PRELIMINARY VERSION

Concentration and Price Rigidity: Evidence for the Deposit Market in Chile*

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Abstract

The effects of monetary policy depend significantly on the capacity of the Central Bank to affect market interest rates by managing liquidity. Therefore, it comes out as an important issue to determine the degree of flexibility of lending and deposit rates to changes in policy rates. In this sense, there is a vast literature that explores sluggishness on bank interest rates. In terms of deposit interest rates a larger rigidity has been associated to higher levels of concentration on the banking industry. Besides, the market discipline hypothesis would imply differences on the response of banks' deposit rates according to their characteristics. This paper analyzes deposit interest rate sluggishness for the Chilean banking industry and its relation with market concentration and bank characteristics. The results support the fact that higher concentration imply more rigidity and that bank characteristics such as solvency, size and loan risk would also make a difference in the speed of adjustment.

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I. Introduction

For the conduction of monetary policy it has an outstanding importance the effect of changes of the base rate over the market interest rates. When the effects of monetary policy over prices and output are evaluated it is often assumed that there is a complete and quick pass-through. However, there is international evidence that supports the fact that there is important sluggishness of market interest rates[1]. It might be presumed that the predictability and effectiveness of a change on the policy rate would depend significantly on the flexibility of market interest rates. Additionally, in the case of Chile as in many other countries, market concentration on the banking industry has increased considerably over the last years, which according to Hannan and Berger (1991) would imply stronger price rigidity.

Price stickiness can be a consequence of a collusive behavior as it is modeled by Hannan and Berger (1991), or menu costs, as in Blinder (1994), or durable relationships between banks and customers as a result of switching costs (Newmark and Sharpe, 1992). It is also the case that differences are observed between banks and even between different products offered by the same bank.

The analysis presented in this article includes a time series examination of the deposit interest rates, testing the effects of concentration over price rigidity. In addition, panel data estimation at the bank level is exposed, which considered the effects of bank characteristics over the speed of adjustment. The results support the fact that there is some sluggishness in deposit interest rates and that the stickiness increases with market concentration. At the bank level we found that certain characteristics of banks as solvency, market share and credit risk jointly with market concentration are the determinants of the speed of the deposit rate adjustment to changes in the monetary policy rate. The inclusion of variables like credit risk and solvency try to capture whether market discipline has anything to do with the transmission of the monetary policy rate to deposit rates.

The paper proceeds as follows. Section II provides with a review of the literature, stressing the conceptual framework of the analysis. Afterwards, Section III has a data

[1] Berger and Hannan (1991), Newmark and Sharpe (1992), Scholnick (1996), Heffernan (1997), Blinder (1998), Mizen and Hofmann (2002).

description and Section IV shows the time series results. Subsequently, Section V presents the panel data estimation, including some methodological issues and the results. Finally Section VI concludes.

II. Literature Review and Conceptual Framework

There is a broad literature that relates deposit interest rates stickiness with market concentration. One of the seminal papers that study this relationship is Berger and Hannan (1989). This article tries to identify the structure-performance hypothesis from the efficiency-structure hypothesis. The former would mean that there is collusion in a certain market and the second one would mean that firms with different levels of efficiency would survive in a concentrated market. In this last case, as firms that are more efficient would have a higher market share, a study that relates profits with concentration will conclude that there is a positive relationship, but the reason would be that there are more efficient firms in the market, and not necessarily a collusive behavior. So the policy implications are different from the case where the structure-performance hypothesis prevails. To identify this, instead of looking to the profit concentration relationship, they study the price concentration relationship by using a panel of U.S. banks in different markets, for the period that goes from September 1983 to December 1985. The paper gives evidence that supports the fact that more concentrated markets imply lower deposit rates than less concentrated markets.

The same authors, Hannan and Berger (1991), provide a stylized model of monopolistic competition that illustrates how firms with market power not necessarily change prices when there is a change in costs. This theoretical model shows how firms decide to change prices or not by comparing costs and benefits of such decisions; moreover, they allow for differences between down-pricing and up-pricing decisions. For the U.S. banking industry they found that there is greater price rigidity in more concentrated markets, and the stickiness was higher when there was a stimulus to increase deposit rates.

A later paper, Newmark and Sharpe (1992), explores evidence of price rigidity for the banking industry by using a different methodology. This article argues that there are long run relationships between banks and its customers, which would imply certain degree of stickiness in prices. The evidence found in this paper supports the facts stated Hannan and Berger (1991), this is that higher concentration imply more rigidity and that decreases in deposit rates are faster than increases. However, Jackson III (1997) argues that there is a non monotonic relationship between concentration and price rigidity, the paper provides an empirical estimation based on the model taken from Worthington (1989). A different approach is presented in Sharpe (1997), this paper considers Klemperer's (1995) switching costs model for the case of bank deposit interest rates, arguing that in the presence of switching costs banks have monopoly power which imply lower deposit rates. The authors identify the effects of switching costs by separating locations with high presence of movers where it is assumed that movers have no switching costs, so that locations with high portion of movers would have higher deposit rates.

