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Solange Berstein Rodrigo Fuentes

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Huérfanos 1175, primer piso.
Teléfono: (56-2) 6702475; Fax: (56-2) 6702231

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IS THERE LENDING RATE STICKINESS IN THE CHILEAN BANKING INDUSTRY?

Solange Berstein
Economista Senior
Gerencia de Investigación Económica
Banco Central de Chile

Rodrigo Fuentes
Economista Senior
Gerencia de Investigación Económica
Banco Central de Chile

Resumen

Existe una amplia literatura que estudia la flexibilidad de la tasa de interés en diferentes países. En este trabajo mostramos evidencia para la industria bancaria chilena, concluyendo que hay algún grado de rigidez en el ajuste de la tasa de préstamos a cambios en la tasa de política. Sin embargo Chile está entre los países que tienen tasa de interés más flexible. Usando datos de bancos individuales y un modelo teórico, identificamos características de los bancos que podrían afectar el grado de rigidez. Hechos estilizados y las estimaciones de panel sugieren que los bancos con proporciones de cartera vencida más bajas y porcentajes más altos de personas dentro de su portafolio se ajustan más rápido a los movimientos de la tasa de política.

Abstract

There is a vast literature that studies the flexibility of bank interest rates in different countries. In this paper we show some evidence for the Chilean banking industry, concluding that there is some sluggishness of adjustment of the bank-lending rates to changes in policy rate. However, Chile is among the countries that have more flexible interest rate. On the basis of individual bank data and a theoretical model we identified bank characteristics that might affect the degree of stickiness. Stylized facts and estimation results suggest that banks with smaller portion of past-due loans and higher percentage of household adjust faster to policy rate movements.

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E-mail: rfuentes@bcentral.cl.

1. Introduction

This paper studies the transmission of the monetary policy in terms of the interest rate pass-through in the case of Chile. Specifically, we are interested in the response of commercial banks lending rate to a money market interest rate movement. International evidence suggests that there is some sluggishness of adjustment of lending interest rates to changes on the policy rate. In general this stickiness is related to lack of competition in the banking sector, capital flow restrictions and volatility of the policy rate.

One of the first comprehensive empirical studies on bank interest rate pass-through for monetary policy is Cottarelli and Kourelis [1994]. They found important differences between countries. The estimated impact effects varied between 0.06 and 0.83, and the long run effects ranged from 0.59 to 1.48 with an average of 0.97. Our estimates for the Chilean case are an impact of 0.81 and a long run pass-through of 0.97 for nominal interest rates[1].

Previous studies suggest that sluggishness of adjustment is associated to market conditions and regulation of the banking sector. In this paper, by using data at the bank level, we explore other factors that may influence the degree of delay in market interest rate response to changes in the policy rate. The aim is to identify which characteristics may explain the differences in the average rates charged by each bank and their responsiveness to movements in the policy rate. The main variables considered were the size of the bank, type of customers and the loan risk level, which are related to demand elasticity and cost of adjustment for banks. A theoretical model presented in the paper motivates the choice of these factors and dynamic panel data estimation supports the implications of the model.

The paper proceeds as follows. In Section 2 we briefly review the previous literature and present our own estimations for the Chilean case, at an aggregate level. In Section 3 we discuss some stylized facts for the Chilean banking industry and a model of monopolistic competition with asymmetric information for bank lending rates, together with the panel data econometric analysis. Finally in section 4 we summarize and present some concluding remarks.

2. Chile versus the International Evidence

This section shows a brief literature review on empirical studies related to the flexibility of the bank-lending rate in different countries. After the review, our own estimations for Chile are presented and compared to what have been found for other countries.

The lending interest rate stickiness refers to the small response of commercial banks lending rate to a money market interest rate movement. Hannan and Berger [1989 and 1991] and Cottarelli and Kourelis [1994] provide arguments and evidence for short run sluggishness of adjustment of the lending interest rate. They found that in the long run the lending rate fully adjusts to the shift in the money market rate. After these studies many papers have tested the monetary policy transmission for specific countries under different periods and type of regulations. All of them are based on different parameterization of the following basic model:

$$i_t = d + \sum_{j=1}^{m} b_j i_{t-j} + \sum_{k=0}^{n} a_k m_{t-k} + \sum_{l=0}^{p} g_l \Delta MPR_l \qquad [1]$$

Where *i* represents the bank-lending rate, *m* is the money market or interbank rate, ΔMPR is the change in the monetary policy interest rate. The difference between the money market or interbank rate and the monetary policy rate is that the first two are interest rate determined in the market, while the latter is set by the Central Bank as a target value. In Chile monetary policy is conducted, as in many other countries, by managing liquidity such that the interbank or money market rate is in line with the policy rate. Therefore, we can separate the effect of monetary policy in two steps: from policy rate to money market rate and from money market rate to lending rate; we are interested in the second step. The coefficients of interest are a_1 that indicates the impact or the short run effect of the money market or interbank rate on the lending rate. It is expected to be positive and less than or

[1] Espinoza and Rebucci (2002) compare the degree of the stickiness in the Chilean banking sector with OECD countries. They found that Chile is not different than those economies.

equal to one. The coefficient that measures the long run effect of the money market rate on the lending rate is estimated as:

$$l = \frac{\sum a_k}{1 - \sum b_j} \qquad [2]$$

This coefficient is expected to be positive and close to one in an industry that is highly competitive.

2.1 Literature Review

In the empirical literature we found two types of studies. Those that analyze monetary transmission mechanisms using cross-country data and those that give evidence using time series data for specific countries. The first group computes impact and long run effects for different countries and later they relate their findings with financial structures and macroeconomic variables of the different economies included in the sample. The second group goes for country case type of study to check if there are differences in the monetary policy transmission over time and for different interest rates. The main idea of both types of studies is to capture the effect of institutional features on the transmission of the monetary policy.

One of the first comprehensive empirical studies on interest rate pass through for monetary policy is Cottarelli and Kourelis [1994]. This study estimates equation [1] for 31 countries including developed and developing countries. They found important differences across countries on the impact coefficient, but the long run coefficient tended to one in most of the cases. In a second step they correlate the different coefficients with explanatory variables that could explain the cross-country differences. The main finding here is that the impact coefficient is highly correlated with the structure of the financial system. Specifically the lending interest rate becomes more flexible when: the barriers to entry to the banking industry are low, the share of private ownership in the banking system is high, the constraints to the international capital movement do not exist and a market for negotiable short-term instruments exists. Neither market concentration nor the existence of market for instruments issued by firms' affect the degree of stickiness of the interest rate.

An important policy implication obtained by Cottarelli and Kourelis is the relevance of the discount rate or monetary policy rate as a policy instrument. In general they argue that the movement in the discount rate are interpreted as a signaling that helps to reduce the degree of stickiness, especially in those economies with a weak financial structure.

