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The risk-taking channel and monetary transmission mechanism in Colombia

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The Risk Taking Channel and Monetary Transmission Mechanism in Colombia

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Outline

1. Motivation
   - The impact of monetary policy on risk taking behavior of financial intermediaries
   - Previous Work: First empirical study for Colombia
2. The Model: hazard rate model
3. Our Results/Contribution
   - Lower interest rates raise the probability of default on new loans but reduce that on outstanding loans
   - This channel of policy transmission depends on some bank, loan and borrower characteristics and
   - On macroeconomic conditions such as the rate of growth of the economy.
   - Effect of monetary policy is asymmetric

Motivation

- The recent financial crisis has brought to the forefront the need of a better understanding of the transmission mechanisms of monetary policy.
- The main step forward in this direction has drawn on work aimed at stressing the role of the financial sector in this transmission.
- Particular emphasis has been placed on how policy actions impact risk perceptions and attitudes of banks and other financial institutions, leading to shifts in the supply of credit

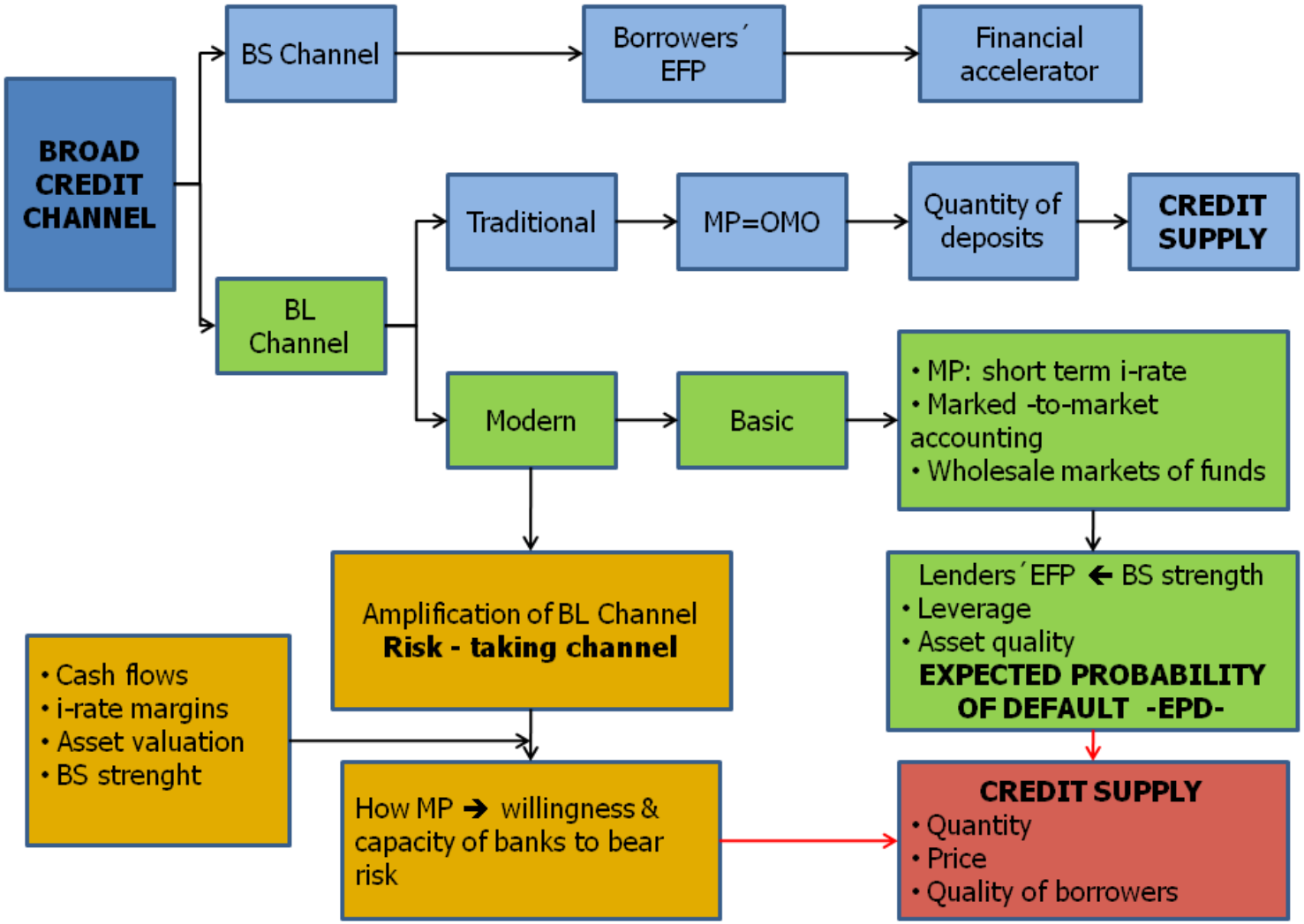
Our Work.