Each of the above studies uses panel data analysis for different time periods, different methodologies and data of different locations for the U.S. economy. There is a smaller amount literature that explores this subject for other countries. In fact, studies for other countries investigate the dynamics of deposit interest rates, by using time series analysis instead of panel data. These papers focus on deposit interest rate pass-through without directly estimating its relationship with concentration, but interpreting any findings of stickiness as a signal of collusion. This is the case of Scholnick (1996), which estimates speed of adjustment for Malaysia and Singapore. The methodology considers an Error Correction Model (ECM) that it is estimated for both countries, and explores price rigidity and possible asymmetries between increases and decreases of deposit rates. For the U.K. Heffernan (1997), by also using an ECM finds significant differences between banks, products and over time, even between products offered by a same bank. Mizen and Hofman (2002) also study the UK, by using an ECM allowing for asymmetries between increases and decreases of deposit rates, but assuming also non-linearities, arguing that there might be a different response depending on the size of the change. They found that there is complete pass-through in the long run for deposit rates and the speed of adjustment increases when the gap between the retail rate and the base rate is widening and it get slower when the movements are in the direction of automatically closing the gap. Another interesting finding is that the speed of adjustment was affected by expectation and interest rate volatility, but not concentration.

Summarizing, the literature supports the fact that there is interest rate stickiness and that concentration implies lower deposit rates and more rigidity. Moreover, there seems to be differences across markets, banks and products that might be explained by other factors, not only market concentration. In this sense, there is another line of literature that analyzes market discipline in depositors behavior. According to this literature interest paid should be higher for banks that show lower performance, because they would appear to be riskier. Therefore, these banks would be penalized in a world where there is less than100% deposit insurance. If this is the case, banks that show lower performance not only would pay higher interest rates but potentially might be the case that the pass-through of changes in the policy rate would be different according to bank characteristics. In fact, Cook and Spellman (1994) show that deposit interest rates respond to individual bank risk factors, even in the case there is 100% insurance. Peria and Schmukler (2001) also provide evidence of market discipline for Argentina, Chile and Mexico. Finally, Budnevic and Franken test the market discipline hypothesis for Chile and found stronger evidence for interest rates than for the quantity of deposits. For testing market discipline the study considers a CAMEL (Capital Adequacy, Assets Quality, Management, Earnings and Liquidity) indicator for each bank.

Thus, this paper studies the deposit interest rate stickiness at an aggregate level and afterwards we look for differences across banks by using panel data estimation. In the analysis it is considered the effect on price rigidity of concentration, so that we test for the possibility of a positive relationship between these two variables, which would be consistent with previous findings. Additionally we include bank characteristics, to capture any effect of these variables over price sluggishness, which might be a consequence of market discipline.

III. Data Description

The data required for the analysis are basically deposit interest rates of different denominations and maturities. These interest rates are the effective interest rates for transactions that take place during a specific month. It is important to notice that in the

Chilean financial system there are three units of account that coexist: peso, US dollars and UF. The UF is a unit of account indexed to the previous month inflation. It varies daily with the past inflation but the one-month variation is exactly the previous month inflation. Deposits and financial instruments, in general, of short-term maturity (less than 90 days) are usually expressed in pesos, while medium and long-term deposits (90 days and above) are denominated in UF terms. Dollars denominated deposits have small share of total deposits (less than 10% on average in our sample period, but increasing over time).

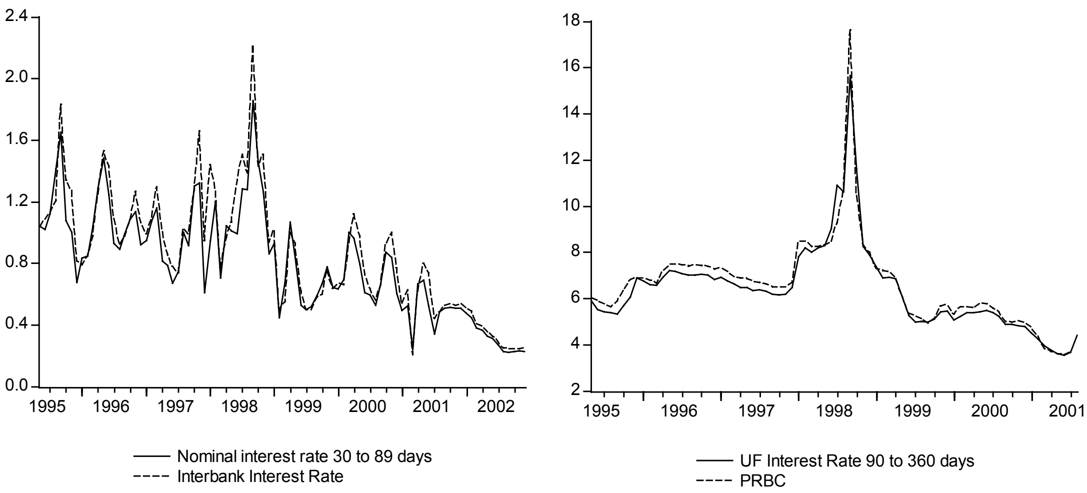
The monetary policy is announced using a monetary policy rate in UF terms. However, in practice, since May 1995, the monetary policy is implemented using the money market rate, which is a nominal rate. In August 2001, the Central Bank modified the denomination of the monetary policy rate from indexed to nominal rate. This change has several short-term consequences on the financial market and two important long-term effects. First, the volatility of the nominal rates decreases, but as counterpart the volatility of indexed interest rate increases. Second, it helped to implement a more expansive monetary policy in the last two years in Chile[2].