Borio and Fritz [1995] examine the relationship between the monetary policy rate; money market rate and the lending rate for a group of the OECD countries. Great Britain, Netherlands and Canada show a high short-run coefficient [above 0.7], on the other hand Spain, Japan, Italy and Germany exhibit the highest degree of interest rate stickiness. However, in the long run the pass through is more homogenous across countries and it gets closer to one. They argue that the difference in the results for different countries may be affected by the type o lending rate available. In fact interest rate for prime customer tend to adjust faster than other interest rates.

Benoit Mojon [2000] analyzes the monetary policy transmissions across Euro area countries. He also looks for the implications of different financial structures on the stickiness of the retail interest rate. As Cottarelli and Kourelis, he finds large differences in the short-run coefficients for different countries, ranging from 0.5 in Italy to 0.99 in Netherlands[2]. The pass through coefficient is lower the higher is the volatility of the money market rate and lower is the competition from other sources of finance [the level of banking desintermediation]. Competition among banks reduces asymmetries through the interest rate cycle; i.e. the size of the pass-through coefficient is less affected for upward movement in the interest rate compared to downward movement.

A second group of studies concentrates their analysis in specific country cases. Following the paper by Cottarelli and Kourelis [1994], Cottarelli, Ferri and Generale [1995] explored why the transmission of the monetary policy rate is so slow in Italy. They found that the high degree of stickiness is explained by the constraints to competition in the banking and financial system. In general banks that operate in more competitive markets tend to translate movements on money market rate into lending interest rate faster. This conclusion is based not only on the international comparison of Italian banking industry

[2] Toolsema, Sturm and Haan (2001) find similar results for the same group of countries.

with the rest of the countries, but from the data analysis at the individual bank level. The stickiness of lending rate tend to decline with financial liberalization in Italy which is consistent with the results using micro data for different banks and regions of that country.

Using the same methodology as previous studies Moazzami [1999] confirms that interest rate stickiness in the US is higher than in Canada during the 70s and 80s. However, the degree of flexibility has changed, for both countries, in opposite direction over the first half of the nineties compared to previous decades. Thus the short-run pass through has converged to around 0.40 for both Canada and US. The author attributes these changes to a more competitive environment for the US banking system and less competitive for Canada.

Winker [1999] combined an adverse selection model with a marginal cost pricing model to find an empirical equation where the lending and deposit rate depend on the money market rate in the long run but not in the short run due to the adverse selection problem. Based on the same argument he justified the lower speed of adjustment of the lending rate toward its long run level compared with the deposit rate, since the short run coefficient for the lending rate is much smaller than in the deposit interest rate case. Winker provides evidence for his model for the case of Germany.

For the case of Spain, Manzano and Galméz [1996] use an interesting database that allows analyzing the speed of interest rate adjustment for type of banks. They define four groups of financial institutions: national banks specialized in commercial banking, saving banks, foreign banks, and merchant banks. The degree of short-run interest rate response to changes in the interbank rate varies greatly across groups from 0.25 to 0.75 in the short-term impact coefficient. In the long run all of them, with the exception of saving banks, have a total impact coefficient greater than one accordingly with the reported confidence interval. In the case of saving banks the coefficient is strictly less than one. On the other hand the deposit rate shows higher degree of stickiness in the short run and in the long run. The impact coefficient ranges from 0.2 to 0.46 and the total impact varies between 0.63 and 0.81.

The following table summarizes the results of the literature reviewed.

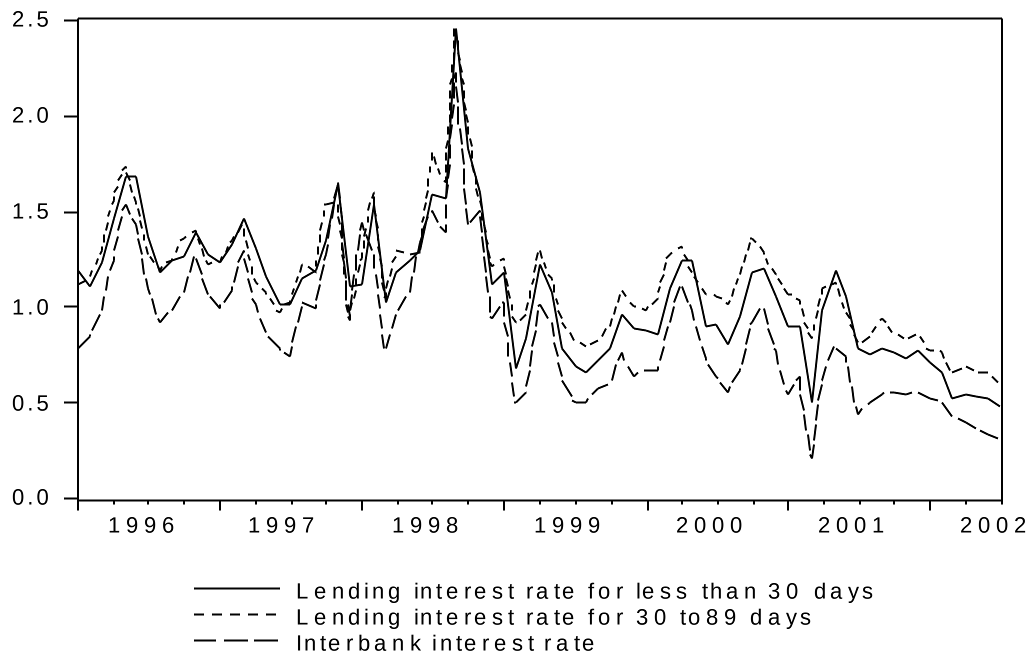
Table 2.1. Panel A Cross-country studies		
Cross-country Studies	**Degree of Transmission**	**Main Conclusions**
Cottarelli and Kourelis[1994] Sample: 31 countries	Short term: 0.06 to 0.83 Long term: 0.59 to 1.48 with an average equal to 0.97	The degree of flexibility increases with the elimination of capital flow restrictions, lower barriers to competition, private property in the banking industry and the existence of short-run instruments
Borio and Fritz [1995] Sample: 12 OECD countries	Response to a simultaneous change in policy and money market rate Short term: 0.0 to 1.08 Long term: 0.74 to 1.17	The type of lending interest rate used could explain the differences across countries. For some countries the lending rate is applied to the best larger customer while for others the rates correspond to retail banking.
Mojon, Benoît [2002] Sample: Panel data of 6 European countries	Short term: 0.5 [Italy] to 0.99 [Netherlands] Long run: Around 1 for all countries	The flexibility of interest rate increases with lower volatility of the monetary policy interest rate, higher external and within banking industry competition

