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Resumen

Este artículo examina los problemas de agencia que surgen cuando los bancos centrales rescatan a los bancos con problemas financieros. Específicamente, los objetivos de este artículo son: (i) determinar los problemas de agencia que surgen cuando los bancos centrales compran la cartera riesgosa de los bancos con problemas financieros y; ii) estudiar la respuesta de los bancos rescatados frente a los nuevos incentivos que enfrentan. La evidencia empírica de la crisis bancaria chilena de los ochenta muestra que los bancos recatados tuvieron más altos niveles de riego y fueron menos eficientes. Sin embargo, no es claro que los niveles de riesgo más altos se debieron a problemas de riesgo moral. También encontramos que algunas medidas adicionales implementadas por el banco central ayudaron a minimizar los problemas de agencia. Entre estas medidas se encuentran los límites impuestos a la ayuda financiera por banco, la venta o cierre de los bancos con problemas financieros más serios y, la designación de administradores provisionales impuestos por el gobierno en algunos bancos.

Abstract

This paper examines the agency problems that arise when a Central Bank rescues a failing bank. Specifically, the objectives of this paper are to determine: (1) the agency problems that derive from the mechanism of the purchase of risky loans and (2) the response of the banks to the incentives that they face when the Central Bank purchased their risky loans. The empirical evidence from the Chilean banking crisis of the 1980s shows that the rescued banks had higher levels of risk and they were less efficient. However, it is not clear that the higher level of risks were due to moral hazard behavior. I also found that some additional measures mitigated the agency problems. These mitigating factors included limiting the amount of financial assistance per bank, the closing or selling of the banks with more serious solvency problems and, the designation of Provisional Administrator in some banks.

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1. Introduction

The way in which a financial crisis is handled could generate several agency problems. A common response to a financial crisis is for the government to provide financial assistance, purchase the risky loans portfolio, or change the regulations to keep the banks afloat. However, if these solutions are improperly implemented, the banks could be left with an incentive to engage in "gambling for resurrection" or "looting the bank" behavior. The US Saving & Loan crisis is an example of a case in which such problems arose.[1] The main regulatory responses to the S&Ls' problems was deregulated the industry to allow S&Ls to diversify their activities, the government lent money to troubles institutions and capital adequacy ratios were reduced. Although, a significant amount of S&Ls recovery from its solvency problems, the institutions deeply insolvent experienced rapid growth and diversify to riskier assets, becoming more insolvent at the end of the 80s.

The solutions to the Chilean banking crises of the 1980s provide the opportunity to study the agency problems that arose when the government rescues a failing bank, as well as the response of the banks to the incentives that they face. In the Chilean case, the Central Bank purchased the risky portfolio of the banks, with the commitment that the banks had to buy back these same portfolios as future profits appeared.

The first objective of this paper is to determine the agency problems that arise when the mechanism of acquiring risky loans is implemented to solve banking crisis. The second objective is to study the response of the banks to the incentives to increase their risk and operating expenses that they face and to estimate how significant these

agency problems were during the period of study. Our analysis is based on the moral hazard problem that derives from the relation between bondholders and equity holders, as well as the relationship between outside equity holders and managers, based on the theories of Jensen and Meckling (1976). In the empirical part of the research, I worked with information on all Chilean banks for the period of 1986-1998.

This paper contributes to the literature on moral hazard and banking crises by analyzing empirically the responses of the Chilean banks to the agency problem. Salanié (1999) states that there is a lack of empirical research on moral hazard due to the lack of information. Thus, this paper helps to fill the gap. In particular, the Chilean banking crisis is an interesting case because one can inquire into agency problems, and moral hazard as well as the behavior of different individual banks and classes of banks.

In the case of the solutions to the Chilean banking crises of 1980s, there were two channels through which agency problems, specifically moral hazard, arose. [2] First, there was the standard problem that the equity holders could exploit debt-holders, making use of their limited liability. If a bank increase its risk level, there is a probability of higher return that benefit the equity holders. However, there is also a higher probability of lower return that negative affect the debt-holder. The second problem was that there was a divergence of interests between the commercial bank managers and the Central Bank. This divergence was due to the fact that the bank managers did not bear the costs of any non-pecuniary benefit (e.g., size and location of the office, secretarial staff, charitable contributions, personal relationship with employees) that operated to increase their own

[1] See Dewatripont and Tirole for a summary of the US S&L crisis, also White (1991) and Akerloff and Romer (1993).

[2] According to Selanié (1999) there are three elements that define a moral hazard problem: i) the Agent takes a decision that affects his utility and that of the Principal; (ii) the Principal only observes the outcome, an imperfect signal of the action taken; and iii) the action the Agent would choose spontaneously is not

utility. So, the banks managers had an incentive to increase some expenses that enhanced their own utility but not the profit of the banks. This problem is similar to the outside equity agency problem outlined by Jensen and Meckling (1976), where there was a similar conflict between the manager shareholder and the rest of the shareholders. The Central Bank problem was worse because the Central Bank did not have voting rights and could not remove the managers.

According to the distinction made by Akerloff and Romer (1993), one can classify the incentive to exploit the Central Bank by increasing the risk of the bank as "gambling for resurrection." And, one can classify the incentive to increase the expenditure as "looting." The difference is that looting is a deliberate plunge into negative net worth, while gambling for resurrection is intended to give the bank an opportunity to get back to a position of positive net worth.

In the estimations, I developed indicators of moral hazard behavior, such as risk level and cost efficiency for each bank, and then applied non-parametric and parametric procedures to test the different behaviors of the banks with subordinated debt and the banks without subordinated debt. To develop cost efficiency indicators, I applied panel data procedures to estimate a translog cost function.

The main results of the paper indicate that, when the Central Bank purchases bad loans to handle bank failure, there is a potential risk of moral hazard behavior on the part of the rescued bank, increasing its risk to maximize the value of the equities and increasing operating cost to increase the managers utility. The empirical evidence from the Chilean banking crisis of the 1980s shows that the rescued banks had higher levels of

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Pareto-optimal.

risk and they were less efficient. However, it is not clear that the higher level of risk was due to an agency problem or to moral hazard behavior.

Additionally, in reviewing the Chilean cases, I found that there were some measures that the Central Bank and the Superintendency of Banks were able to implement to reduce the agency problems. These measures included: (a) limiting the amount of financial assistance per bank; (b) closing or selling those banks with more serious solvency problems and; (c) changing the management of some banks.

It is interesting to note that, beyond the potential moral hazard problem, new financial problems appeared in only one of the banks that were rescued during the Chilean financial crisis. The Superintendency took full control of the Banco Nacional and the owner had to sell the bank because he could not raise sufficient advanced capital funds, in 1989. This outcome can be considered successful when compared with the results of the US Saving & Loans crisis where a significant amount of rescued bank at the beginning of the 80s, fail again at the end of the 80s.[3]

The paper is divided in an introduction (Section 1) and five remaining sections. Section 2 examines the agency problems that involve purchases of risky loans and/or artificial inflation of real costs. Section 3 describes non-parametric and parametric estimation procedures. Section 4 presents and describes the data. Section 5 presents the results of our estimations. Finally, Section 6 contains concluding remarks.