- We use a data set from the Credit Register from Colombia that contains detailed information on individual bank loans during the period 2000:I-2008-IV to investigate the impact of monetary policy stance on the risk-taking behavior of banks.
- Using econometric models of duration, the present paper finds a significant link between low interest rates and banks' risk taking in Colombia.

The risk taking channel of monetary policy

- The monetary policy shocks may be reinforced as the result of:
  1. Variations in the health of financial intermediaries in terms of leverage and asset quality,
  2. Variations in perception of risk and willingness to bear risk.
- The level of interest rates may influence risk taking behavior, Borio and Zhu (2008)
- In times when interest rates are low, the search for yield is often associated with the expansion of investment into riskier assets and borrowers as downside risk are played down. Adrian and Shin (2008).

The risk taking channel



The risk taking channel

Testing the BLC/RTC for Colombia

1. Funding of banks: basically core liabilities (deposits, CDs) + repos. No wholesale market for funds.
2. Marked-to-market accounding, not well-developed. Even less for banks' liabilities

What is the relevance of concepts such as EFP and EDP?

MP regime in Colombia, Inflation Targeting: the CB sets the over-night interest rate and provides the liquidity demanded at that rate.

Two approaches

A

Perceived probability of default as influenced by both interest rate decisions of the central bank and the state of the economy: Gambacorta (2009), Jimenez et al (2009), Altunbas et al (2009a), and López et al (2010).

B

Studies with a longer tradition that look for a direct link between changes in the policy rate and the supply of credit: Altunbas et al (2009b), Kashyap and Stein (2000), Ioannidou et al (2009) and López and Tenjo (forthcoming).

Our measure of bank risk and the data

- Our measure of credit risk is the hazard rate or the probability of loan default during each period of the life of the loan given that default did not occur before.
- The basis for the estimation of a measure of bank risk is a data set for Colombia, consisting of quarterly information on 2,095,755 individual commercial loans for the period 2000:I to 2008:IV provided by Superfinanciera.
- We were able to obtain information for borrower (age as borrower, borrower risk),
- lending bank (bank size, leverage) and
- some details of the loans (amount, collateralization, maturity and payment information)

How to handle the endogeneity of the policy rate

- In principle, there could be a two-way relation between loan risk and monetary policy.
- However, during the period of the study, 2000 to 2008, the central bank in Colombia did not *systematically* take into account bank risk considerations in its policy decisions on interest rates.
- Nevertheless, as a robutness excersice, we used as the stance of monetary policy the deviations of the policy rate from the natural rate of interest and from a rate implied by a Taylor rule (as in Gambacorta (2009)).

The model

- We use a duration or hazard function model to study the time to default of individual bank loans.
- In duration models the dependent variable is duration, in this case, the time it takes for a loan to change from one state to another.
- Let T represent the time that elapses before the occurrence of the default of the loan. The passage of time is often referred as a spell.
- A simple way to describe the behavior of a spell is through its survivor function,$S(\xi) = P(T \geq \xi)$, which yields the probability that the spell T lasts at least to time ξ

The model

- Alternatively, the hazard function determines the conditional probability that the spell ends in a short time after, provided that it has reached time

$$\lambda(\xi) = \lim_{\triangle\xi \to 0} \frac{P(\xi \leq T + \Delta\xi | T \geq \xi)}{\Delta\xi} = \frac{f(\xi)}{S(\xi)} \qquad (1)$$

where $f(\xi)$ es the density function associated with the distributions of spells.