Table 2.1. Panel B Country case studies		
Cases	**Degree of Transmission**	**Main Conclusions**
Cottarelli, Ferri and Generale [1995] Italy	Short term: 0.07 Long term: 0.92	The degree of stickiness is inversely related with the degree of competition and financial liberalization
Moazzami, B. [1999] Canada and United States	Short term [CAN]: 0.46 to 1.1 Short term [USA]: 0.25 to 0.6 Long term [CAN]: 0.6 to 2.0 Long term [USA]: 0.8 to 1.2	The impact coefficient has increased over time while in Canada has moved in the opposite direction. The reason for these results could be found in the changes in financial system structure in those countries
Winker, P. [1999] Germany	Short term: 0.1 [lending rate] and 0.42 [deposit rate] Long run coefficient tends to 1	The speed of adjustment to changes in the money market rate is lower in lending rates than in deposit rate
Manzano and Galmés [1996] Spain	Short term: 0.25-0.75 [lending rate] and 0.2–0.5 [deposit rate] Total impact: 0.66-1.2 [lending] and 0.63-0.81 [deposit]	The lending rate tends to response faster in the short and the long run. The type of customer affects the degree of response

2.2 Chile compared to other countries

This section presents the results at the aggregate level for the Chilean Banking industry. The lending rate at the aggregate level was constructed using a weighted average of interest rate for individual banks; the weights were the total amount of loans in the corresponding category. Figure 2.1 plots the lending interest rate and the interbank rate for the period under analysis. Visual inspection shows that the lending rates follow very closely the interbank interest rate.

Graph 2.1 Lending Interest Rate and Interbank Rate

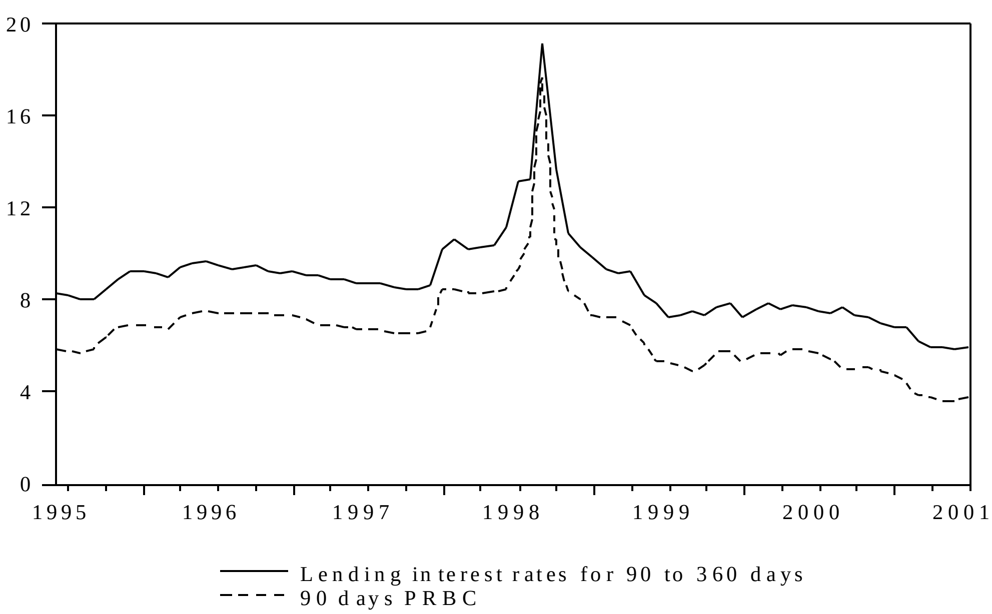


An important feature to take into account is that Chilean bank conduct several transactions in pesos and in *unidades de fomento* [UF], which is a unit of account indexed to the past inflation[3]. This unit of account is used for medium and long-term transactions.

[3] See Schiller (2002) for a discussion about the use of indexed unit accounts around the world and the UF.

Therefore equation [1] was estimated for peso denominated loans and UF denominated loans. The most common maturity for the former type of loans is less than 30 days (aprox. 50% of total nominal loans). For the latter the typical maturity is 90 to 360 days but mainly concentrated around 90 days (aprox. 40% of total UF indexed loans). The next figure presents the evolution of the lending interest rate for loans of longer maturity and the interest rate on 90 days Central Bank Indexed Promissory Note (PRBC). Again, both interest rates move closely together[4].

Graph 2.2 Lending Interest Rate and 90 days PRBC



A model represented by equation (1) was estimated. The number of lags is sufficiently high to make the error term white noise. Several papers estimate this equation using different parameterization. The most popular one is the error correction model based on the idea that the interest rates are not stationary. There are good economic arguments to disregard that possibility for interest rate[5]. Nevertheless, to be skeptical, in the appendix,

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[4] The monetary policy is handled through the interbank interest rate. However the 90 days interest rate on PRBC is good measure of the monetary policy for 90 days.
[5] See Chumacero (2001) for a discussion of unit roots using economics.

different test for unit roots are presented. All of them reject the presence of unit roots; thus the model was run in levels.

Table 2.2 presents the results for the interest rate applied to peso denominated loans. Columns 1 and 3 show the results of equation (1) controlling by inflation; columns 2 and 4 take into account the dramatic increase in the interest rates during 1998, using a dummy variable D98 that takes the value one for January to October of 1998. Despite the dummy variable is statistically significant the overall conclusions do not change much. The impact coefficient fluctuates between 0.7 to 0.8, while in all the cases the hypothesis of the long run coefficient equal to one cannot be rejected. Therefore in the long run, on average, banks fully adjust the lending rate to a change in the interbank interest rate.

Table 2.2 **Interest Rate Transmission: Nominal Lending Rate**				
Variable	30 days lending Interest rate	30 days lending Interest rate	30-89 days Interest rate	30-89 days Interest rate
Interbank rate	0.7932 [14.7964]**	0.8109 [22.8482]**	0.7122 [12.6719]**	0.7098 [18.8454]**
Interbank rate [t-1]		-0.3355 [-3.8715]**	-0.1670 [-1.8404]	-0.1994 [-2.3729]*
Interbank rate [t-2]	-0.3129 [-2.3391]*	-0.3193 [-2.9958]**	-0.2659 [-4.4942]**	-0.3330 [-4.1670]**
Interbank rate [t-3]			0.0750 [2.2498]*	0.0874 [2.3841]*
Interbank rate [t-4]		-0.0560 [-2.1570]*		
Interbank rate [t-6]		0.0784 [3.4636]**		
MPR[t] – MPR[t-1]	0.0281 [2.8474]**	0.0259 [3.2080]**	0.0419 [4.0445]**	0.0406 [4.2109]**
Lending rate [t-1]	0.2865 [3.0554]**	0.5629 [6.1349]**	0.4583 [4.0831]**	0.4059 [4.6310]**
Lending rate [t-2]	0.2320 [2.2617]*	0.2750 [2.8149]**	0.1896 [2.5192]*	0.3185 [3.2959]**
Inflation [t-2]	-0.1033 [-2.7302]**	-0.0953 [-3.5682]**	-0.2190 [-4.1982]**	-0.5084 [-3.8040]**
D98				0.4462 [3.9445]**
D98* Interbank rate		-0.3820 [-3.1078]**		
D98* Interbank rate [t-1]		0.3547 [2.9385]**		-0.1996 [-4.8414]**
D98*D[MPR]		0.2038 [4.6452]**		
Constant	0.1358 [3.8643]**	0.0473 [1.2736]	0.1737 [3.4792]**	0.1538 [3.2508]**
Long-run coefficient (λ)	0.9972	1.1017	1.0060	0.9604
[Wald test λ=1]	[0.0015]	[0.3202]	[0.0044]	[0.0932]
R-squared	0.9554	0.9742	0.9466	0.9569