2. Agency Problems

One of the solutions to banking crises is for the Central Bank to purchase the risky portfolio of the banks. During the Chilean financial crisis of the 1980s, the Central Bank

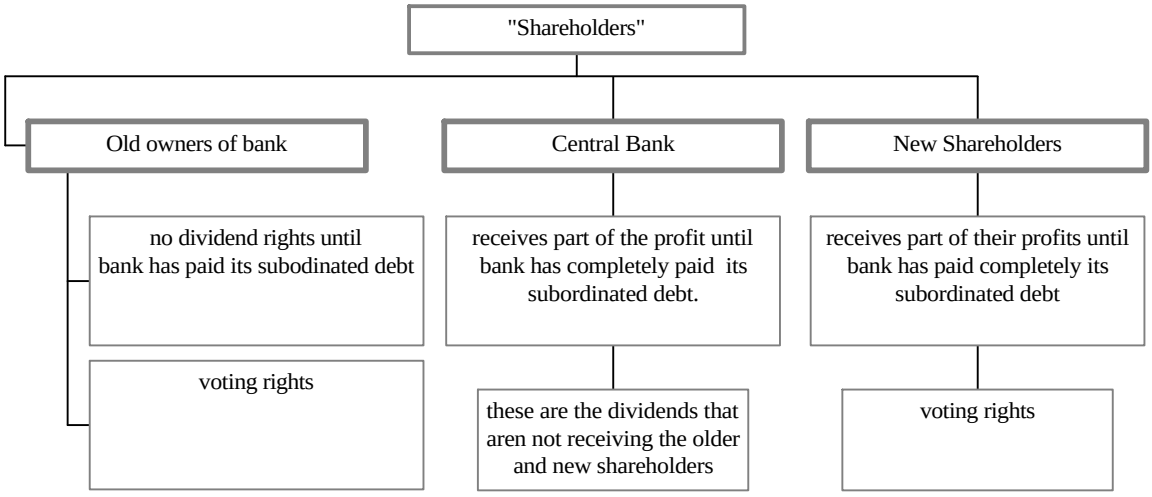
purchased the risky portfolio of the banks with the commitment from the banks that they would have to buy back their risky portfolios with a proportion (70% or more) of their future profit. It was only a proportion of the profit because the banks needed to raise new capital, and the incentive to the shareholders to invest money lies in receiving dividends. In the Chilean case, preferential shares were created. These shares were issued when the bank needed new capital. The distinctive characteristic of the new shares was that they had limited rights to dividends. Thus, the banks that sold their risky portfolio to the Central Bank had a subordinate debt with the Central Bank. These debts had to paid with a proportion of future profits of the banks. [4]

This mechanism of solution leaves three types of agents sharing the profits of the bank. Figure 1 shows that the older owners of the bank continued owning a part of the bank, but would not receive dividends until the bank had paid back all its subordinated debt to the Central Bank. These shareholders kept their voting rights and participated in new capital issues that were not acquired with retained profits.

[3] Barth et al. 1991, indicates that around 200 institutions were sold or liquidated in 1988.

[4] Some of the measures applied in the US Saving & Loans rescue have the same results as did the purchases of risky portfolio, in terms of keeping afloat an institution and allowing to it achieve a high level of leverage. According to Dewatripont et al. 1994, some of the measures applied in the US Saving & Loans rescue were: (i) the government lent money to institutions that were unable to raise new capital; (ii) capital adequacy ratios were reduced; and (iii) intervention rules for institutions that were undercapitalized were weakened.

Figure 1. Participation on the Profits of the Banks with Subordinated Debt.



The second group of shareholders bought shares when the financial institutions sought to raise new capital in the wake of the financial crisis. Their shares have limited dividend rights. The “new” shareholders could receive only a fraction of the earnings of theirs shares (the maximum was 30%) until the bank had paid back all its subordinated debt. They had voting rights and could participate in new capital issues.

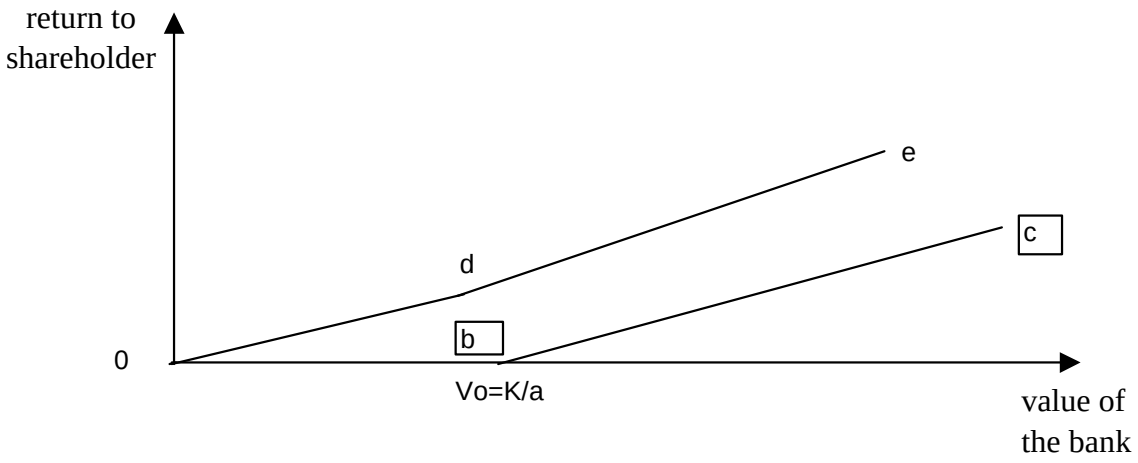
The third agent is the Central Bank, which receives the dividend amount that corresponds to the old owners of the bank and the proportion of earnings that was not received by the new shareholders. The Central Bank does not have voting rights and it is not involved in the management of the bank. However, it has to approve the conditions under which each bank raises capital.

The agency problems or moral hazard problem arise because this way of splitting the profit of the bank creates a non-linear relationship between the value of the bank and the return for old and new shareholders. Figure 2 shows that if the subordinated debt for

a bank is an amount equal to K, and the proportion of profit that goes to pay the subordinated debt is "a", then when the value of the bank (V) is equal to K/a the shareholders will have completely recovered their right to dividends. This is the point V_0 in figure 2. The old shareholders will receive a return equal to zero if the value of the bank is less than V_0 and, from that point on, their return will be equal to their proportionate share of the bank's earnings. As such, the relationship between the value of the bank and his return is non-linear and is given by the line obc.

The new shareholders have a return equal to their percentage share of the bank (θ) times bank earnings, times their fractional right to dividends (ρ), if the value of the bank is less than V_0. After that, their investment increases in an amount equal to the increment in the value of the bank ($V-V_0$) times their share in the property equity (θ). Without applying the limiting fraction, ρ. The differential treatments with respect to ρ makes the relationship between their return and the value of the bank is non-linear, as shown by the line ode.

Figure 2. Return for Old and New Shareholders



To explain the moral hazard problem that arises with the subordinate debt, I use a simple two-periods model. At t=0, I have a bank with a loan portfolio of L, deposits of B, a subordinate debt of K, and capital equal to E. During the next period, the value of the loan portfolio (L') will reflect the return on its existing loans. If the value of the loan portfolio (L') is lower than the value of the deposits (B), the value of the deposits will be equal to the value of the loan portfolio (L'), and the value of the subordinated debt and the equities will be equal to zero. If the value of the loan portfolio is higher than B but less than B plus K, the value of the subordinated debt will be equal to L' minus B, and the value of the equities will be equal to zero. Finally, if the value of the loan portfolio (B) is higher than B plus K, the value of the deposits will be equal to B, the value of the subordinated debt will be K, and the value of the equities will be equal to the difference between L' minus B, minus K. Thus, the firm's equity value is equal to:

(1) $$E' = Max[0, L' - (B + K)]$$

It was shown by Black-Scholes (1973) that the firm's equity value could be regarded as a European call option. The idea is that shareholders have an option to buy back the firm from the bondholder for an exercise price equal to the face value of the firm's debt at time t = 1. As such, applying the standard formula for the price of a call option and working with one period, the value of equity capital at t=0 is equal to S:

$$(2)\quad S = LN(d_1) - (B+K)e^{r}N(d_2)$$

Where: N(.) is the standardized normal cumulative probability density function; r is the interest rate, and $d_1 = \frac{\ln(L/(B+K)) + (r + s^2/2)}{s}; d_2 = d_1 - s$

A standard result is that the semi elasticity of the value of the equity capital, with respect to the variance of the assets (σ^2), is positive and its size depend on the ratio of total debt to total assets, as in equation 3. This implies that if the shareholder wants to maximize the value of the firm's equity, then within the class of projects with the same net present value, banks will choose those with the higher risk. In this way, the banks increase the value of their equity, reducing the value of its debt.[5] Thus, I have a typical moral hazard problem, according to the definition of Salanié (1999): (a) the agent (the bank) takes an action (risk) that affects its utility and that of the principal (Central Bank); (b) the principal only observes the outcome, an imperfect signal of the action taken; and (c) the action that agent would choose spontaneously is not Pareto-optimal.