This paper analyzes the relationship between the monetary policy and the deposit rate exploiting monthly data at the aggregate level of the banking industry as well as at the individual bank level. By a first look at the aggregate data, one notices that the deposit rate follows closely the money market rates (Figure III.1). For the UF deposit rate we use the interest rate on 90 days Central Bank promissory notes, which is denominated in UF until august 2001. After that period due to the nominalization process, these promissory notes were issued in nominal terms.

[2] See Fuentes et al (2003).

Figure III.1

Evolution of the Interest Rates



For the bank level analysis, specific bank characteristics were required. For this purpose it was collected information from banks balance sheets. The variables chosen were solvency, liquidity, risk and size. Solvency was computed as capital over total assets. Liquidity is measured as liquid fund over demand deposit. Concerning size the variable was defined as market share defined over total deposit. Finally, risk is measured as non-performing loans over total loans. Different measures of concentration were used C3, C5 and Herfindhal index in terms of total deposits.

IV. Time Series Results with Aggregate Data

An empirical model that intends to capture the effect on the deposit rate adjustment of concentration to changes in the policy rate using data of the banking industry for the time period between May 1995 and December 2002 for the case of nominal rates is estimated[3]. Thus the equation to be estimated is:

[3] For the case of indexed rates the data is from May 1995 to July 2001.

$$y_t = \delta + \sum_{j=1}^{m} \beta_j y_{t-j} + \sum_{k=0}^{n} \alpha_k z_{t-k} + \sum_{l=0}^{p} \gamma_l \Delta MPR_l + \varepsilon \ , \tag{1}$$

where y represents the bank-deposit rate, z the money market or interbank rate, ΔMPR the change in the monetary policy interest rate, and ε is the error term that is assumed to be white noise. 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. One of the coefficients of interest is α_0, which measures the impact effect of a change in the money market rate on the deposit rate. The other coefficient of interest is the one that measures the long run effect:

$$\lambda = \frac{\sum \alpha_k}{1 - \sum \beta_j} \tag{2}$$

To complete the model we establish a relationship between the coefficients of interest and our measure of concentration given by the Herfindhal index (H). We assume that α_0 is a linear function of H, and each coefficient in (1) is a linear function of H. Thus the long-term coefficient is a non-linear function of H. That is:

$$y = 1_T \delta + X\mathrm{B} + \mathrm{ZA} + R\Gamma + \mu \tag{3}$$

where 1_T is a vector of ones, B, A, Γ are vectors of parameters. X is a $T \times 2l$ matrix comprised by lags of the dependent variables and the interaction variables. Z is a $T \times (2l+2)$ matrix of the contemporaneous and lags values of the money market rate and the interaction of z and the Herfindhal index. R is a $T \times (2l+2)$ matrix of the contemporaneous and lags values of the monetary policy rate and the interaction of MPR and the Herfindhal index. Each element of X, say x_{ij}, is defined as:

$$x_{ij} = \begin{cases} k_{t-j} & j = 1, ..., l \\ k_{t-j+l} H_{t-j+l} & j = l+1, ..., 2l \end{cases} \tag{4}$$

Where in the case of Z and R the variable k is replaced by the money market rate and the MPR. Note that the number of lag l in each case could be different and they are chosen in order to make μ white noise. It is worth noticing that the model is estimated in levels, because there is no economic reason for unit roots for the variables used and in any case unit root tests are included in the Appendix.

Table IV.1 shows the estimation results of equation (3) for short-term deposits that received a nominal interest rate. Model [1] does not control for the year 1998, and it shows a smaller impact coefficient than model [2], where the year 1998 is controlled for. This result implies that in an unusual year the banks do not pass through the jump in the interest rate to the deposit rate. In any case the coefficient is not very different and it varies from 0.75 to 0.88, meaning that banks modify the deposit rate in 75% or 88% when they face a change in the interbank interest rate.

It is interesting that our measure of concentration does not affect the size of the impact coefficient. However concentration affects the coefficient of the lags variables and thus it affects the long run coefficient. Table IV.2 shows the value of this coefficient when concentration is evaluated in the mean, the median, the maximum and the minimum of concentration, as a way to see the effect of the Herfindhal index on the long-run parameter. This exercise shows that at the mean or the median the coefficient is statistically equal to 1. But, market concentration affects negatively the interest rate pass through.