The model

- Usually, when estimating hazard functions it is convenient to assume a proportional hazard specification:

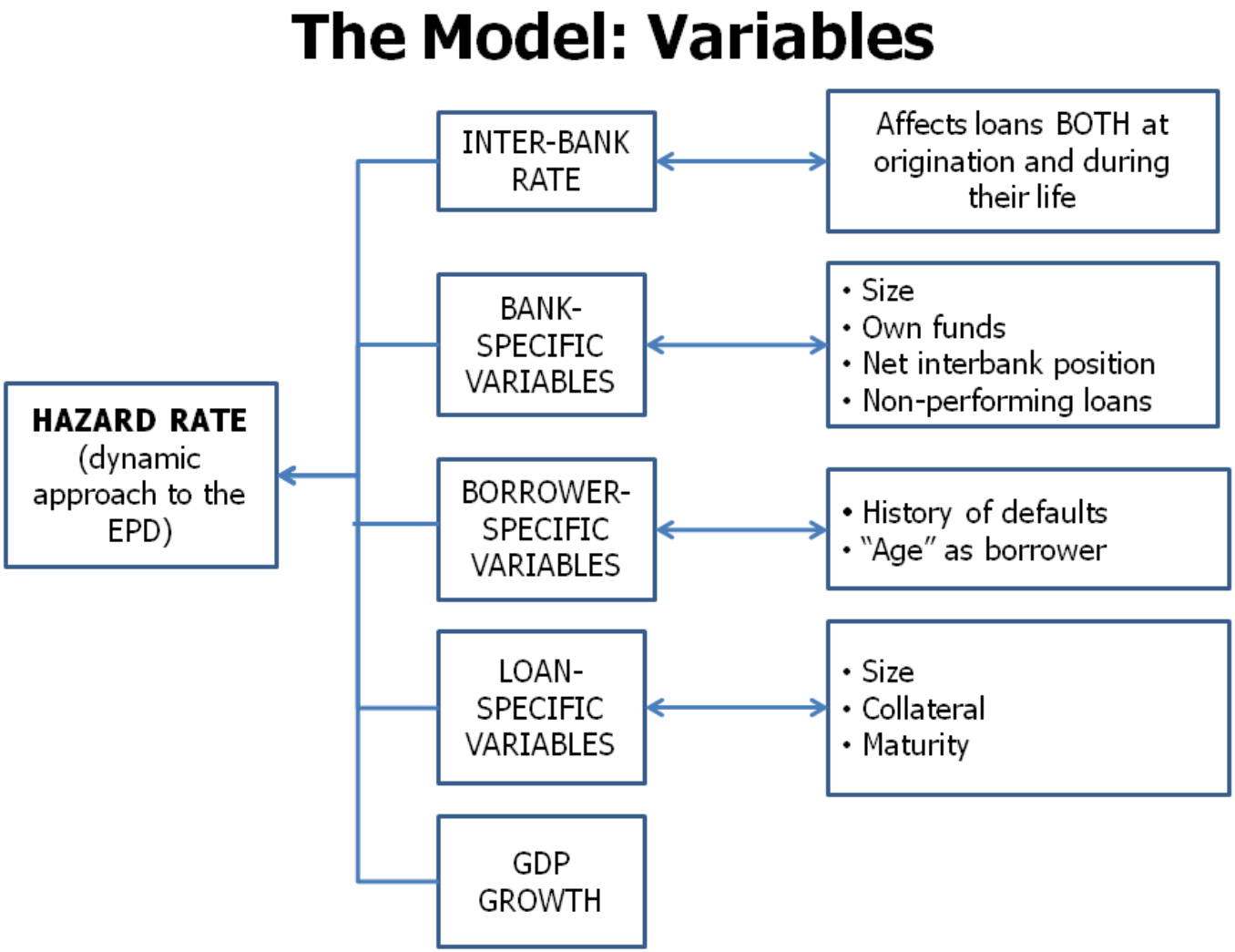
$$\lambda(\xi, x, \beta) = \lambda_0(\xi) exp(x'\beta) \tag{2}$$

  - where x is a vector of covariates, β a vector of parameters and λ_0 is a baseline hazard function
- The test of proportional hazard specification was rejected when we used the test proposed by Shoenfeld and graphical analysis of the residuals.
- Therefore we use an Accelerator Failure Time Model by modelling lnt instead of t

The baseline hazard rate

- In our benchmark model we use a Weibull specification for the baseline hazard rate λ_0 , where $\lambda_0 = \lambda\alpha\xi^{\alpha}$, which is monotonically increasing if $\alpha > 1$, and monotonically decreasing if $\alpha < 1$
- Our benchmark model has this specification because after one or two initial quarters overdue, repayments could become conditionally more likely over the life of the loan.
- We estimate different models with different specifications for the baseline hazard rates.