[5] See Ingersoll (1987) for the derivation of these expressions. He has an illustrative example on p. 418.

$$\frac{\Delta \% S}{ds^2} = \left(\frac{B+K}{L} \right) \frac{e^{-r} z(d_2)}{2s} \quad (3)$$

Where z() is the normal standard density function at d_2

Thus, it is clear that the banks with subordinated debt have an incentive to increase their risk, and the incentive is proportional to its level of subordinated debt. The authority can reduce this problem by limiting its purchase of bad loans from the financial institutions. In fact, that was one of the measures implemented in the solutions of the Chilean banking crisis. The limit initially was 1.5 times the capital of each bank, later this limit was augmented to 2.5 times and finally to 3.5 times capital.

However, the fact that a bank with subordinated debt shows a higher level of risk does not necessarily mean that it is a result of moral hazard behavior. An alternative hypothesis is that the bank with subordinated debt started out, after the crisis, with the worst indicators of risk. Additionally, if there is inertia, it would take a time to adjust to a more reasonable level of risk.

The other problem that the mechanism of solution generated is that banks with a high level of subordinated debt (which means that it takes a long time for the banks to pay back their subordinated debt and for shareholders to recover their right to receive dividends), and whose profit were mostly used to repurchase their subordinated debt, have little incentive to show a profit. This leads to shareholders having incentives to mask any potential profit by using transfer prices (such as higher wages or better offices or other amenities), thus increasing the operating costs of the bank instead of producing a profit to pay the subordinated debt. This problem is more serious in the cases in which the owner manages the bank. Thus, again I have the three elements of the moral hazard

problem: (a) the agent (the bank) takes an action (reducing cost efficiency) that affects its utility and that of the principal (Central Bank); (b) the principal observes, just the outcome, an imperfect signal of the action taken; and (c) the action that agent would choose spontaneously is not Pareto-optimal.

Jensen and Meckling (1976) outline this problem in the context of the managers and outside shareholders. They compare the behavior of a manager, who is a 100% owner of the firm, with his behavior when owning less than 100%. The problem is that there is a divergence of interest between the manager-shareholder and the outside shareholders because the manager-shareholder bears only a part of the costs of any non-pecuniary benefit (e.g., size and location of the office, secretarial staff, charitable contributions, personal relationship with employees) that he or she takes out to maximize his or her own utility.

However, the fact that a bank with subordinated debt has a higher level of cost inefficiency than the other banks does not necessarily mean that it is involved in moral hazard behavior. It is possible that, because of the crisis, the loan portfolio was reduced and the bank had to adjust to a smaller scale. If there is inertia to make the adjustment, as a result of the crisis and/or if economies of scale are presents, the bank will became more inefficient as a results of this adjustment.

The Superintendency tried to reduce this agency problem by designating a Provisional Administrator in the banks in greatest financial distress, during the period of the crisis.

In the next section, I review the procedures for testing these hypotheses. The first hypothesis is that other things being equal, the banks with subordinated debt incurred greater risk in order to enhance the value of their equity. The second one is that the banks

with subordinated debt were less cost efficient because the managers incurred greater operating expenses in order to augment their own utility.

3. Methods of Estimation

I applied non-parametric and parametric methods to test whether the rescued banks ended up with higher levels of risk and cost inefficiency than banks without subordinated debt, and to study how these factors are related to the phenomena of subordinated debt. The non-parametric test provides the degree of evidence for an association between these variables. However, the parametric method permits us to explore the causality among variables and to make inferences about the significance of the effects.

3a. Non-Parametric Tests

Working with two-way contingency tables, I classified the banks according to whether or not they have subordinated debt and whether their risk or efficiency levels are high or low. I developed several indicators of risk and efficiency and classified a bank as high risk if its risk indicator was above the median and low risk if it was below. I did the same with the efficiency indicators. Thus, I ended with one contingency table for each indicator.

Using these contingency tables, I tested the hypothesis that the different classifications are independent. Specifically, I was interested in testing whether the level of a bank's risk or efficiency is independent of its status with respect to subordinated debt. I used the Pearson chi-square to test the hypothesis of independence.[6]

3b. Parametric Techniques

I estimated a model for bank risk that combines time series data and cross-sectional data. The model states that a bank's risk level (y) depends on its subordinated debt (SD), an unobserved individual specific effect (v), and an random error (e). Using subscripts k for the bank and t for the year, the risk function for a given bank is specified by the following equation:

$$(4) \qquad y_{kt} = a + bSD_{kt} + v_k + e_{kt}$$

I have three proxies for the variable SD that measure the subordinate debt. First, I used a dummy variable that distinguishes between a bank with subordinated debt and a bank without subordinate debt. This allowed me to measure the effects that are non-linear. Second, I used the amount of subordinate debt that each bank had as a proportion of its capital. Third, the share of the profit of the banks that was transferred to the Central Bank.

This model allows me to control for individual effects specific to each bank, but invariable through time. If I do not control for these effects, the estimators would be biased.

To identify unobserved individual effects (v_k) from random error (e), I used the error components procedure, in which the disturbances of the regression (u_{kt}) take the following form:

$$(5) \qquad u_{kt} = v_k + e_{kt}$$

[6] See Agresti (1996) for two-way contingency table tests and procedures.

There are different ways in which one could statistically manage unobserved individual effects (v). One is to assume that there is no heterogeneity, so each parameter v is equal to zero. A second possibility is to assume that the unobserved individual effects are fixed parameters, different for each firm and can be estimated by introducing a dummy variable for each firm. This model is known as the fixed effects model (DVLS). Once can interpret this model as being the same as equation 4, but with α different for each bank, and with a random error equal to e. An alternative is to assume that there are no systemic differences among the firms and thus that v_k is zero. This model is known as the random effects model.