Table IV.1
Nominal Rate for 30 to 89 days

	[1]	[2]
Constant	-0.217	0.053
	[0.154]	[0.028]
Interbank Rate	0.755	0.884
	[0.028]***	[0.023] ***
Interbank Rate (-1)	0.749	0.514
	[0.249]***	[0.117] ***
Interbank Rate (-5)	-0.165	
	[0.071]**	
Nominal Rate 30ds (-4)	0.130	0.184
	[0.055]**	[0.033] ***
Nominal Rate 30ds (-5)	0.151	
	[0.084]*	
Nominal Rate 30ds (-6)	0.114	
	[0.037]***	
DTPM(-2)	0.055	0.030
	[0.011]***	[0.007] ***
Herf	0.028	
	[0.016]*	
Herf(-1)*Interbank Rate (-1)	-0.106	-0.054
	[0.026]***	[0.012] ***
Herf(-1)*Nominal Rate 30ds (-1)	0.049	
	[0.010]***	
Herf(-2)*Nominal Rate 30ds (-2)	-0.039	-0.017
	[0.008]***	[0.004] ***
Herf(-3)*Nominal Rate 30ds (-3)	0.013	
	[0.005]**	
Adjusted R-squared	0.972	0.979
SE of regression	0.053	0.046
Durbin-Watson statistic	2.190	1.707

Standard deviations in brackets. In model [2] we control for year 1998.
* Significant at 10%; ** significant at 5%; *** significant at 1%;

Table IV.2
Impact and Long Run Coefficients for Nominal Interest Rate 30 to 89 days

	Model [1]		Model [2]	
Concentration	Impact	Long Run	Impact	Long Run
Mean	0.755	1.05**	0.884	0.97**
Median	0.755	1.03**	0.884	0.96**
Maximum	0.755	0.66	0.884	0.84
Minimum	0.755	1.28*	0.884	1.06**

In model [2] we control for year 1998. Chi-Square (1) in brackets for λ=1.
** Can't reject at 5%, * at 10%.

To check the robustness of our results we cut the sample in July 2001, to isolate the process of nominalization. Our results did not change much. We tried other measures of concentration like C3 and C5, but the results did not change in a qualitative manner. We also explored for the existence of asymmetrical effects between ups and downs of the interbank interest rate. For doing so we introduced a dummy variable that takes a value equal to 1 when the interbank rate increases. We test for changes in every slope coefficient, but we couldn't find evidence of asymmetries.

Using indexed deposit interest rate we estimated equation (3). Now the money market rate was associated to the 90 days Central Bank promissory note. The results are shown in Table IV.3. When the 1998 effect is not controlled, concentration does not affect the impact coefficient. But after controlling for that year effect the relationship between the impact coefficient and concentration become significantly negative.

Table IV.4 shows the result for the relation between market concentration and the pass through coefficient. Again, at the average level of concentration the long-term coefficient is statistically equal to 1 in model [1], but not in model [2]. In this case when controlling for year 1998 effect, concentration affect negatively both coefficients, meaning that more concentrated makes slower pass through interest rate movements, even in the long run. This result is consistent with the international evidence. However in the case of Chile we could not find evidence of asymmetries in the pass through between ups and downs, which has been the case of previous studies for other countries.[4] In fact a dummy variable that takes value equal to 1, when the interbank rate increases cannot find to have an economically significant coefficient[5].

[4] Berger and Hannan (1991).

[5] Espinoza and Rebucci (2003) found no evidence of asymmetries for Chile. They also found that Chile do not have different pass through coefficient when comparing with a group of OECD countries.

Table IV.3
90 days Indexed Interest Rate

	[1]	[2]
Constant	-0.078	-5.009
	[0.087]	[1.93]**
PRBC	0.774	1.511
	[0.008]***	[0.29]***
PRBC (-1)	-0.338	
	[0.141]**	
PRBC (-4)	0.052	0.061
	[0.027]*	[0.030]**
UF 90 ds 1yr (-1)	0.691	0.318
	[0.183]***	[0.010]***
UF 90 ds 1yr (-2)	-0.206	-0.100
	[0.046]***	[0.011]***
Herf		0.593
		[0.219]***
Herf * PRBC		-0.098
		[0.032]***
Herf (-3)*UF 90 ds 1yr (-3)	0.012	0.007
	[0.003]***	[0.001]***
Herf (-4)*UF 90 ds 1yr (-4)	-0.010	-0.008
	[0.003]***	[0.004]**
Adjusted R-squared	0.983	0.997
SE of regression	0.237038	0.103747
Durbin-Watson statistic	1.969082	1.959175

Standard deviations in brackets. In model [2] we control for year 1998.
* Significant at 10%; ** significant at 5%; *** significant at 1%;

Table IV.4
Impact and Long Run Coefficients for UF Interest Rate 90 days to 1 year

	Model [1]		Model [2]	
Concentration	Impact	Long Run	Impact	Long Run
Mean	0.774	0.991**	0.666	0.930
Median	0.774	0.992**	0.656	0.913
Maximum	0.774	1.001**	0.493	0.849
Minimum	0.774	0.985**	0.782	1.066**

In model [2] we control for year 1998. ** Chi-square (1) λ=1 Can't reject at 5%, * at 10%.