Variables


The Model: Variables
HAZARD RATE
(dynamic approach to the EPD)
INTER-BANK RATE
Affects loans BOTH at origination and during their life
BANK-SPECIFIC VARIABLES
• Size
• Own funds
• Net interbank position
• Non-performing loans
BORROWER-SPECIFIC VARIABLES
• History of defaults
• "Age" as borrower
LOAN-SPECIFIC VARIABLES
• Size
• Collateral
• Maturity
GDP GROWTH

Variables

Table 1. Descriptive Satistics

Variables	Definition	Mean	Std.Dev	Min	Max
Default	1 if default, i.e. if three months after the date of maturity or the date of an interest payment, the debt balance remains unpaid	0.099	0.298	0.000	1.000
INTEREST RATE (%)	Real TIB (interbank rate)	2.183	1.711	-0.593	4.764
BANK SIZEb (%)	Relative size of the bank vis-a vis the other banks	8.467	5.366	0.034	20.672
OWN FUNDS/TOTAL ASSETSb (%)	The amount of bank equity over total bank assets	5.096	2.752	0.093	101.080
INTERBANK POSITION/TOTAL ASSETSb(%)	The net amount of interbank lending by the bank over total assets	-1.028	2.880	-23.330	10.461
BANK NPLb-NPL(%)	The difference between the bank and the other banks level of NPLs	0.000	11.394	-80.440	29.743
BORROWER RISKf (0/1)	1 if the borrower was overdue any time before on another loan	15.184	35.886	0.000	100.000
LN(2+AGE AS BORROWERf)	Age is the number of years from the first time the firm borrowed from a bank	2.889	0.683	1.386	3.727
LN(SIZE OF THE LOANl)	The log of the loan amount	16.308	1.510	12.467	19.499
COLLATERALl(0/1)	1 if the loan is collaterized	0.522	0.500	0.000	1.000
MATURITY 3m-1y (0/1)	1 if the loan matures between 3 months and 1 year	0.058	0.234	0.000	1.000
MATURITY 1y-3y (0/1)	1 if the loan matures between 1 year and 3 years	0.148	0.355	0.000	1.000
MATURITY 3y-5y (0/1)	2 if the loan matures between 3 year and 5 years	0.206	0.404	0.000	1.000
GDPG(%)	Growth in real gross domestic product	0.048	0.023	-0.005	0.084
EFFICIENCY RATIO (%)	Operating Margin/Total Assets	0.392	0.458	-0.975	0.994
FINANCIAL INCOME/ATA(%)	Interest income plus dividends received over average total assets	2.558	0.300	1.988	3.133