It is not clear whether we should prefer the fixed or random effects model. The fixed effect model is reasonable if it is truthful that the model applies only to the cross-sectional units in the study, not to additional ones outside. An additional problem with the fixed effects model is that the use of many dummy variables results in the loss of degrees of freedom. This loss is avoided if the individual effects specific to each firm (v) can be assumed to be random. In the event, I estimated both variants, and applied the standard test to determine (ex post) which model appears more appropriate. [7]

However, as I will show in the estimations, I have to introduce inertia in the model, so the equation to estimate is equal to:

(6) $$y_{kt} = a + gy_{kt-1} + bSD_{kt} + v_k + e_{kt}$$

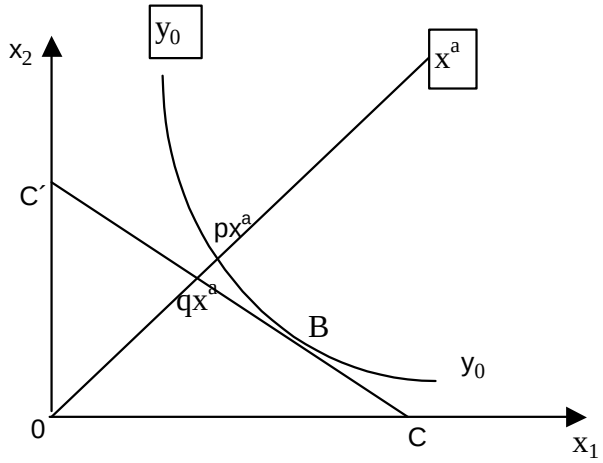
[7] There are two tests to distinguish if there is heterogeneity in the sample across units and one test to identify if this heterogeneity must be thought as fixed or as random effects. The first is an F-test to test for the joint significance of the dummy variables associated with each bank. The second is a Lagrange Multiplier test developed by Breusch and Pagan (1980) to test if the variance of the individual effects is equal to zero. Finally, there is the Hausman´s test to determine if the random effects and the regressors are orthogonal as it is assumed in the random effects model. If they are not independent then the parameters will be bias in the random effects model.

When one has the lagged dependent variable as the explanatory variable, the DVLS estimator becomes inconsistent. To deal with this problem, I followed the Anderson and Hsiao (1982) procedures, estimating the model in the first difference, to eliminate the individual specific effect, and used instrumental variables.[8]

For the study of the relationship between cost efficiency and subordinated debt, I first estimated an indicator of the cost efficiency for each bank. The literature about cost efficiency distinguishes three types of efficiencies. Scale efficiency refers to whether the firm is operating at the most cost efficient scale. Depending on the cost function, there be a range of output levels over which there are economies of scale, implying that there is an least-cost optimum level or range of output. Thus, a bank which starts out operating in the least-cost range, could end up increasing its average cost if events cause it to reduce its scale. The other two types of efficiency are known as X-efficiency. Technical inefficiency refers to using too large a proportion of the inputs to produce a determined quantity of output. Allocative inefficiency refers to using the wrong combination of inputs to produce a given level of output. In figure 3, I have a typical isoquant. If I am producing y_o with the vector of inputs x^a, the technical inefficiency is given by the parameter p, because I can reduce the quantity of both inputs until px^a and produce the same quantity y_o. However, I also can change the combination of inputs x_1 and x_2 until point B and still produce y_o but with an additional reduction in the cost. This is the allocative inefficiency given for the parameters q/p.[9]

[8] See Hsiao (1986) to the analysis of dynamic models with variable intercepts.
[9] Pesaran and Schmidt (1999), explains the econometric implications of the different types of inefficiencies.

Figure 3. Technical and Allocative Inefficiency



To measure the X-inefficiency, the standard procedure is to estimate a best practice cost function, which is the predicted cost function of banks that are X-efficient, and then measure the degree of inefficiency relative to this best practice technology. [10] As I had time series data and cross-sectional data, I used a panel data technique to develop our indicator of efficiency.[11]

I estimated a cost function (C), in which the cost depends on the prices of the variables inputs (w), the quantities of variable outputs (y), random error (e), and the efficiency (u). This cost function is given by the following equation:

(7)

$$C = c(w, y, e, u)$$

[10] There are several techniques to estimate the best practice cost function, such as the data envelopment approach, the fee disposable hull analysis, the stochastic frontier approach, the thick frontier approach, and the distribution free approach. For a review of these procedures, see Mester (1996), Berger et al. (1997) and Pesaran and Schmidt (1999).

[11] See Lang and Wezel (1996) for an estimation of the efficiency cost using panel data and Pesaran (1999) for the advantages of panel data estimation over other procedures.

Assuming that the inefficiency and the random error are multiplicatively separable from the rest of the cost function, and using a non-homothetic translog functional form, the natural log of the cost function using subscript k for the bank and t for the time is the following:[12]

$$\ln C_{kt} = a_0 + \sum_{i=1}^{n} b_i y_{ikt} + \sum_{j=1}^{m} b_j \ln w_{jkt} + 1/2 \sum_{i=1}^{n}\sum_{l=1}^{n} d_{il} \ln y_{ikt} \ln y_{lkt}$$

$$1/2 \sum_{j=1}^{m}\sum_{h=1}^{m} \ln w_{jkt} \ln w_{hkt} + 1/2 \sum_{j=1}^{m}\sum_{i=1}^{n} \ln w_{jkt} \ln y_{ikt} + u_k + e_{kt} \quad (8)$$

This cost function is estimated following the same procedure as was used to estimate the risk function, that is by using the component error regression model, as well as the fixed and random effects model, to identify the individual effects. These individual effects are measures of differences in cost efficiency. If I compare the cost functions of two banks that have the same values for the exogenous variables on the right side of equation 8, the cost function will be different just because the parameters u_k will be different. The bank with a higher u_k will show higher costs, so it will be less efficient. Our indicator of cost efficiency is given the following equation:

$$Ce^k = \frac{a_0 + u_m}{a_0 + u_k} \quad (9)$$

[12] See Brown et al. (1979) for the advantages of the translog function. Berger and DeYoung (1996) and Berger and Mester (1997) have shown that there are small differences with other cost function specifications, such as the Fourier transformation.

where Ce^k is the indicator of cost efficiency for bank k, u_m is the minimum individual effect, and u_k is the individual specific effect of bank k. This indicator is equal to one for the best practice cost efficiency bank and a lower level indicates a less efficient bank.

This indicator of efficiency measures both technical and allocative efficiencies. The indicator shows the proportion of resources that the bank is using efficiently. The indicator does not measure the efficiencies of scale because I control for the output level of each bank.

Once I had the indicator of cost efficiency for each bank, I tested whether the banks with subordinated debt were less efficient than the banks without subordinated debt. I split the banks between high efficiency (about in a efficiency scale the median) and low efficiency (below the median). Then, using a two-way contingency table, I classify the banks according to whether they do or do not have subordinated debt, and by their levels of efficiency. Finally, a χ^2 test is used to assess whether the two criteria are independent.

Additionally, I ran a simple regression model in which the dependent variable was the indicator of efficiency and the regressor was a proxy for the subordinated debt. I used my two proxies: (a) the level of subordinated debt of each bank as a proportion of its capital; and (b) the proportion of each bank's profit that went to the Central Bank as payment of the subordinated debt.

4. Data

I worked with annual data from the publications of the Superintendency of the Banks of Chile, covering all Chilean banks for the period of 1986-1998. At the end of 1986, there were 40 banks in the Chilean financial system. Of these, 19 had been rescued from the financial crisis during the period of 1981-1985 and had subordinated debt with the Central Bank. Table 1 presents the evolution of the institutions that were rescued and had subordinate debt. Six paid their subordinate debt between 1986 and 1990 and another two were merged with institutions that had subordinated debt at the time. Between 1990 and 1995, another six institutions paid their subordinated debt with the Central Bank. Finally, under a new system of payment, four institutions were freed of any further obligation, after making partial payments (of subordinated debt) to the Central Bank during the period of 1996-1998. Only one institution still has subordinated debt.

In the non-parametric estimations, I included all the banks in the sample. This meant that if a bank closed its operations, I included its information until the last year that it was in operation. However, in the parametric estimation, I excluded those banks for which I did not have complete information.

A summary of the information that I used is given in Table 2. As one can see the distribution functions of the data are not symmetric. Given that, I use the median instead of the mean to represent the "average" value of the variables. I used total assets of the bank divided by its equity capital, as well as non-performing loans divided by total loans.[13] The first indicator measures the insolvency risk because the banks depend on their financial capital to absorb default risks or portfolio losses that occur when a

borrower is not able to repay a debt. Additionally, the financial capital absorbs the losses of the market risks associated with fluctuations in the market value of the bank's assets and liabilities. The second indicator measures the quality of the bank's loan portfolio. A bank can decide to increase its risk lending to the riskier borrower. A bank that lends to riskier borrower's should have a higher ratio of bad loans to total loans than a bank that follows more conservative credit policies.