V. Panel Data Estimation

In the previous section using aggregate data we explored the relationship between market concentration and the pass through interest rate coefficient. In this section we study this relationship using data at the individual bank level. The advantage of doing so is twofold. On the one hand, it allows for controlling by specific bank characteristics. In an environment of market discipline, depositors will choose carefully where they are making their deposits. On the other hand, the panel data analysis gives equal weight to all banks. With aggregate data, large banks may drive the results.

A similar analysis conducted by Berstein and Fuentes (2003) found that bank characteristics matter for the pass through of the monetary policy rate to bank lending rates. They also found that the short run coefficient was around 0.7 and the long run tends to be equal to 1.

In this paper we construct a panel data using nominal and indexed interest rate at the bank level as dependent variables. The explanatory variables are those used in the previous section plus banks characteristic defined in section III (liquidity, solvency, size and risk portfolio). For short-term deposit our sample includes 21 banks, and 20 banks for the 90 to 360 days deposit. Recall that short-term deposits are denominated in pesos and longer-term deposits are in UF.

1. Methodological Issues

The literature on dynamic panel data estimation, as our empirical model presented in section IV, has been revitalized in the second half of the nineties. Anderson and Hsiao (1981) presented the well-known problem of inconsistency of the least square dummy variable estimate in dynamic panel data. They proposed a 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:

$$y_{it} = \rho\, y_{it-1} + \beta\, x_{it} + \eta_i + u_{it} \quad (t = 1,...,T; i = 1,...N) \qquad (5)$$

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

$$y_{it} - y_{it-1} = \rho(y_{it-1} - y_{it-2}) + \beta(x_{it} - x_{it-1}) + u_{it} - u_{it-1} \quad (6)$$

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 better instrument for a significant range of values of the true ρ in equation (6).

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[6]. The method is based on T(T-1)/2 moment condition and it is consistent for fixed T or for T that grow to a slower path than N when both go to infinity. The application of this method requires that $T - 1 \leq N$.

In a recent paper Alvarez and Arellano (2003) 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 ρ is consistent. Moreover, if lim(N/T)=0 as N and T goes to infinity, there is no asymptotic bias in the asymptotic distribution of the within group estimator, while in the opposite case if lim(T/N)=0, as N and T goes to infinity, 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.

2. Panel Data Estimation

Using the data described above and the methodology, which was explained in the previous section, we estimate equation 3. We assume that the responsiveness of deposit interest rate to monetary policy rate is affected by the level of concentration of the banking industry, the market share of each bank (as a proxy of size) and solvency. The hypothesis for concentration was explained in section II. Market share is used for testing whether large banks are able to pay lower interest rate on deposits. Solvency may affect the speed of adjustment of deposit rate, since one should expect that more solvent banks will not pass

[6] . 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.

through the monetary policy rate at the same speed as less solvent bank. This hypothesis comes from the market discipline literature.

Table V.1 summarizes the results for the coefficients of interest in the case of nominal interest rate and the appendix shows the results in greater detail. To isolate the effect of each variable on the coefficients, we evaluated the value for each coefficient moving one variable at the time. For instance, we estimate the impact coefficient for the maximum and the minimum values of solvency, assuming that the other variables are equal to their sample mean. According to our results, concentration and market share do not affect the short-term or impact coefficient. However, solvency affects negatively, consistent with Cook and Spellman (1994), the long term and the impact pass through coefficient, i.e. banks that are more solvent adjust the deposit rate to a lower path. As shown the pass through coefficient varies between 0.573 and 0.886.

In the long run the three variables are relevant determinants of the stickiness in deposit rate. In any case, taking the maximum and the minimum of each variable at the time (the other two are set equal to their mean value) the long-term coefficient fluctuates from 0.83 to almost 1.1, showing a higher degree of flexibility in the long-term than in the short term. As expected, according to Hannan and Berger (1991), concentration has a positive effect on the degree of stickiness of the deposit rate. The opposite was found for market share, large banks tend to show a more flexible deposit rate, which could be due to higher level of efficiency. When considering solvency, the long-run coefficient shows the same pattern than the impact coefficient. Banks that are more solvent tend to pass through the monetary policy rate more slowly since they are more reliable. This is consistent with the market discipline hypothesis.