t-test in parenthesis
**1% Significance; *5% Significance

Table 2.3 shows the results for indexed lending rate. Again the 1998 interest rate turmoil is controlled, but it was not statistically significant except for July 1998. The inflation rate was not included since the variables are indexed interest rates. The impact coefficient is around 0.85, while the long-term coefficient is statistically equal to one.

Table 2.3
Interest Rate Transmission: Indexed Lending Rate

Variable	90-360 days lending Interest rate	90-360 days lending Interest rate
PRBC	0.8575 [63.3162]**	0.8553 [48.3335]**
PRBC (t-1)	-0.4324 [-4.9115]**	-0.2931 [-4.7812]**
PRBC (t-2)	-0.0775 [-5.1854]**	-0.0694 [-3.5892]**
PRBC (t-4)	0.0357 [4.0652]**	
PRBC (t-5)	-0.0245 [-1.7402]	-0.1674 [-2.9301]**
Lending rate (t-1)	0.6396 [6.1577]**	0.4940 [7.4194]**
Lending rate (t-5)		0.1643 [2.8632]**
D98 (July)		1.6035 [9.1060]**
Constant	0.8019 [3.3145]**	0.8342 [4.6351]**
Long-run coefficient (λ) [Wald test λ=1]	0.9953 [0.0757]	0.9520 [0.0404]
R-squared	0.9837	0.9924

t-test in parenthesis
**1% Significance; *5% Significance

How are these results compared with the international evidence? Table 2.4 exhibits the comparison between the coefficient reported in column 2 of Table 2.2 and Table 2.3. It is easy to check that the estimates for Chile show a high flexibility of the banking interest rate. In fact the estimation poses Chile close to Mexico and United Kingdom. According to Cottarelli and Kourelis, the variables that tend to increase the interest rate pass through are the degree of competition and financial liberalization. It is important to take into account that the time periods are different for the countries included in Cottarelli and Kourelis (1994) with respect to the present study. The former uses data for the 80s while the current study uses data for the 90s. Relevant conditions for interest rate sluggishness have been different in nineties than in previous decade.

Table 2.4
International comparison of the
Interest rate stickiness

Countries	Impact	Long Term
Chile (en $)	**0.81**	**0.97**
Chile (en UF)	**0.86**	**0.95**
Colombia	0.42	1.03
Mexico	0.83	1.29
Venezuela	0.38	1.48
Canada	0.76	1.06
United States	0.32	0.97
Germany	0.38	1.04
Italy	0.11	1.22
Spain	0.35	1.12
United Kingdom	0.82	1.04

Sources: Cottarelli and Kourelis (1994) and
Preliminary own estimation for Chile

3. Evidence for Chile at the Bank Level

In Section 2 we exposed some evidence in favor of interest rates stickiness, this was the case for almost all of the countries that have been studied and it is also the case of Chile, up to some extent.[6] It was also argued that previous studies suggest that sluggishness of adjustment is related to market conditions and regulation of the banking sector. In this section, using data at the bank level, we explore what factors may influence the degree of delay in market interest rate response to changes in the policy rate.

For this purpose we analyze the differences in the levels of interest rates charged by banks and the adjustment to changes in the policy rate. It is interesting to notice that in the Chilean case we observe important divergence between the interest rates charged by banks, moreover, there are significant differences within a bank depending on the kind of loan, the type of customer, firm or household, or the amount of the loan. However, legislation imposes a ceiling to the interest rate charged by loan category, which somewhat limits this dispersion (50% above the average market interest rate by loan category[7]).

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[6] In Section 2 it was shown that impact effect of changes in policy rate were less than 1 for most of the countries studied, including the Chilean case.
[7] Recopilación de Normas Bancos y Financieras, Cap. 7-1 pp. 10, SBIF.

The aim is to identify which characteristics might explain the differences in the average rates charged by each bank and their responsiveness to movements in the policy rate. The main characteristics considered were the size of the bank, type of customers and the loan risk level. Other variables such as solvency or liquidity were also considered, but they didn't show up significant for explaining differences on lending rates so the results are not shown in the paper. The data used is at the bank level, we don't have, at this point, enough information with respect to the different transactions within a bank. This would be a future extension subject to the availability of this information.

3.1 Stylized facts for the Chilean Banking Industry

In Table 3.1 and 3.2 we show that larger banks charged, on average, lower interest rates than smaller banks. For smaller banks the nominal monthly rate was 1.21, whereas for larger banks this rate was 1.16 for the period 1996-2002. In the case of the UF rate, smaller banks showed on average a yearly rate of 8.55%, i.e. 3.5% higher than the average for larger banks (8.26%). This evidence might support two alternative hypotheses. What is called the "structure performance" hypothesis or the "efficiency structure" hypothesis. Under the first hypothesis differences in prices would respond solely to imperfect competition with differences in price elasticities across markets served by different banks. The second would imply that there are cost advantages for lager banks together with some degree of market imperfection that allows inefficient banks to survive, at least in the short run.

In terms of loan risk, as expected, banks with a higher percentage of past-due loans (more than 2%) charged, on average, higher interest rate to their clients. This is 11.1% higher in the case of nominal rates and 8.6% in the case of UF rates, over the sample period. When we compute simple correlation between lending rates and our indicator for policy rate (interbank rate in the case of nominal interest rate and PRBC90 in the case of UF interest rate),this correlation is smaller for banks with lower quality of loans. This may be due to adverse selection problems in the sense that if interest rates increase only riskier projects (with higher expected return) would stay in the market and the average quality of the loan portfolio will decrease lowering bank's profits. In this sense, banks will not respond rapidly to an increase in the policy rate, especially in the case of banks with a higher portion of past-due loans. On the other hand, if the policy rate decreases we would expect less responsiveness from banks with a riskier portfolio, because for riskier clients it is more difficult to move to other banks. Therefore, there is less incentive to decrease interest rates for banks with a larger portion of past due loans, at least in the short run.