I also included three indirect indicators of risk. One indicator is the rate of growth of total loans. If a bank grows faster than the other banks, it will likely be more aggressive in its lending policies, relaxing some parameters, or to have penetrated riskier markets. A second indicator is the liquidity ratio, which I define as the proportion of deposits over cash plus bonds. This is an indicator of risk because, if a bank is solvent but faces an imbalance between short-term payments and short-term income, a run may occur, and the bank will be forced to sell its assets at distress prices, threatening its solvency. In fact, in the early warning system, called the Camel system, the liquidity ratio is one of the three most important indicators; the other two are the asset to equity capital ratio and the quality of the portfolio.[14]

A third indicator is the volatility of the bank net interest income plus commissions. If a bank is more risky than the rest of the banks, this should be reflected in a greater volatility of its net income.

I included two variables as proxies for the degree of rescue. One variable is the amount of subordinated debt that each bank owes to the Central Bank, as a proportion of its equity capital. The other variable measures the share of the Central Bank on the profit of the banks, i.e., the percentage of each bank's profit that the Central Bank receives.

[13] In Chile, a loan is classified as non-performing after 90 days of delay in its payment.

This is not a fixed quantity because, when a bank raises capital, the share of the Central Bank is reduced. Additionally, I used a dummy variable to identify the banks with subordinated debt.

In relation to the efficiency indicators, there is some debate in the literature about which concept of cost efficiency one should use. There are production and intermediation (or asset) approaches. The production approach focuses on operating expenses and defines output as total loans plus bonds, cash, and deposits. The inputs are labor and physical capital. Thus, this approach includes deposits as an output for which high operating costs are incurred. Under the intermediation approach, total variable cost includes the operating expenses plus interest and commissions paid, deposits being here considered an input. In any event, the difference is not important, empirically.[15]

The translog cost function allow to works with different types output. I selected two types of output. One is total loans plus deposits in the case of the production approach or only total loans in the case of the intermediation approach. The other is cash plus bonds.

One problem that I had to face is that the panel data was unbalanced because some banks merged at some point during the course of the study. In regard to the issue of missing data, the literature about missing panel data distinguishes between ignorable and non-ignorable cases. Our case was non-ignorable because the events were not random, given that the unbalance came from the merger of banks. Thus, I decided to eliminate the

[14] See, Economic Review, 1983, which is a special issue on early warning systems.
[15] Mester (1994) recognizes that the difference is not important "..Luckily, the empirical results . . . on scope efficiency do not seem to be very sensitive to which approach is taken."

banks about which I did not have complete information. This left me with 29 banks. I am aware that this solution could create a selection bias.[16]

Even though the cost function includes input prices, I was unable to include this variable due to a lack of data. I am aware that this could create a bias in the parameters due to missing variables. This bias can be considered absent, however, if relative prices are constant during the period of study. I tried to overcome this problem by estimating the models over shorter periods of times, 1990-1995, because it is more plausible to assume that the relative prices had been constant in a shorter period of time.

5. Estimations and Results

In this section, I show the main results of my estimation in regard to the effects of the mechanisms implemented to solve financial crisis on the management of the risk and on efficiency of the bank.

5a. Risk Level

The first results show that there is a high degree of dependence between the risk level of a bank and its subordinated debt status. Table 3 and 4 shows two contingency tables which classify banks according to their level of risk (ratio of total assets to equity capital or ratio of bad loans to total loans, respectively). A bank is considered to have high risk if its risk is above the median and low risk if it is below the median. As can be seen, a bank with subordinated debt has a probability of 0.8 of being a high risk bank,

[16] Baltagi (1995) explains the problem of missing data and its eventual solutions.

while a bank without subordinated debt has a probability of only 0.4. This difference is statistically significant. Additionally, the test of independence was rejected, confirming that the variables are not independent. Similar results were achieved with the indicators of bad loans to total loans.

Also, the medians of the indicators of risk are higher for banks with subordinated debt than for banks without subordinated debt. In fact, the median of the ratio total assets to equity capital for banks with subordinated debt is equal to 18, while for the banks without subordinated debt, the median is only 10. These results are similar when the risk indicator is the ratio of bad loans to total loans. In this case, the banks with subordinated debt had a median of 0.016, while the banks without subordinated debt had a median of 0.04%.

To obtain more information about moral hazard behavior, I analyzed some indirect indicators of risk. The advantages of these indirect indicators are that they respond directly to the decision of the management and are normally correlated with the risk of the banks.

The results summarized in Table 5,6 and 7 are mixed. Both types of banks have the same probability of having a high rate of growth of loans. However, a bank with subordinated debt has a higher probability of iliquidity (0.7) than a bank without subordinated debt (0.4). However, a bank with subordinated debt has less probability of having high volatility of its net income than a bank without subordinated debt. Thus, the results are not conclusive.

The relationship between the subordinated debt and the risk of the banks declined over time. Table 8 and 9 shows how the probability of falling in the high risk category changed over time, for banks with and without subordinated debt, during the period

1986-1995. Ten years after the financial crisis, there was no longer connection between risk level and subordinated debt status.

I then estimated the risk models, using cross-sectional and time series data, using different procedures. One problem that I had to face was that the initial conditions were significantly different for each group and that some inertia is present in the process of adjusting the risk level. Thus, our estimates could be biased. For example, a bank with subordinated debt, as a result of the financial crisis, has significantly higher ratio of total assets to equity capital and of bad loans to total loans as compared to the bank without subordinated debt. Then, if during the period of analysis the bank with subordinated debt reduced its indicators of risk and its level of subordinated debt or the shares of the Central Bank in the profits, there is a positive and significant relationship between the indicators of risk and the subordinated debt. However, this does not mean that the banks with subordinated debt increased their risk due to moral hazard behavior.

To control for the inertia in the process, I estimated the models using a lag of the dependent variable as an additional explanatory variable, as in equation 6. I followed the Anderson and Hsiao (1982) procedures, estimating the model in first differences, to eliminate the individual specific effect, and used instrumental variables. The results indicate that the relationship between the level of risk and the subordinated debt is positive and significant, when the indicator is the ratio of total assets to equity capital. However, the relationship is not significant when the indicator is the ratio of bad loans to total loans. In Table 10 and 11, I show these results, with robust variance estimates. As can be seen, the results are similar for all three proxies variables for subordinated debt.

A graphical analysis confirms these results. Figure 4 plots, for each bank with subordinated debt, the ratio of total assets to equity capital and the average ratio for the

banks without subordinated debt. As can be seen, at the beginning of the period, there was a reduction in the level of risk, but then it started to increase again, before the level of risk of the bank with subordinated debt regressed to the average. Figure 6 presents the results when the indicator is the ratio of bad loans to total loans. Here the results are different; as the banks with subordinated debt significantly reduced their bad loan portfolios over time. Thus, it is not completely clear that the banks with subordinated debt were increasing or sustaining higher levels of risk.

For the next step, I analyzed the indirect indicators of risky behavior. In Table 12, 13 and 14, the results again show that there is no clear evidence that the banks with subordinated debt were increasing or sustaining higher levels of risk. The estimation of the total loans growth model indicates that there is a negative and significant relationship between total loans growth and whether a bank had subordinated debt. This means that the banks with subordinated grew less than banks without subordinated debt. Also, the estimation of the liquidity ratio indicates that there is a significant negative relationship between a bank's liquidity ratio and its subordinated debt status. Thus, banks with subordinated debt had a lower probability of a liquidity problem. Additionally, no significant relationship was found between the volatility of a bank's net income and its subordinated debt status.

