	-2.529
	(1.137)	(4.699)	(1.806)	(1.62)	(5.04)
$BANK\ CAPITAL_{bt}$	-6.512***	-11.371***	-7.648***	-5.244***	-6.163***
	(0.243)	(1.132)	(0.393)	(0.337)	(1.039)
$TAYLOR_{t-1} * BANK\ CAPITAL_{bt}$					
$*I\left(FIRM\ RISK_{ft}\right)$	116.158***	313.819***	76.652***	126.195***	65.27
	(14.603)	(65.887)	(22.046)	(21.542)	(62.479)
$BANK\ SIZE_{bt}$	0.311***	0.26***	0.346***	0.262***	0.527***
	(0.007)	(0.033)	(0.012)	(0.01)	(0.03)
$BANK\ NPL_{bt}$	-6.785***	-7.06***	-3.214***	-10.334***	0.567
	(0.509)	(2.095)	(0.853)	(0.709)	(1.977)
$BANK\ ROA_{bt}$	2.84***	0.399	5.477***	1.016	1.888
	(0.682)	(2.858)	(1.108)	(0.956)	(2.808)
$\triangle GDP_t$	-0.002	0.006	0.002	-0.012***	0.041***
	(0.003)	(0.014)	(0.005)	(0.004)	(0.014)
$\triangle CPI_t$	1.161**	-6.247***	2.894***	0.887	-0.039
	(0.456)	(1.896)	(0.747)	(0.638)	(1.866)
$RERI_t$	-0.013***	-0.019***	-0.006***	-0.018***	-0.018***
	(0.00)	(0.002)	(0.001)	(0.00)	(0.002)
No. of groups:	3,019	259	863	1,649	248
No. of observations:	285,363	16,564	105,593	142,654	20,552
R^2	0.419	0.418	0.398	0.427	0.421

[a] This tables report estimates for the risk-taking channel by sector. Regressions explain the loan benchmark between riskier and non-riskier borrowers, and the risk-taking channel for more capitalized banks using a triple interaction between $TAYLOR_{t-1}$, $BANK\ CAPITAL_{bt}$ and $FIRM\ RISK_{ft}$. Estimation results are presented using OLS with firm fixed effects. The dependent variable is $Ln(LOAN_{ft})$ which accounts the total loan amount a firm f has with a bank b in period t. The definition of the independent variables can be found in Table 1. First row of each variables represent the coefficient, second row the standard errors clustered at the firm level. ***, ** and * represent significance at the p<0.01, p<0.05 and p<0.01 percent level respectively.

[b] Firms were classified according to ISIC rev. 3

Tab. 6: **Robustness**[a]

Dependent Variable: $LN(LOAN_{fbt})$					
2 year horizon:	**Total**	**Agriculture**	**Manufacturing**	**Services**	**Construction**[b]
$BANK\ CAPITAL_{bt}$	-6.421***	-10.735***	-7.854***	-5.34***	-5.294***
	(0.252)	(1.198)	(0.409)	(0.350)	(1.071)
$TAYLOR_{t-1} * BANK\ CAPITAL_{bt} * I\left(FIRM\ RISK_{ft}\right)$	86.196***	287.795***	30.571***	96.567***	98.12
	(12.705)	(60.073)	(19.500)	(18.405)	(58.731)
No. of groups:	2944	234	851	1566	231
No. of observations:	258,109	14,327	95,415	126,609	17,891
R^2	0.435	0.435	0.419	0.442	0.441
3 year horizon:					
$BANK\ CAPITAL_{bt}$	-6.496***	-11.233***	-7.669***	-5.477***	-5.725***
	(0.245)	(1.173)	(0.397)	(0.340)	(1.050)
$TAYLOR_{t-1} * BANK\ CAPITAL_{bt} * I\left(FIRM\ RISK_{ft}\right)$	116.723***	308.611***	77.473***	127.591***	5.567
	(15.170)	(70.558)	(22.675)	(22.707)	(67.296)
No. of groups:	2,944	234	851	1,566	231
No. of observations:	258,109	14,327	95,415	126,609	17,891
R^2	0.436	0.435	0.420	0.442	0.441