Table 3.1 Nominal Rates 30 ds and Correlation with Interbank Rate
By risk and type of customer
(Average 1996-2002)

*Larger Banks**

		Loan Risk***		
Type of Customer**		<2%	>2%	Total
<10%	Rate			
	Correlation			
	#Banks			
>10%	Rate	1. 08	1.20	1.16
	Correlation	0.90	0.86	0.88
	#Banks	2	4	6
Total	Rate	1. 08	1.20	1.16
	Correlation	0.90	0.86	0.88
	#Banks	2	4	6

*Large Banks are the ones that have a market share over total loans of more than 5%.
**Type of customer measured as percentage of households loans over total loans.
***Risk measured as past due loans as percentage of total loans

Table 3.2 Nominal Rates 30 ds and Correlation with Interbank Rate
By risk and type of customer
(Average 1996-2002)

*Smaller Banks**

Type of Customer**		Loan Risk***		
		<2%	>2%	Total
<10%	Rate	1.12	1.37	1.19
	Correlation	0.83	0.76	0.81
	#Banks	5	3	8
>10%	Rate	1.25	1.21	1.23
	Correlation	0.87	0.79	0.83
	#Banks	3	3	6
Total	Rate	1.17	1.27	1.21
	Correlation	0.85	0.78	0.82
	#Banks	8	6	14

*Small Banks are the ones that have a market share over total loans of less than 5%.
**Type of customer measured as percentage of households loans over total loans.
***Risk measured as past due loans as percentage of total loans

Finally, in Tables 3.3 and 3.4 we analyze differences in interest rates charged by banks classified by type of loan.[8] We are able to do this distinction only for smaller banks because in the case of larger banks there is not much difference according to this category, since all of them have more than 10% of household loans. So, for smaller banks we have two groups, less than 10% of the loans given to households and more than 10%.

Table 3.3 Interest Rate UF 90 ds to 1 yr and Correlación with PRBC rate
By risk and type of customer
(Average 1996-2002)

*Large Banks**

Type of Customer**		Loans Risk*** <2%	Loans Risk*** >2%	Total
<10%	Rate			
	Correlation			
	#Banks			
>10%	Rate	8.02	8.38	8.26
	Correlation	0.95	0.94	0.95
	#Banks	2	4	6
Total	Rate	8.02	8.38	8.26
	Correlation	0.95	0.94	0.95
	#Banks	2	4	6

*Large Banks are the ones that have a market share over total loans of more than 5%.
**Type of customer measured as percentage of households loans over total loans.
***Risk measured as past due loans as percentage of total loans

Table 3.4 Interest Rate UF 90 ds to 1 yr and Correlation with PRBC rate
By risk and type of customer
(Average 1996-2002)

*Small Banks**

Type of Customer**		Loans Risk*** <2%	Loans Risk*** >2%	Total
<10%	Rate	8.17	9.14	8.52
	Correlation	0.92	0.80	0.87
	#Banks	5	3	8
>10%	Rate	8.38	8.80	8.59
	Correlation	0.91	0.94	0.92
	#Banks	3	3	6
Total	Rate	8.25	8.96	8.55
	Correlation	0.92	0.87	0.90
	#Banks	8	6	14

*Small Banks are the ones that have a market share over total loans of less than 5%.
**Type of customer measured as percentage of households loans over total loans.
***Risk measured as past due loans as percentage of total loans

[8] The type of loan is measured as the percentage of total loans made to households (consumption plus mortgage).

It is interesting to notice that in the case of nominal interest rates and UF interest rates for smaller banks, the higher average rate charged corresponds to banks that have a larger portion of past-due loans and lower share of household loans. While the lower interest charged is in the case of banks with low risk and low share of households. This indicates that there is an important dispersion of interest rates charged to companies, which seems to be larger than in the case of households. This evidence suggests that households demand elasticity is larger than in the case of firms. A possible explanation for this is that due to asymmetric information companies establish a long run relationship with a banks at a higher extent than households, which gives additional market power to banks, due to higher switching costs for firms.

3.2 A model for lending interest rate stickiness

In this section we will present a model that will help us to build on some hypothesis that we test for the Chilean banking industry. These hypotheses are related to the stylized facts presented in the previous section. This model gives us some insights about what we might expect from our empirical analysis and some possible explanations for our findings.

It seems appropriate to assume an imperfect competition model in the case of the banking sector, where it is argued that there are significant barriers to entry or an important degree of product differentiation.[9] Besides, it is also suitable to assume that there is asymmetric information in this industry, which leads to adverse selection and moral hazard problems. We will combine these two issues by assuming that banks make a two step decision, which considers the long run equilibrium and the short-run behavior that will take them to this condition.[10]

For the long run let us assume a simple Monte-Klein model for a monopolistic bank that faces a downward sloping demand for loans $L(i_L)$ and an upward sloping supply of deposits $D(i_D)$. This is capturing the fact that banks have some monopoly power. The decision variables for the firm are the quantities of loan (L) and deposits (D). Bank k maximizes the following profit function:

---

[9] Freixas and Rochet (1998).

[10] This way of combining these two factors is similar to Scholnick (1991) and Winker (1999)

$$\pi_k(L,D) = (\gamma_k i_{L,k}(L) - m)L_k + (m(1-\alpha) - i_{D,k}(D))D_k - C(D_k, L_k) \qquad (3)$$

Where γ_k is the probability that the loan will be repaid, m is the interbank rate (which is given for individual banks), α is the proportion of deposits that constitutes cash reserve, i_D is the deposit interest rate and i_L is the lending interest rate. $C(D,L)$ accounts for the total cost of intermediation services, which is a function of the total amount of deposits and loans.

Solving for the first order conditions and rearranging terms we get to the following expressions for the lending interest rate:

$$i_L^* = \frac{\varepsilon_k}{(\varepsilon_k - 1)\gamma_k}\left[m + C'_L\right] \qquad (4)$$

Where, ε_k is the absolute value of the demand elasticity for loans, which is greater than 1 since we are assuming monopolistic competition. For the purpose of this paper we are interested on the loans market and we will assume that costs are separable, so that the optimal lending rate is independent of the characteristics of the deposit market. This simple model leads us to conclude that different interest rates charged on loans may reflect different demand elasticity and the probability of loan repayment (portfolio risk).

The previous model is interpreted as the long run equilibrium for the banks. To simplify our model we assume a constant elasticity demand function faced by each bank. This is that ε might be different for each bank, but is independent of i_L. We can write this relationship between lending interest rate and interbank rate as: $i_L^* = \Phi_k m$ ($\Phi_k = \varepsilon_k / (\varepsilon_k - 1)\gamma_k$ is a mark up, which is a function of demand elasticity and the repayment probability). Thus, the long-run pass-through coefficient is larger the smaller is the demand elasticity and the smaller is the probability of repayment. This long run coefficient may or may not be equal to 1, when there is monopoly power to some extent.