Finally, I ran regressions to estimate the long-term relationship between our indicators of risk and whether a bank had subordinated debt. These were cross-sectional regressions using period averages of the variables, Table 15 and 16 confirms that the difference in risk levels, when I used the direct indicators, is significant during the period 1986-1998. Similar results are achieved from the period 1990-1995.

To summarize, I can say that banks with subordinated debt had a significantly higher level of risk than banks without subordinated debt during the period 1986-1998. All the indicators and models of risk show that such banks to be riskier, and that this was a long-term relationship. However, it is not clear that these higher levels of risk were due to moral hazard behavior. First, the indirect indicators of risk do not show that banks with subordinated were increasing their levels of risk. Second, the banks with subordinated debt had higher levels of risk at the beginning of the period as a result of the financial crisis. That could be the reason that a relationship was found between subordinated debt and risk. However, when I controlled for the initial conditions, the relationship held steady. This is the only evidence that supports the idea that the bank with subordinated debt may have, to some extent, exhibited moral hazard behavior.

There are other ways in which one can understand that the banks with subordinated debt had objectively higher levels of risk. If these banks had a high level of risk at the beginning of the period, they did not have to do anything to increase their risk because it was already high. This could be the reason why I did not find that the indirect indicators revealed moral hazard behavior. Additionally, this could be the reason why, when I controlled for inertia, the model of the ratio of total assets to equity capital showed that the subordinated debt positively and significantly affected the level of risk. But, the graphs are consistent with the idea that the banks with subordinated debt did not make a substantial effort in either directions, to reduce or to increase their level of risk. However, the results of the model of the ratio of bad loans to total loans do not support this hypothesis. The explanation could be that banks with subordinated debt keep a relatively high level of risk through the ratio of total assets to equity capital. However,

they do not seek to increase their risk through "looting behavior" such as lending money to risky segments or relaxing their lending policies.

5b. Efficiency

To estimate the effects of subordinated debt on the cost efficiency of the banks, I first estimated a cost function for the Chilean banking industry for the period of 1986 to 1993. I used information only until 1993 because this permitted me to have just one indicator of efficiency for all periods. With this indicator, I compared the group of banks with subordinated debt with the group of banks without subordinated debt.

The results of the estimation of the translog cost function are given in Table 17. The production and the intermediation models show that the variables are significant and the R^2 is high (0.97). These results are the same under both procedures of estimation--the fixed and random effects model. In any case, I conducted tests to select the more appropriate model. First, I tested for individual effects using the F-test for the fixed effects models and the Breusch and Pagan Lagrange multiplier tests for the random effects models. The results of both tests called for the rejection of the hypothesis of homogeneity, implying that the individual effects in equation 8 are different across bank. The next concern was to distinguish whether the heterogeneity should be managed as a fixed effect or as a random effect. The results of the Hausman test indicated the rejection of the hypothesis of independence; thus the fixed effects model is more appropriate.

After estimating the production cost and the intermediation models, I developed indicators of efficiency with the individual specific effects, according to equation 9. I used both models, the cost production and the intermediation approach, and I used both estimation procedures, fixed and random effects. Thus, I had four indicators of cost

efficiency for each bank. In general, the correlation between the four indicators is very high[17]. However our preferred model is the cost of production approach, because its results are more robust to changes in estimation procedure. As seen in Table 17, the parameter does not change much, in this model, as we moves from fixed effects to random effects estimations.

I found X-efficiency to be an average of 51%. This level of efficiency is lower than the level of efficiency founded for the US economy. Mester (1994) reported that the average for the US economy is between 70% and 80%. Berger and Mester (1997) reviewed 130 studies on cost efficiency. Their results confirmed those of Mester (1994) for the US economy; they also presented the average of other countries, including the UK with 55%, France with 95%, Denmark with 67%, and Norway with 90%.

Other results that can be used to validate the model are the economies of scale estimated. Equation 10 is the formula used to estimate the economies of scale from the translog cost production function. I estimated 0.7 to be the elasticity of real cost with respect to output, evaluated at the mean output for the entire sample. This value reveals greater economies of scale than has been found for developed countries. Mester (1994) reports a relatively flat curve for the US economy, with a cost elasticity of around 0.95. Lang and Wezel (1996) report moderate economies of scale for the German cooperative banks.

(10) $$SE = b_1 + b_2 + d_{11}\ln y_1 + d_{22}\ln y_2 + d_{12}\ln y_2 + d_{21}\ln y_1$$

[17] The correlation table is in appendix C.

This assumes that each elements of the vector of output (y_1 and y_2) increases by the same percentage.

I then estimated the relationship between the cost efficiency of the banks and whether a bank had subordinated debt, using our four indicators of cost efficiency, as a means to achieve more robust results. Table 18 and 19 presents a classification of banks according to their level of efficiency (cost of production model). A bank is given a "high" rating if its efficiency is above the median and a low rating if it is below the median. As can be seen, a bank with subordinated debt has a probability of .87 of having a low rating, while a bank without subordinated debt has a probability of only .33. This difference is statistically significant. Additionally, the test of independence was rejected, confirming that the variables are not independent. Similar results were achieved with the cost of intermediation model.

I then ran a regression analysis between efficiency indicators from the cost of production model and the subordinated debt indicators. The proxies of the subordinated debt are the ratio of subordinated debt to equity capital and the share of the Central Bank in the profits of the bank. Table 20 shows a negative and significant effect of subordinated debt on efficiency, confirming the results presented in the contingency tables. The results are the same using each of the two proxies for subordinated debt.[18]

The results indicate that if a bank increases its subordinate debt by an amount equal to its capital, it will use about 6% more of resources, per unit of output than the most efficiency bank. Additionally, if the participation of the Central Bank in a bank's profits increases by 10 percentage points, that bank will be using 3% more resources than

[18] I included a dummy variable to control for the effect that a banks was controlled but a group of shareholders on the operating cost. This variable was not statistically significant.

the most efficient bank. On average, the banks with subordinated debt use 20% more resources, per unit of output, than the bank without subordinated debt.

I wondered whether there could be an alternative hypothesis for the agency problem that could explain the lower efficiency of a bank with subordinated debt. It is possible that a financial crisis leads to a significant reduction in the scale of production of the rescued banks, for example, a loss of deposits or clients. In this case, the bank is less efficient because it is too big for its number of clients or amount of assets and liabilities and. However, this type of inefficiency, which is measured by our indicators of efficiency, is not due to agency problems. It is the result of the crisis and the inertia in adjusting the size of the banks.

To test this alternative hypothesis, I ran the cost production function and re-calculated the indicators of efficiency during the period of 1990-1995. Thus, even if there were some inertia in adjusting the size of the banks, four years after the crisis is sufficient time to make the adjustment. However, the results remained the same.

In summary, the results indicate that the banks with subordinated debt were less efficient than the other banks. It is likely that the inefficiency is more related to agency problems than to the initial conditions.

6. Concluding Remarks

When the Central Bank purchases bad loans to handle bank failure, there is a potential risk of moral hazard behavior on the part of the rescued bank. There are two channels through which the decisions of the bank might be affected. First, the bank could increase its level of risk and, second, the bank could become less cost efficient.

The empirical evidence from the Chilean banking crisis of the 1980s indicates that the banks with subordinated debt did have higher level of risk and were less cost efficient. However, it is not clear that the higher level of risk was due to moral hazard behavior.

Despite the fact that expensive rescue packages were implemented, all the rescued banks started with a significantly higher level of risk after the crisis. This means that the solutions implemented left an important group of banks operating with higher levels of risk. Thus, it is difficult to determine whether the higher risk of the bank with subordinated debt is due to these initial conditions or to moral hazard behavior.