Non Time-Varying Duration Models

Independent Variables	Weibull		Lognormal		Logistic		Normal	
	Coefficient	Sig.	Coefficient	Sig.	Coefficient	Sig.	Coefficient	Sig.
INTEREST RATE $_{\zeta-1}$	-0,0131	***	-0,0200	***	-0,0180	***	-0,1262	***
INTEREST RATE $_{\zeta+T-1}$	0,1330	***	0,1011	***	0,1188	***	0,7987	***
INTEREST RATE $_{\zeta-1}$ * BANK SIZE$_{b\zeta-1}$								
INTEREST RATE $_{\zeta-1}$ * OWN FUNDS$_{b\zeta-1}$								
BANK SIZE $_{b\zeta-1}$	-0,0232	***	-0,0217	***	-0,0243	***	-0,1535	***
OWN FUNDS/TOTAL ASSETS $_{b\zeta-1}$	-0,0228	***	-0,0349	***	-0,0466	***	-0,2347	***
INTERBANK POSITION /TOTAL ASSETS $_{b\zeta-1}$	0,0206	***	0,0238	***	0,0195	***	0,1679	***
BANK NPL $_{b\zeta-1}$ - NPL $_{\zeta-1}$	0,0054	***	0,0055	***	0,0059	***	0,0393	***
BORROWER RISK $_{f\zeta-1}$ (0/1)	0,0005	***	0,0003	***	0,0003	***	0,0029	***
LN (2+AGE AS BORROWER $_{fi\zeta}$)	0,0375	***	0,0054	***	-0,0040	***	0,3271	***
LN (SIZE OF THE LOAN $_{i\zeta}$)	-0,0114	***	-0,0111	***	-0,0102	***	-0,0337	***
COLLATERAL $_{i}$ (0/1)	0,3437	***	0,3329	***	0,3330	***	2,0724	***
FINANCIAL CREDIT $_{i}$ (0/1)								
MATURITY $_{i}$ 0m.-3m. (0/1)	-1,0102	***	-0,8798	***	-0,8753	***	-4,8370	***
MATURITY $_{i}$ 3m.-1y. (0/1)	-0,3250	***	-0,2508	***	-0,2352	***	-2,1767	***
MATURITY $_{i}$ 1y.-3y. (0/1)	0,0251	***	0,0333	***	0,0459	***	-0,0024	***
MATURITY $_{i}$ 3y.-5y. (0/1)								
GPDG $_{\zeta-1}$	0,9547	***	1,0746	***	0,7250	***	7,7296	***
GPDG $_{\zeta+T-1}$	-12,5974	***	-13,6722	***	-14,8366	***	-97,3673	***
TIME TREND	-0,0058	***	0,0037	***	0,0020	***	0,0033	***
TIME TREND ^{2}	-0,0002	***	-0,0008	***	-0,0011	***	-0,0086	***
EFFICIENCY RATIO $_{i\zeta}$								
FINANCIAL INCOME/ATA $_{i\zeta}$								
CONSTANT	2,6345	***	2,6273	***	2,7490	***	12,0662	***
ln(ά) (duration dependence)	0,5703	***	0,6629	***	0,3850	***	4,3274	***
Log pseudolikehood	-609386		-579179		-588617		-1456861	

Non Time-Varying Duration Models - Part Two

Independent Variables	Weibull Coefficient	Sig.	Weibull with interaction Coefficient	Sig.	Weibull with interaction Coefficient	Sig.
INTEREST RATE $_{\zeta-1}$			-0,0430	***	-0,0154	***
INTEREST RATE $_{\zeta+T-1}$			0,1342	***	0,1328	***
LNATURAL $_{\zeta-1}$	-0,0045	***				
LNATURAL $_{\zeta+T-1}$	0,1754	***		***		
INTEREST RATE $_{\zeta-1}$ * BANK SIZE$_{b\zeta-1}$			0,0036			
INTEREST RATE $_{\zeta-1}$ * OWN FUNDS$_{b\zeta-1}$					0,0006	***
BANK SIZE $_{b\zeta-1}$	-0,0237	***	-0,0308	***	-0,0235	***
OWN FUNDS/TOTAL ASSETS $_{b\zeta-1}$	-0,0226	***	-0,0225	***	-0,0252	***
INTERBANK POSITION /TOTAL ASSETS $_{b\zeta-1}$	0,0192	***	0,0200	***	0,0199	***
BANK NPL $_{b\zeta-1}$ - NPL $_{\zeta-1}$	0,0056	***	0,0053	***	0,0054	***
BORROWER RISK $_{f\zeta-1}$ (0/1)	0,0005	***	0,0005	***	0,0005	***
LN (2+AGE AS BORROWER $_{fi\zeta}$)	0,0409	***	0,0383	***	0,0373	***
LN (SIZE OF THE LOAN $_{i\zeta}$)	-0,0112	***	-0,0109	***	-0,0114	***
COLLATERAL $_{i}$ (0/1)	0,3422	***	0,3440	***	0,3429	***
FINANCIAL CREDIT $_{i}$ (0/1)						
MATURITY $_{i}$ 0m.-3m. (0/1)	-1,0141	***	-1,0083	***	-1,0102	***
MATURITY $_{i}$ 3m.-1y. (0/1)	-0,3214	***	-0,3237	***	-0,3252	***
MATURITY $_{i}$ 1y.-3y. (0/1)	0,0211	***	0,0263	***	0,0251	***
MATURITY $_{i}$ 3y.-5y. (0/1)						
GPDG $_{\zeta-1}$	0,8327	***	0,9013	***	0,9446	***
GPDG $_{\zeta+T-1}$	-9,4598	***	-12,6153	***	-12,5946	***
TIME TREND	-0,0061	***	-0,0059	***	-0,0058	***
TIME TREND ^{2}	-0,0003	***	-0,0002	***	-0,0002	***
EFFICIENCY RATIO $_{i\zeta}$						
FINANCIAL INCOME/ATA $_{i\zeta}$						
CONSTANT	2,7283	***	2,6832	***	2,6491	***
ln(á) (duration dependence)	0,5696	***	0,5703	***	0,5703	***
Log pseudolikehood	-609386		-609144		-609379	