However, due to asymmetric information, there might be some sluggishness in the adjustment process to get to this long run equilibrium. In fact we are interested in finding out if there is some delay in the response of market interest rates to changes in policy rate and if this delay depends on banks' characteristics, that would be related to demand elasticity and asymmetric information.

Specifically we are thinking of a setup where in the short-run banks solve an inter-temporal problem where they have on the one side a cost of adjusting too slowly to this long run equilibrium and on the other side a cost of moving too fast. This last cost is due to adverse selection and moral hazard problems in the banking industry. For instance if a bank increases the lending rate as a response to an increase of the money market rate, to adjust to the new long run equilibrium, it may end up attracting debtors that have a lower repayment probability and lowering its profits. At the same time there is a moral hazard problem because in face of a higher interest rate debtors would have incentives to invest in riskier projects which would also decrease banks' profits.[11] So under this framework we assume that there are some adjustment costs due to asymmetric information. This is modeled as a quadratic lost function following Nickell (1985), Scholnick (1991) and Winker (1999), which is tractable because from it we get a linear decision rule.[12] The loss function for bank *k* in period *t* is the following:

$$\Gamma_{t,k} = \sum_{s=0}^{\infty} d^s \left[w_{1,k} \left(i_{k,L,t+s} - \Phi_k m_{t+s} \right)^2 + w_{2,k} \left(i_{k,L,t+s} - i_{k,L,t+s-1} \right)^2 \right] \qquad (5)$$

Where ω_1 and ω_2 represent the weight that the bank gives to achieving the long run target value for lending interest rate and the cost of moving to that target value, respectively. Recall that Φ_k is a function of the demand elasticity and the probability of repayment that bank k faces. On the other hand, ω_j, j=1,2, will depend on bank's average loan risk. We might expect that if the portion of past due loans for bank *k* is higher, the adverse selection or moral hazard problem for that bank is more important and it will give more weight to changes in interest rate, which would imply a slower adjustment. From minimizing (5) we obtain:

[11] Stiglitz and Weiss (1981)

[12] Scholnick (1991) and Winker (1999) include also a third term in this loss function, but it is not included in this setup. For an argument see Nickell (1985). The other difference is that we have a multiplicative mark-up instead of an additive mark-up.

$$i_{k,L,t+s} = \frac{w_{1,k}}{w_{1,k} + w_{2,k}} \Phi_k m_{t+s} + \frac{w_{2,k}}{w_{1,k} + w_{2,k}} i_{k,L,t+s-1} \qquad (6)$$

From (6) we can see that the impact coefficient depends on the relative size of $\omega_{1,k}$ respect to $\omega_{1,k}+\omega_{2,k}$ and the mark up Φ_k. Therefore, the long run coefficient is always larger than the short-term coefficient. On the other hand Φ_k and $\omega_{2,k}$ depends on the bank's loan risk. The lower the probability of repayment (higher risk) the higher is Φ_k and the larger is $\omega_{2,k}$. If the debtors are too risky and the effects on $\omega_{2,k}$ is more important, the bank may not pass completely a money market interest rate increase (in the short run) because it will stifle the debtors. But in the long run the interest rate charged will be according to the risk characteristic of the debtor. In other words we should expect a negative effect of unpaid loan over the impact coefficient and positive effect on the long-term multiplier.

The main difference between our setup and the one presented by Scholnick (1991) and Winker (1999) is that they derive an error correction model (ECM) from this quadratic lost function. However, in our case even if we are assuming that there is a long run relationship between the interbank rate and the lending rate, our variables are stationary so our econometric model will be estimated in levels and not in an ECM form. Recall that the ECM has this interpretation only if the variables are non-stationary and cointegrated, which is not the case for our data.[13]

The other important difference is that we use the above model in panel data estimation in section 3.3 that allows the parameters to be different for different banks depending on their characteristics.

3.3 Econometric Results

The model described above suggests that differences in interest rate pass-through might be related to product characteristics such as: type of customer or risk level of the loan portfolio. The econometric analysis presented in this section will allow us to address this issue by estimating a dynamic panel data model where bank characteristics are interacted with the interbank rate and its lags.

An alternative method is time series estimation by bank, but it has the drawback that changes in bank characteristics during this time may be affecting the sluggishness of adjustment for each bank, which is not correctly captured.[14]

We estimate the following equation, which is based on the model described in section 3.2. Considering that there is adverse selection captured by the adjustment cost coefficient of the model, which is a function of the quality of loan portfolio. Besides, we allow demand elasticity to be a function of the type of customers the bank has and the size of the bank.

$$i_{h,t} = h_h + \sum_{j=0}^{m} b_j i_{h,t-j} + \sum_{k=0}^{n} a_k l_{h,t-k} m_{t-k} + \sum_{k=0}^{n} d_k s_{h,t-k} m_{t-k} + \sum_{k=0}^{n} g_k c_{h,t-k} m_{t-k} + \sum_{l=0}^{p} f_{t-l} \Delta TPM_l \quad (7)$$

Where l is the loan portfolio risk measured as the portion of past-due loans, c is the type of customers measured as the share of household loans (consumption and mortgage), s is the bank size measured, as the percentage of total loans, and η_h is a bank specific effect.

The problem of estimating dynamic panel data has been widely discussed in the literature and different methods have been proposed to obtain consistent estimates of the parameters. Anderson and Hsiao (1981) proposed method based on instrumental variable, which consist of taking first differences of the equation to eliminate unobserved heterogeneity and then use instrumental variables to estimate consistently the parameters of the lag dependent variables.

For instance, let's assume that the following equation is to be estimated using panel data:

$$y_{it} = r y_{it-1} + b x_{it} + h_i + u_{it} \quad (8)$$

Where y_{it} represents the lending interest rate, x_{it} represents a dependent variable like the interbank interest rate, h_i is the unobserved heterogeneity. Taking first difference the equation to be estimated is:

$$y_{it} - y_{it-1} = r(y_{it-1} - y_{it-2}) + b(x_{it} - x_{it-1}) + u_{it} - u_{it-1} \quad (9)$$

[13] Unit Root tests is presented in the appendix. Derivation of the ECM and explanation of why it is not appropriate with stationary data are found in Nickell (1985) and Wickens and Breush (1988).
[14] See Berstein and Fuentes (2003) for time series estimations at the bank level.

Anderson and Hsiao propose $y_{i,t-2}$ or ($y_{i,t-2}$- $y_{i,t-3}$) as instrument for ($y_{i,t-1}$- $y_{i,t-2}$). But Arellano (1989) showed that $y_{i,t-2}$ is a much better instrument for a significant range of values of the true r in equation (9).