It is interesting to note, however, that only one of the rescued banks failed again. This is a good result compared with the results of the rescue of the US Saving & Loans, in which a significant number of institutions were sold or liquidated at the end of the 1980s.

One hypothesis is that the success of the mechanism implemented in Chile is due to the fact that the authority took certain measures to reduce the moral hazard problem. First, the banks with the greater financial problems, in which moral hazard problems were potentially most serious, were closed. Second, ceilings put by the authority on its financial assistance also to limit moral hazard problems. Third, during the time of the crisis, in the banks with the greater financial problems, the management was changed and a Provisional Administrator was assigned by the government.

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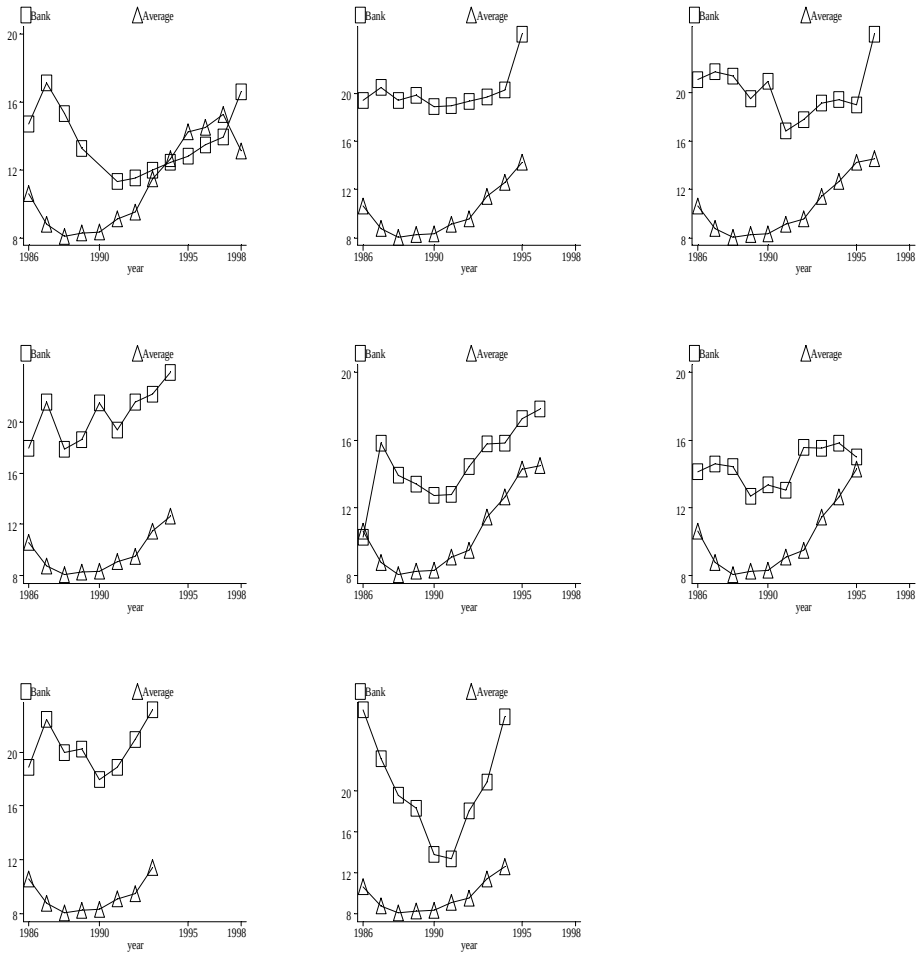
Figure 4

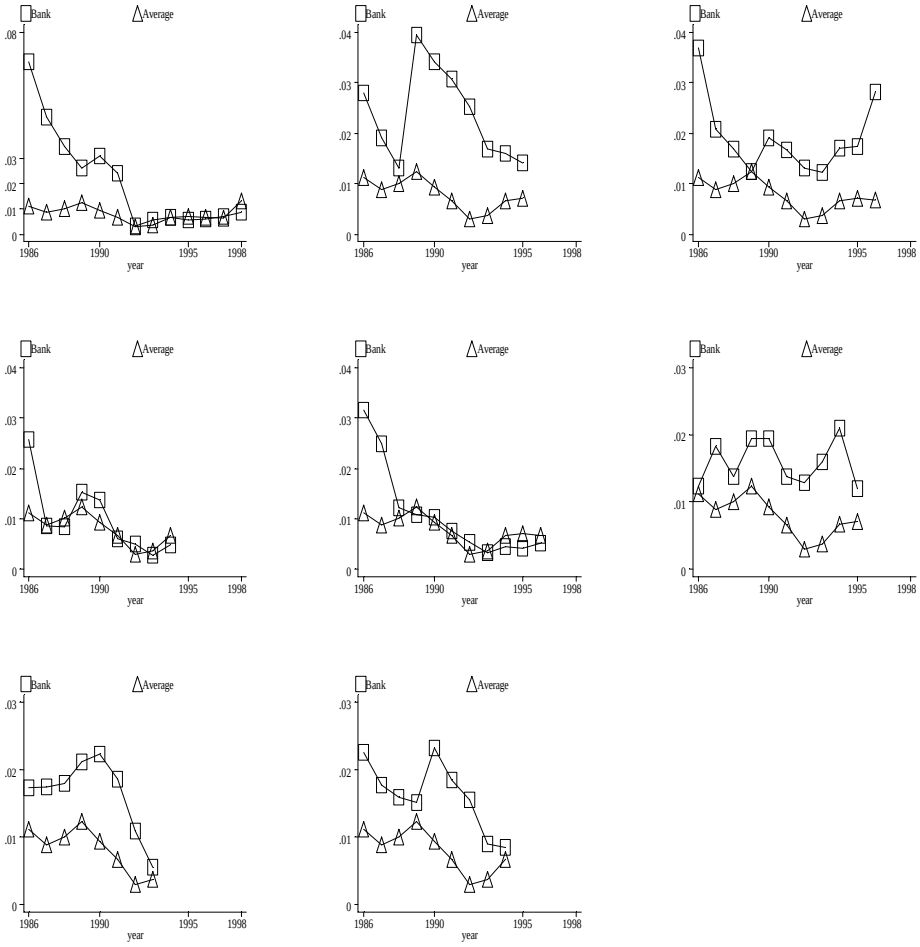
Ratio of Total Assets to Equity Capital by Bank that have Subordinated Debt
(banks that have subordinated debt at least for four years)



Note: Each graph represents a bank that have subordinated debt for at least eight years. The square symbols is line of the ratio of total assets to equity capital of a bank and the triangle symbol is line of the average of the ratio of total assets to equity capital of the banks that do not have subordinated debt.

Figure 5

Ratio of Bad Loans to Total Loans by Bank that have Subordinated Debt
(banks that have subordinated debt at least for eight years)



Note: Each graph represents a bank that have subordinated debt for at least eight years. The square symbols is line of the ratio of bad loans to total loans of a bank and the triangle symbol is line of the average of the ratio of bad loans to total loans of the banks that do not have subordinated debt.

Table 1

Evolution of the Chilean Financial System

	Banks have Subordinated Debt	Total
1986	19	40
1990	11	40
1995	5	34
1998	1	32

Note: This table shows the number of financial institution that have subordinated debt each year and the total number of financial institutions. Source: Superintendence of Banks.