Our Results/Contribution

- More Interesting results:
  - Lower policy interest rates are associated with:
    - Higher HR on new loans
    - Lower HR on existing loans
  - Higher GDP growth is associated with:
    - Higher HR on new loans
    - Lower HR on exisint loans

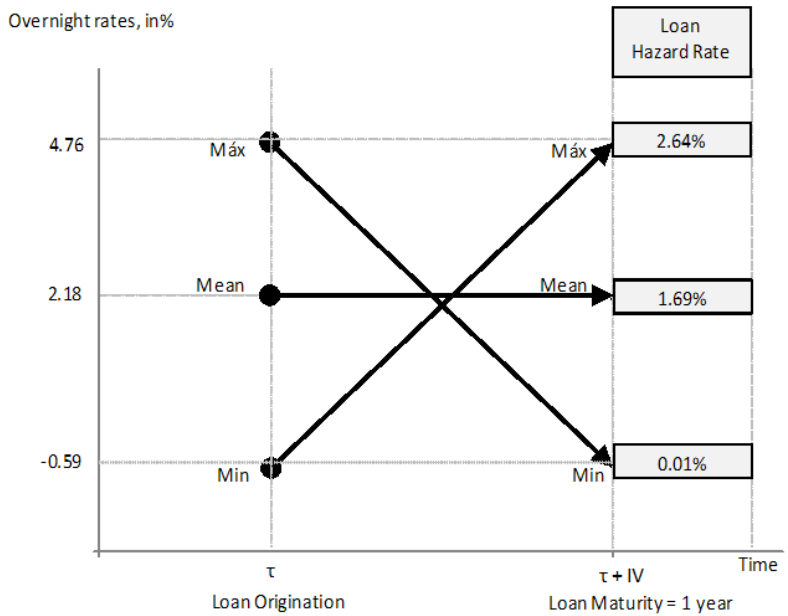
- Other more intuitive results:
  - Smaller and more highly leveraged banks are more willing to take risks
  - More reliance on interbank market and higher incidence of non-performance loans increase hazard rates
  - Size and maturity of loans, negatively correlated with probability of default
  - There is a sort of "path dependence" in borrowers' probability of default on their loans.

From the conceptual to the empirical model

- HRs, sensitive to balance sheet strength:
  - leverage
  - asset quality (non-performing loans)
  - reliance on inter-bank market
- Risk-taking affected by monetary policy and GDP growth and translated into looser lending standards, lower quality borrowers and higher HRs.
- Amplification mechanisms: effect of lower policy rates and GDP growth on outstanding loans, and joint effect of policy shocks with leverage and small bank-size.

Implications for Monetary Policy

- Asymmetric effects of monetary policy:
  - Hazard rates on outstanding loans are more sensitive to shifts to an expansive stance than to shifts to a restrictive stance.
  - This asymmetry is stronger the higher is GDP growth.



Implications for Monetary Policy

- Closely linked with the asymmetry of monetary policy...
  - Literature on transmission mechanism emphasizes effects of short term rates on: cost of funds or financing conditions, long-term interest rates, or inflation expectations
  - From the risk-taking channel perspective: transmission of MP shocks goes through the revision of risk perceptions (the price of risk, hazard rates, perceived default probabilities, etc.) by lending institutions.
  - The relationship interest rates – risk perceptions, however, most probably is not linear.

Conclusions

- Financial intermediaries play an important role in the transmission of monetary policy in Colombia.
- Furthermore, there is evidence in support of the relevance of risk considerations in the response of banks to monetary policy shocks.
- More concretely, monetary policy in Colombia affects banks' perceptions and attitudes toward risk.
- Low levels of interest rates are an incentive for banks to take more risk in their lending decisions.

Conclusions cont.

- This incentive goes through particular bank characteristics (size and liquidity) and also depends on some loan and borrower characteristics.
- Banks' attitude towards risk is also affected positively by on macroeconomic conditions.
- Together, these patterns give monetary policy an asymmetric effect , which should be taken into account by the central banks when deciding on its policy stance at different stages of the cycle of the economy.