Arellano and Bond (1991) proposed an alternative methodology based on GMM estimators. This method used several lags of the variables included as instruments, so it is especially efficient when T is small and N is large[15]. The method is applied to equation (6), using moment restrictions that come from the use of instrumental variables. Judson and Owen (1999) provided evidence that for small T, GMM is a better estimator than Anderson and Hsiao's methods under the mean square error criterion. But for unbalanced panel data and T around 20 is unclear what method is better.

Based in the traditional within group estimator, instrumental variable and GMM several other methods have been developed. However, the most of instrumental variable type of method work better than the within group estimator when N tends to infinity (N is very large) and T is fixed. In a recent paper Alvarez and Arellano (2002) show the asymptotic property of the within group, GMM and LIML estimators. An important result for our case is that, regardless the asymptotic behavior of N, when T goes to infinity the estimator of r is consistent. Moreover, if lim(N/T)=0 there is no asymptotic bias in the asymptotic distribution of the within group estimator, while in the opposite case if lim(T/N)=0 there is no asymptotic bias in the asymptotic distribution of the GMM estimator. In the case of our panel T is large and it will increase as the time goes by, while N will remain relatively fixed, thus the traditional within group estimator will provide better results.[16]

Tables 3.11 and 3.12 show the results for the 30 days nominal interest rate and for the 90 to 360 days-indexed interest rates, respectively. The first column of Tables 3.11 and 3.12 present the results of the panel estimation without controlling for the 1998 effect and without considering the interaction between bank characteristics and the right hand side variables. If we compare these regressions with the ones from section 2 we observe that impact and long run effects (shown at the bottom of each table) are smaller than what we found previously. Notice that previously, at an aggregate level, we were estimating impact

[15] See Judson and Owen (1999) for further discussion on the advantages of different methodologies.

and long run effects by using the weighted average interest rates, so that large banks were driving the results to a higher extent on those regressions than on the panel data estimation.

Table 3.11 Panel with interaction and 1998 dummies

Dependent Variable: Nominal Rate 30 ds	Model [1]	Model [2]	Model [3]
Interbank Rate	0,74	0,72	0,74
	[41,51]**	[34,80]**	[24,92]**
Interbank Rate [-1]	-0,30	-0,41	-0,48
	[-10,86]**	[-14,44]**	[-13,02]**
Interbank Rate [-5]	-0,12	-0,06	
	[-6,91]**	[-3,84]**	
Interbank Rate [-6]	-0,06		
	[-2,43]**		
Nominal Rate 30ds [-1]	0,57	0,67	0,68
	[26,84]**	[32,80]**	[28,36]**
Nominal Rate 30ds [-3]	0,05		
	[3,44]**		
Nominal Rate 30ds [-6]	0,14	0,06	0,04
	[6,58]**	[4,05]**	[2,72]**
D[TPM]	0,04	0,03	0,06
	[8,62]**	[5,71]**	[7,08]**
Inflation [-2]	-0,13	-0,08	-0,09
	[-6,83]**	[-4,60]**	[-3,65]**
Interbank * Risk [-1]			-2,31
			[-2,13]*
Interbank [-1] * Risk [-2]			5,05
			[4,80]**
Interbank [-1] * Part [-1]			-0,72
			[-2,84]**
Interbank * Cons			0,18
			[1,77]
Long-term coefficient	1,07	0,88	1,09
(Standard Deviation)	[0,07]	[0,06]	[0,08]
Observations	1447	1447	1105
Number of banks	20	20	20

Model [2] and [3] control for the year 1998. The model were estimated using fixed effect, which are not reported

[16] See Berstein and Fuentes (2003) for panel data estimations using Anderson and Hsiao and Arellano Bond methods.

Table 3.11 Panel with interaction and 1998 dummies

Dep Variable: UF Rate 90ds to 1 year	Model [1]	Model [2]	Model [3]
PRBC	0.88	0.71	0.72
	[90.95]	[37.19]	[25.41]
PRBC [-2]	0.05	-0.03	
	[2.62]	[-2.30]	
PRBC [-3]	-0.38	-0.21	-0.21
	[-12.22]	[-7.61]	[-6.54]
PRBC [-4]	-0.09		
	[-3.10]		
PRBC [-5]	-0.05	-0.13	-0.13
	[-3.98]	[-4.98]	[-4.18]
PRBC [-6]	-0.09	-0.05	
	[-3.31]	[-1.96]	
UF Rate 90ds to 1 year [-1]	0.25	0.24	0.19
	[14.10]	[19.36]	[12.13]
UF Rate 90ds to 1 year [-3]	0.26	0.24	0.24
	[9.41]	[9.52]	[8.02]
UF Rate 90ds to 1 year [-4]	0.09		
	[3.19]		
UF Rate 90ds to 1 year [-5]		0.12	0.12
		[4.32]	[4.20]
UF Rate 90ds to 1 year [-6]	0.09	0.05	
	[3.47]	[2.19]	
D [TPM [-1]]	-0.34		
	[-6.14]		
PRBC [-2] * Risk [-3]			-2.48
			[-4.12]
UF Rate 90ds to 1 year [-1] * Risk [-2]			1.47
			[3.34]
PRBC * Part			-0.34
			[-3.11]
PRBC [-2] * Cons [-2]			0.18
			[3.83]
Long-term coefficient	1.04	0.84	0.85
[Standard Deviation]	[0.03]	[0.03]	[0.04]
Observations	1368	1368	990
Number of banks	18	18	18

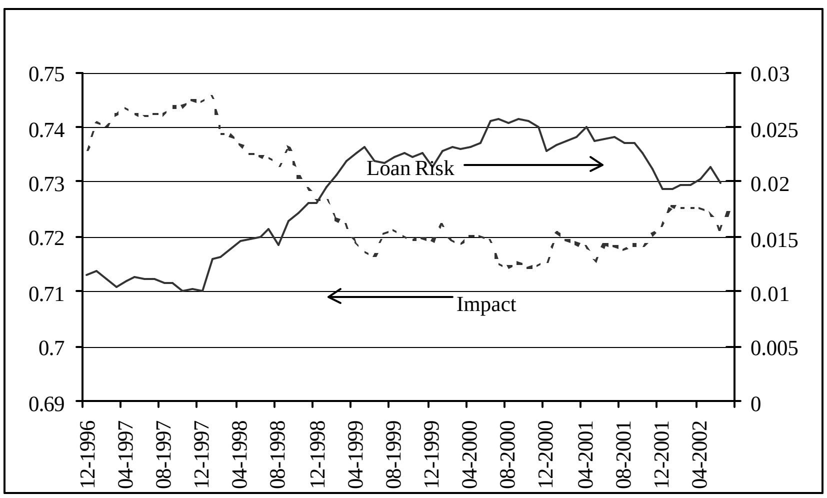
Model [2] and [3] control for the year 1998. The model were estimated using fixed effect, which are not reported

The second column of Tables 3.11 and 3.12 present the results of the panel estimation controlling for the 1998 effect. The impact and the long run coefficient decrease respect to those reported in the first column of each table, but the values are consistent with the idea that the long-term coefficient is larger than the short term. However the long-term coefficient is not statistically equal to 1. The last column in each table allows us to check the hypotheses provided by the theoretical model. In the case of nominal interest rate, the riskier is the portfolio the lower is the impact coefficient, which is consistent with the idea that in the short run banks will not pass interest rate change to debtors, according to the difference equation (6). But in the long run the pass through will be larger the riskier is the portfolio. This relationship can be represented in figures 3.3.1 and 3.3.2 where we show how the average loan risk has increased over time and the estimated impact effect has decreased while the long run effect gets larger.