Table V.1
Impact and Long Run Coefficients for Nominal Interest Rate 30 to 89 days

	Impact	Long Run
Concentration		
Mean	0.849	0.965
Median	0.849	0.975
Maximum	0.849	0.835
Minimum	0.849	1.089
Market Share		
Mean	0.849	0.965
Median	0.849	0.963
Maximum	0.849	0.998
Minimum	0.849	0.958
Solvency		
Mean	0.849	0.965
Median	0.871	0.970
Maximum	0.573	0.841
Minimum	0.886	0.973

Table V.2 presents the results for the indexed interest rate for 90 days to 1 year. In this case market share did not turn significant, while concentration and solvency remain as important explanatory variables of the speed of adjustment. These two variables have similar effect as in the case of nominal rates for the long-run coefficient. However for the impact coefficient, concentration was important but not solvency. Additionally, in this exercise credit risk became important to explain the speed of adjustment. Those banks with a riskier (ex - post) loan portfolio tend to exhibit a higher degree of sluggishness. This result will go against the market discipline hypothesis, since one should expect that the degree of stickiness increase with the level of bank risk. A plausible explanation for our finding is that the risk variable is a measure of ex – post risk, and what is relevant for the depositor is the ex – ante risk. On the other hand, from the bank's point of view when it faces a larger amount of unpaid loans, the bank would need a higher spread to cover from that risk. Therefore it will tend to pay a lower deposit rate and to have a slower adjustment in this interest rate.

Table V.2
Impact and Long Run Coefficients for Nominal Interest Rate 90 to 360 days

	Impact	Long Run
Concentration		
Mean	0.746	0.92
Median	0.754	0.93
Maximum	0.565	0.86
Minimum	0.826	1.11
Risk		
Mean	0.746	0.923
Median	0.751	0.929
Maximum	0.651	0.805
Minimum	0.780	0.964
Solvency		
Mean	0.746	0.923
Median	0.746	0.932
Maximum	0.746	0.856
Minimum	0.746	0.949

Figures V.1 and V.2 show the overtime evolution of the aggregate impact and the long-term coefficients. This evolution is determined by the effect of concentration, solvency, market share, and credit risk on the pass through coefficients. In the same graph, on the left-hand side axis we show the evolution of our measure of concentration. Concentration does not imply movements on the impact coefficient for the nominal interest rate, but it does in the case of UF denominated deposits. At the end of the period the Herfindahl increased due to a merge between two large banks that drastically reduce the long-term pass through coefficient for nominal and indexed deposit rates. Besides, for the indexed interest rate concentration seems to drive the results at the end of the period where there is an increase in concentration and a reduction of both the impact and the long-term coefficient. Note that in this case the deposit rate is for longer-term deposit, which is different for the nominal case.

Figure V.1
Pass through Coefficients and Concentration
Nominal Rate 30ds

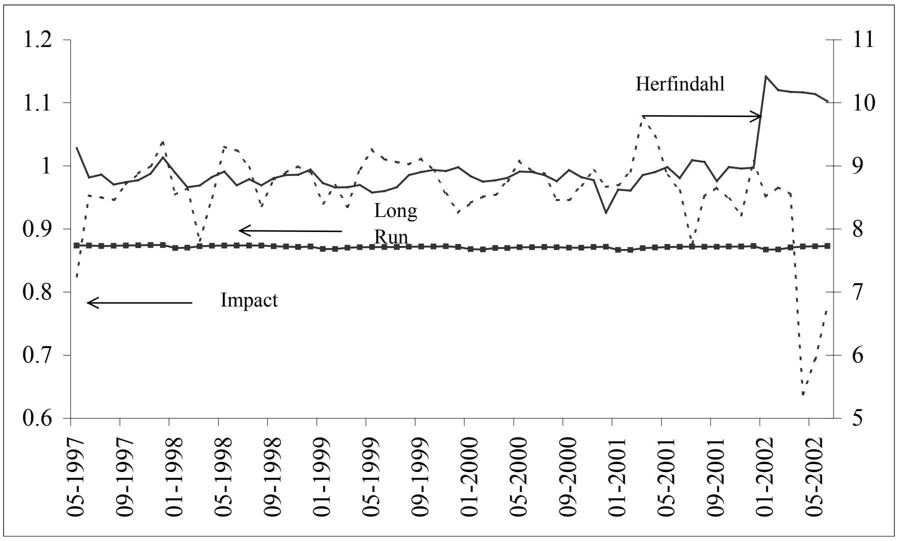
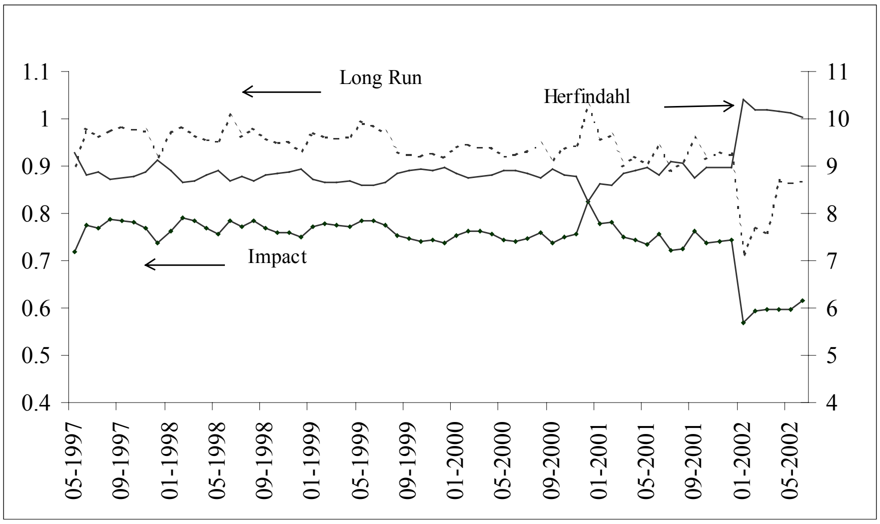