[a] This tables report estimates for the risk-taking channel by sector. Regressions explain the risk-taking channel for more capitalized banks using a triple interaction between $TAYLOR_{t-1}$, $BANK\ CAPITAL_{bt}$ and $FIRM\ RISK_{ft}$. For the first regression, $FIRM\ RISK_t$ equals 1 if in period t the firm had commited default in the two previous years; For the second regression, $FIRM\ RISK_t$ equals 1 if the firm had commited default in the three previous years. Estimation results are presented using OLS with firm fixed effects. The dependent variable is $Ln(LOAN_{ft})$ which accounts the total loan amount a firm f has with a bank b in period t. The definition of the independent variables can be found in Table 1. First row of each variables represent the coefficient, second row the standard errors clustered at the firm level. ***, ** and * represent significance at the p<0.01, p<0.05 and p<0.01 percent level respectively.

[b] Firms were classified according to ISIC rev. 3

Tab. 7: **The Probability that a Firm becomes delinquent with the Bank in the future**[a]

Dependent Variable: $I\left(FUTURE\ DEFAULT_{ft}\right)$					
Independent Variables:	**Total**	**Sector 1**	**Sector 3**	**Sector 4**	**Sector 5**[b]
$TAYLOR_{t-1}$	-20.516***	-25.704***	-22.566***	-19.518***	-15.108**
	(1.696)	(8.042)	(2.658)	(2.467)	(6.891)
$BANK\ CAPITAL_{bt-1}$	-0.423	14.833*	-0.884	-1.987	-1.273
	(1.748)	(8.607)	(2.756)	(2.53)	(7.000)
$TAYLOR_{t-1} * I\left(FIRM\ RISK_{ft}\right)$	172.66***	564.846***	168.488***	164.677***	-85.025
	(34.229)	(168.942)	(53.544)	(49.615)	(138.959)
$BANK\ SIZE_{bt}$	-0.844***	-0.485***	-0.800***	-0.803***	-1.562***
	(0.038)	(0.181)	(0.061)	(0.054)	(0.158)
$BANK\ NPL_{bt}$	26.181***	26.446***	25.801***	27.571***	18.607***
	(1.616)	(7.148)	(2.65)	(2.299)	(6.312)
$BANK\ ROA_{bt}$	10.872***	19.002***	11.819***	9.027***	16.302***
	(1.519)	(7.019)	(2.459)	(2.164)	(6.173)
$\triangle GDP_t$	-0.25***	-0.169***	-0.252***	-0.268***	-0.169***
	(0.008)	(0.035)	(0.013)	(0.011)	(0.033)
$\triangle CPI_t$	4.459***	17.654***	4.104**	5.652***	-16.84***
	(1.025)	(4.65)	(1.665)	(1.458)	(4.196)
$RERI_t$	-0.054***	-0.051***	-0.051***	-0.058***	-0.051***
	(0.001)	(0.006)	(0.002)	(0.002)	(0.005)
No. of groups:	2,905	144	1,037	1,478	207
No. of observations:	74,417	3,073	27,873	37,538	4,852

[a] This tables report estimates for ex-post default by sector. Regressions explain the probability that a loan is granted to a firm and subsequently defaults in a two year horizon. Estimation results are presented using logit models using firm fixed-effects. The dependent variable is $FUTURE\ DEFAUL_{ft}$ which equals 1 when a loan is granted to firm f in t and defaults in some point in a two year horizon. The definition of the independent variables can be found in Table 1. First row of each variables represent the coefficient, second row the standard errors clustered at the firm level. ***, ** and * represent significance at the p<0.01, p<0.05 and p<0.01 percent level respectively.

[b] Firms were classified according to ISIC rev. 3

Tab. 8: **Leverage**[a]

Dependent Variable: $LN(LOAN_{fbt})$				
Under median:	**Agriculture**	**Manufacturing**	**Services**	**Construction**[b]
$TAYLOR_{t-1} * BANK\ CAPITAL_{bt} * I\left(FIRM\ RISK_{ft}\right)$	518.178***	67.062**	141.591***	379.596***
	(100.5703)	(31.784)	(42.597)	(134.679)
No. of groups:	202	715	1130	149
No. of observations:	8962	49154	43495	5325
Above median:				
$TAYLOR_{t-1} * BANK\ CAPITAL_{bt} * I\left(FIRM\ RISK_{ft}\right)$	-96.604	84.939***	63.769**	-8.926
	(103.249)	(31.272)	(26.328)	(74.176)
No. of groups:	82	468	925	183
No. of observations:	4273	37313	66592	10442