Figure 3.3.1

Impact Effect and Loans Risk

Nominal Rate 30 ds



In the case of the indexed interest rate, the results are different. The impact coefficient is not affected by the portfolio risk, while the level of the unpaid loans affects the long run coefficient by reducing it. Again in graph 3.3.1 we observe this relationship.

Finally, for both nominal and indexed rate, bank size affects negatively the pass through, while banks more oriented toward households have a larger pass through.

Figure 3.3.2

Long Run Effect and Loans Risk

Nominal Rate 30 ds

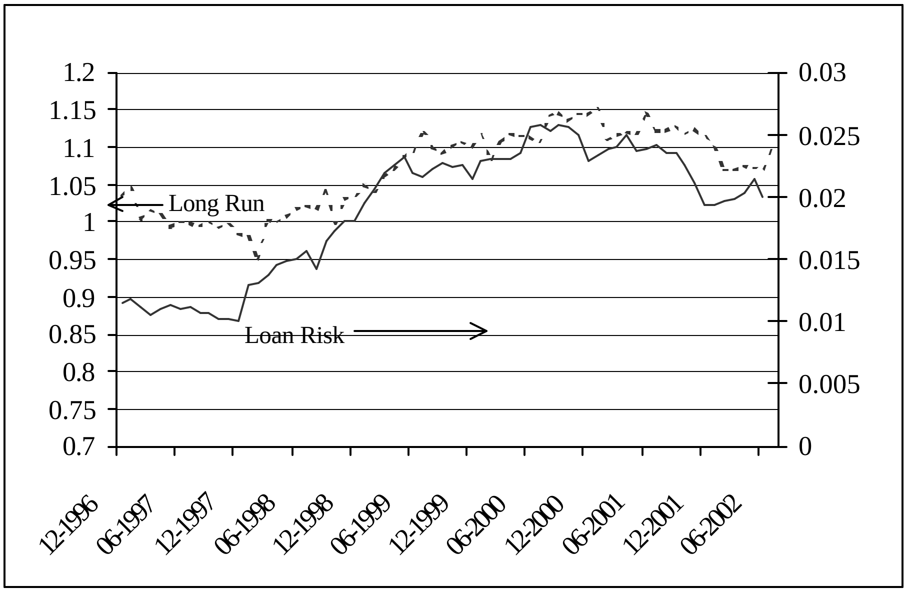
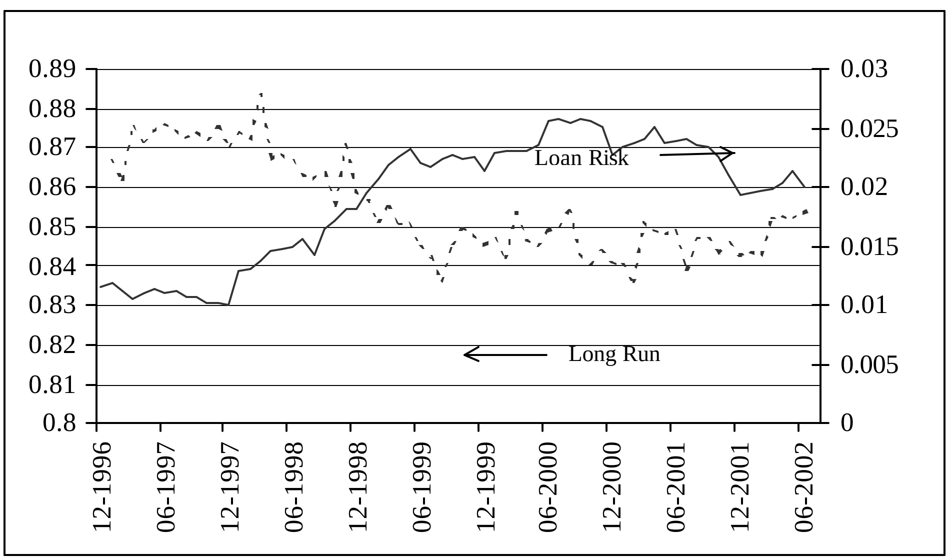


Figure 3.3.3

Long Run Effect and Loan Risk

UF Rate 90ds to 1yr



4. Concluding remarks

According to the estimates presented in this paper Chile shows a high flexibility of the banking interest rate. In fact the estimation poses Chile close to Mexico and United Kingdom, countries with the highest degree of flexibility. A previous study, Cottarelli and Kourelis (1994), identify the degree of competition and financial liberalization as main determinants of the interest rate stickiness.

By using data at the bank level, we explored other factors that influence the degree of delay in market interest rate response to changes in the policy rate. In this sense, we have analyzed the differences in the levels of interest rates charged by banks and the adjustment to changes in the policy rate. The main characteristics identified here are the size of the bank, type of customers and the loan risk level.

In the econometric analysis at the bank level we found significant differences in the response of banks to changes in the policy interest rate. Moreover, the smaller the size of the bank, the lower the portion of past-due loans and the larger the share of household consumers, the faster is the response of lending interest rates to movement in the money market rate. Results that are consistent with the model and the stylized facts presented in the paper.

Topics of future research might include alternative measures that capture loan risk and other characteristics that would help to have better measures of different demand elasticities, at the bank level. Furthermore, with more disaggregate information of interest rates charged for different types of loans within a bank, it would be possible to have better estimates of the effects of loan risk or type of customer over the interest rate responses to changes in policy rates.

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Appendix

Unit Root Test (1995-2001)				
	ADF	DF-GLS	Phillips-Perron	Phillips-Perron Ng Mzt
PRBC	-1.928	-1.949 *	-2.630	-1.995 *
Interbank Rate	-3.733 *	-3.175 *	-4.364 **	-3.135 *
UF 90 ds. to 1 yr	-2.258	-2.292 *	-2.204	-2.134 *
Nominal Rate 30 ds.	-4.619 **	-4.612 **	-4.686 **	-3.562 **

* Non-stationarity rejected at 5%

** Non-stationarity rejected at 1%

The tests consider a trend for the nominal rates and the Modified Akaike was used to choose the number of lags. By using ADF y P-P with the Modified Akaike we solve the size problem of this tests but the power is very low. The power of the tests is higher when using DF-GLS y P-P Ng

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