Figure V.2
Pass through Coefficients and Concentration
UF Rate 90ds to 1yr



VI. Conclusions

There is consensus with respect to the importance of market interest rate flexibility for the conduction of monetary policy. When the effects of monetary policy over prices and output are evaluated it is often assumed that there is a complete and quick pass-through. However, there is international evidence that supports the fact that there is important sluggishness of market interest rates[7]. In the case of Chile there is evidence of sluggishness of adjustment in the case of lending interest rates; however, compared to other countries it appears to be more flexible than average.[8]

In terms of deposit interest rates in many other countries it has been found that there is significant rigidity and that it is closely related to market concentration on the banking industry.[9] Moreover, concentration of these industries around the world has increased considerably over the last years, which is also the case for Chile.

The evidence presented in this article supports the fact that there is some rigidity for deposit interest rates and that it is significantly related to concentration. For instance, as concentration has increased over the last years, sluggishness of deposit interest rates has also increased. In addition, panel data estimation at the bank level supports this finding and also allows identifying the effects of bank characteristics over the speed of adjustment.

In the case of short run nominal rates it was found that larger banks tend to show a more flexible deposit rate, which could be due to higher level of efficiency. When considering solvency, banks that are more solvent tend to pass through the monetary policy rate more slowly since they are more reliable. For indexed interest rates, market share did not turn significant, while solvency continues to be significant with a similar effect to the case of nominal rates for the long-run coefficient. These findings are consistent with the market discipline hypotheses, in the sense that banks that are more trustworthy would have lower deposit interest rates and adjust at a slower path.

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7 Berger and Hannan (1991), Newmark and Sharpe (1992), Scholnick (1996), Heffernan (1997), Blinder (1998), Mizen and Hofmann (2002).
8 Berstein y Fuentes (2003).
9 Berger and Hannan (1991).

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Appendix A
Unit Root Test for Deposit Rates and Policy Rates
(1995-2001)

	ADF	DF-GLS	Phillips-Perron	Phillips-Perron Ng Mzt
PRBC	-1.928	-1.949*	-2.630	-1.995*
Interbank Nominal Rate	-3.733*	-3.175*	-4.364**	-3.135*
UF 90 ds. to 1 year	-2.179	-2.085*	-2.172	-1.999*
Nominal 30 to 89 days	-5.380 **	-5.421**	-5.250**	-4.224**

* No stationarity rejected at 5%
** No stationarity rejected at 1%

Appendix B
Panel Data Estimation

Nominal Rate for 30 days

	[1]	[2]
Interbank Rate	0.724 [0.019]***	0.905 [0.029]***
Interbank Rate(-1)	4.732 [1.137]***	1.091 [0.151]***
Interbank Rate (-2)	-2.657 [1.162]**	
Interbank Rate (-3)	-0.808 [0.186]***	-0.340 [0.132]**
Interbank Rate (-4)	0.246 [0.113]**	-2.480 [0.824]***
Interbank Rate (-5)	3.068 [0.918]***	0.305 [0.031]***
Nominal Rate 30ds (-1)	-2.579 [1.212]**	0.268 [0.134]**
Nominal Rate 30ds (-2)	3.203 [1.293]**	
Nominal Rate 30ds (-5)	-4.822 [1.036]***	1.776 [0.914]*
Nominal Rate 30ds (-6)	0.791 [0.127]***	0.447 [0.104]***
DTPM(-1)	0.015 [0.004]***	0.017 [0.005]***
Herf	0.051 [0.008]***	0.035 [0.006]***
Herf (-1)*Interbank Rate (-1)	-0.555 [0.129]***	-0.160 [0.016]***
Herf (-2)*Interbank Rate (-2)	0.292 [0.132]**	
Herf (-3)*Interbank Rate (-3)	0.107 [0.021]***	0.053 [0.015]***
Herf (-4)*Interbank Rate (-4)	-0.030 [0.014]**	0.014 [0.002]***
Herf (-5)*Interbank Rate (-5)	-0.355 [0.104]***	0.272 [0.093]***
Herf (-1)*Nominal Rate 30ds (-1)	0.327 [0.137]**	
Herf (-2)*Nominal Rate 30ds (-2)	-0.361 [0.146]**	-0.033 [0.015]**
Herf (-4)*Nominal Rate 30ds (-4)	0.007 [0.003]**	-0.015 [0.003]***
Herf (-5)*Nominal Rate 30ds (-5)	0.536 [0.116]***	-0.197 [0.103]**
Herf (-6)*Nominal Rate 30ds (-6)	-0.076 [0.015]***	-0.046 [0.012]***
Risk (-5)*Interbank Rate(-5)	0.810 [0.431]*	2.653 [1.091]**
Risk (-5)*Nominal Rate 30ds(-5)	-1.493 [0.572]***	-3.376 [1.322]**
Risk (-6)*Nominal Rate 30ds(-6)	0.614 [0.257]**	0.675 [0.376]*
Solvency *Interbank Rate	-0.286 [0.081]***	-0.379 [0.125]***
Solvency (-1)*Interbank Rate (-1)	0.152 [0.060]**	0.296 [0.0912]***
Solvency (-3)*Interbank Rate (-3)	-0.209 [0.095]**	-0.451 [0.142]***
Solvency (-3)*Nominal Rate 30ds(-3)	0.230 [0.131]*	0.487 [0.201]**
Market Share (-3)*Interbank Rate(-3)	-0.008 [0.004]**	-0.012 [0.003]***
Market Share (-3)*Nominal Rate 30ds(-3)	0.007 [0.004]*	0.012 [0.004]***
Market Share (-5)*Nominal Rate 30ds(-5)	0.005 [0.002]***	0.005 [0.001]***
Market Share (-6)*Nominal Rate 30ds(-6)	-0.003 [0.002]**	-0.004 [0.001]***
R-squared	0.9620	0.972
S.E. of regression	0.063	0.053
Log likelihood	1755.7	1876.3