[a] This tables report estimates for the risk-taking channel by sector according to the size of the firm. This table present the results of estimating the triple interaction for the firms that are above the average age and under the average age. Estimation results are presented using OLS with firm fixed effects. The dependent variable is $LN(LOAN)$ which accounts the total loan amount a firm f has with a bank b in period t. The definition of the independent variables can be found in **??**. First row of each variables represent the coefficient, second row the standard errors clustered at the firm level. ***, ** and * represent significance at the p<0.01, p<0.05 and p<0.01 percent level respectively.

[b] Firms were classified according to ISIC rev. 3

Tab. 9: **ROE**[a]

Dependent Variable: $LN(LOAN_{fbt})$				
Under median:	**Agriculture**	**Manufacturing**	**Services**	**Construction**[b]
$TAYLOR_{t-1} * BANK\ CAPITAL_{bt} * I\left(FIRM\ RISK_{ft}\right)$	354.313***	60.643**	256.527***	240.062**
	(90.203)	(28.142)	(33.763)	(96.504)
No. of groups:	221	715	1262	191
No. of observations:	9207	46301	49484	6993
Above median:				
$TAYLOR_{t-1} * BANK\ CAPITAL_{bt} * I\left(FIRM\ RISK_{ft}\right)$	435.36***	84.842**	-15.099	-1.81
	(146.28)	(36.583)	(31.361)	(94.7588)
No. of groups:	125	727	1224	192
No. of observations:	4030	40274	60694	8774

[a] This tables report estimates for the risk-taking channel by sector according to the size of the firm. This table present the results of estimating the triple interaction for the firms that are above the average age and under the average age. Estimation results are presented using OLS with firm fixed effects. The dependent variable is $LN(LOAN)$ which accounts the total loan amount a firm f has with a bank b in period t. The definition of the independent variables can be found in **??**. First row of each variables represent the coefficient, second row the standard errors clustered at the firm level. ***, ** and * represent significance at the p<0.01, p<0.05 and p<0.01 percent level respectively.

[b] Firms were classified according to ISIC rev. 3

Fig. 1: Taylor

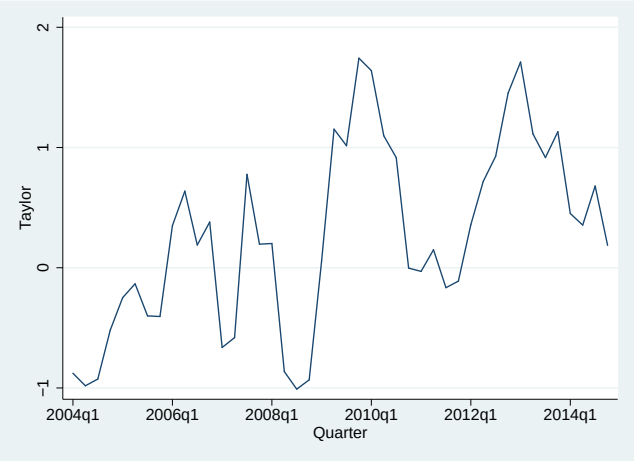
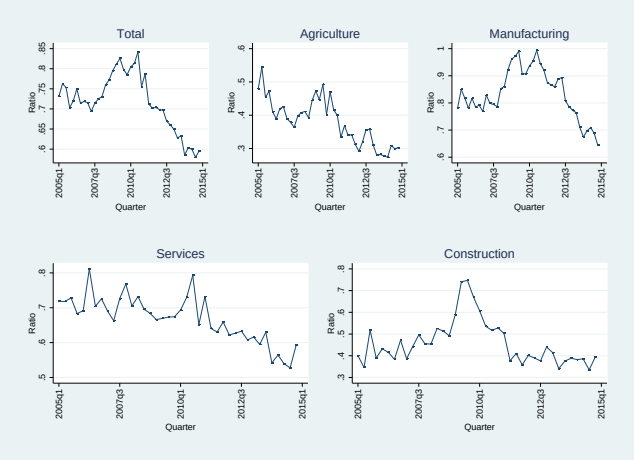


Fig. 2: Ratio of credit to risky versus safe borrowers



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