Standard deviation in brackets In model [2] we control for year 1998.
* significant at 10%; ** significant at 5%; *** significant at 1%.

UF Rate 90 days to 1 year

	[1]	[2]
PRBC	2.735 [0.573]***	1.861 [0.313]***
PRBC (-1)	-12.119 [3.563]***	
PRBC (-2)	15.041 [3.765]***	
PRBC (-3)	-5.580 [2.347]**	-6.901 [2.324]***
PRBC (-6)	0.171 [0.042]***	-0.051 [0.018]***
UF 90 ds 1yr (-1)	13.446 [3.758]***	
UF 90 ds 1yr (-2)	-16.297 [3.999]***	
UF 90 ds 1yr (-3)	6.305 [2.471]**	7.411 [2.444]***
UF 90 ds 1yr (-4)	0.296 [0.093]***	
UF 90 ds 1yr (-5)	0.194 [0.102]*	
UF 90 ds 1yr (-6)	-0.440 [0.113]***	
dtpm	-0.264 [0.086]***	
Herf	1.143 [0.356]***	0.721 [0.212]***
Herf*PRBC	-0.214 [0.064]***	-0.121 [0.035]***
Herf (-1)*PRBC(-1)	1.362 [0.404]***	
Herf (-2)*PRBC (-2)	-1.731 [0.427]***	-0.021 [0.007]***
Herf (-3)*PRBC (-3)	0.626 [0.266]**	0.777 [0.262]***
Herf (-4)*PRBC (-4)	0.015 [0.004]***	
Herf (-1)*UF 90 ds 1yr (-1)	-1.467 [0.425]***	0.026 [0.003]***
Herf (-2)*UF 90 ds 1yr (-2)	1.850 [0.451]***	0.017 [0.008]**
Herf (-3)*UF 90 ds 1yr (-3)	-0.701 [0.279]**	-0.831 [0.275]***
Herf (-4)*UF 90 ds 1yr (-4)	-0.049 [0.012]***	
Herf (-5)*UF 90 ds 1yr (-5)	-0.024 [0.011]**	-0.002 [0.001]***
Herf (-6)*UF 90 ds 1yr (-6)	0.031 [0.011]***	0.010 [0.002]***
Risk *PRBC	-1.934 [0.660]***	-1.593 [0.609]***
Risk (-6)*UF 90 ds 1yr (-6)	-0.789 [0.289]***	
Risk	17.154 [4.334]***	11.954 [3.629]***
Solvency (-1) *PRBC(-1)	0.883 [0.305]***	0.816 [0.254]***
Solvency (-2)*PRBC (-2)	1.185 [0.364]***	1.053 [0.393]***
Solvency (-1)*UF 90 ds 1yr (-1)	-1.637 [0.399]***	-1.327 [0.341]***
Solvency (-2)*UF 90 ds 1yr (-2)	-1.066 [0.382]***	-0.986 [0.407]**
Market Share	0.053 [0.026]**	0.040 [0.009]***
Liquidity (-2)*PRBC(-2)	0.005 [0.000]**	
R-squared	0.977	0.986
S.E. of regression	0.340	0.255
Log likelihood	-315.4	-32.5

* significant at 10%; ** significant at 5%; *** significant at 1%. In model [2] we control for year 1998.