Table 2

Description of the Data, 1986-1998
(million of Ch$, 1986)

Description	Median Value	Range	Percentil (90%)
Equity Capital	4,521	663 - 83,628	18,830
Total Assets	43,682	2,369 - 1,292,064	382,208
Total Loans	25,330	778 - 900,679	217,736
Non-Performing Loans	154	0 - 23,994	2,502
Bond and Cash	14,240	44 - 425,032	82,837
Demand, Saving, and Time Deposits	20,725	46 – 554,987	169,033
Operating Expenses	1,286	72 – 28,031	9,354
Interest and Commission Earned	8,545	118 – 192,346	50,668
Interest and Commissions Paid	5,489	.6 – 148,315	33,728
Shares of Central Bank on Profits	76%%	26,4% - 100%	96%
Ratio of Subordinated Debt to Capital	2.6	0 – 8.4	6.1

Source: Superintendence of Banks.

Table 3

Cross Classification of Types of Banks by Level of Risk:
ratio of total assets to equity capital
(Contingency Table)

	Subordinated Debt		
Risk Level	Yes	No	Total
High	103 84.4%	129 38.0%	232
Low	19 15.6%	210 62.0%	229
Total	122	339	

Pearson Chi2 (1) = 77,7 ***

Note: This table classifies banks according to their level of risk (ratio of total assets to equity capital). A bank is considered to have high risk if its ratio of total assets to equity capital is above the median and low risk if it is below the median.
*** significant at the 1% level.

Table 4

Cross Classification of Types of Banks by Level of Risk:
ratio of bad loans to total loans
(Contingency Table)

	Subordinated Debt		
Risk Level	Yes	No	Total
High	104 85.2%	128 37.8%	232
Low	18 14.8%	211 62.2%	229
Total	122	339	

Pearson Chi2 (1) = 81***

Note: This table classifies banks according to their level of risk (ratio of bad loans to total loans). A bank is considered to have high risk if its ratio of bad loans to total loansl is above the median and low risk if it is below the median.
*** significant at the 1% level.

Table 5

Cross Classification of Types of Banks by Level of Risk:
rate of loans growth
(Contingency Table)

	Subordinated Debt		
Risk Level	Yes	No	Total
High	70 57%	185 55%	255
Low	52 43%	154 45%	206
Total	122	339	

Pearson Chi2 (1) = 0.3

Note: This table classifies banks according to their level of risk (rate of loans growth). A bank is considered to have high risk if its rate of loans growth is above the median and low risk if it is below the median.
*** significant at the 1% level.

Table 6

Cross Classification of Types of Banks by Level of Risk:
ratio of liquidity
(Contingency Table)

	Subordinated Debt		
Risk Level	Yes	No	Total
High	84 69%	147 43%	231
Low	38 31%	192 57%	230
Total	122	339	

Pearson Chi2 (1) = 23***

Note: This table classifies banks according to their level of risk (ratio of liquidity). A bank is considered to have high risk if its ratio of liquidity is above the median and low risk if it is below the median.
*** significant at the 1% level.

Table 7

Cross Classification of Types of Banks by Level of Risk:
volatility of the net income
(Contingency Table)

	Subordinated Debt		
Risk Level	Yes	No	Total
High	1 13%	12 60%	13
Low	7 87%	8 40%	15
Total	8	20	

Pearson Chi2 (1) = 5.2**

Note: Volatility on net income is equal to the variance of the net income during the period 1986-1993. The table classifies banks according to their level of risk (volatility of the bank net income). A bank is considered to have high risk if its volatility of the net income is above the median and low risk if it is below the median.
** significant at the 1% level.

Table 8

Bank's Probability of Being High Risk
(Cross Classification of Types of Banks by Level of Risk)

	total assets to equity capital			bad loans to total loans		
	Subordinated Debt		Chi2 (1)	Subordinated Debt		Chi2(1)
Bank probability of being high risk	Yes	No		Yes	No	
1986-1998	84%	38%	78***	85%	38%	81***
1987-1998	85%	39%	67***	85%	40%	63***
1988-1998	85%	40%	51***	83%	41%	47***
1989-1998	84%	42%	38***	83%	43%	34***
1990-1998	80%	44%	25***	80%	44%	24***
1991-1998	76%	45%	14***	80%	45%	19***
1992-1998	77%	45%	12***	74%	47%	9***
1993-1998	76%	46%	8***	64%	49%	2
1994-1998	71%	48%	3*	65%	50%	1.4
1995-1998	60%	50%	.4	60%	50%	.3

Note: (1) Pearson test of independence.

The table shows the probability that a bank with and without subordinated debt is classify as a high risk bank. Appendix A show the probability by year.
*** significant at the 1% level.
** significant at the 5% level.
* significant at the 10% level.

Table 9

Bank's Probability of Being High Risk
(Cross Classification of Types of Banks by Level of Risk)

	total loans growth			liquidity ratio		
	Subordinated Debt		Chi2	Subordinated Debt		Chi2
Bank probability of being high risk	Yes	No		Yes	No	
1986-1998	57%	55%	.3	69%	43%	23***
1987-1998	50%	52%	.2	75%	42%	33***
1988-1998	50%	52%	.08	83%	41%	47***
1989-1998	48%	52%	.3	88%	41%	50***
1990-1998	50%	52%	.04	89%	41%	42***
1991-1998	49%	51%	.09	89%	42%	32***
1992-1998	49%	52%	.12	86%	44%	21***
1993-1998	56%	51%	.25	84%	45%	13***
1994-1998	53%	51%	.02	82%	46%	8***
1995-1998	50%	51%	.0	80%	48%	3.8**

Note: (1) Pearson test of independence.

The table shows the probability that a bank with and without subordinated debt is classify as a high risk bank. Appendix B show the probability by year.
*** significant at the 1% level.
** significant at the 5% level.
* significant at the 10% level

Table 10

Effects of the Subordinated Debt on the Risk Level of the Banks, Dependent Variable: total assets to equity capital (1986-1998)

	Model 1	Model 2	Model 3
Dummy	2.8** (1.3)		
Subordinated debt to equity capital		.64*** (.1)	
Share of Central Bank on profits			4.2** (2.01)
Lag dependent variable	0.00003 (0.006)	-0.002 (0.007)	0.002 (0.007)
R^2	0.04	0.03	0.05

Table 11

Effects of the Subordinated Debt on the Risk Level of the Banks, Dependent Variable: bad loans to total loans

	Model 1	Model 2	Model 3
Dummy	0.002 (0.002)		
Subordinated debt to equity capital		0.0004 (0.0007)	
Share of Central Bank on profits			-0.002 (0.002)
Lag dependent variable	-0.07*** (0.02)	-0.07*** (0.02)	-0.07*** (0.2)
R^2	0.01	0.01	0.1

Note: Each column reports the regression coefficients with robust variance estimate. The standard deviation is in parenthesis.
*** significant at the 1% level.
** significant at the 5% level.

Table 12

Effects of the Subordinated Debt on the Risk Level of the Banks, Dependent Variable: total growth of the banks

	Model 1	Model 2	Model 3
Dummy	-.2** (.09)		
Subordinated debt to equity capital		-.06** (.03)	
Share of Central Bank on profits			-.3*** (.1)
Lag dependent variable	-.05 (.08)	-.05 (.08)	-.05 (.08)
R^2	0.01	0.01	0.01

Table 13

Effects of the Subordinated Debt on the Risk Level of the Banks, Dependent Variable: liquidity ratio

	Model 1	Model 2	Model 3
Dummy	-.8*** (.2)		
Subordinated debt to equity capital		-.2*** (.03)	
Share of Central Bank on profits			-1.0*** (.3)
Lag dependent variable	-.009*** (.002)	-.009*** (.002)	-.009*** (.002)
R^2	0.01	0.01	0.01

Note: Each column reports the regression coefficients with robust variance estimate. The standard deviation is in parenthesis.
*** significant at the 1% level.
** significant at the 5% level.

Table 14

Effect of the Subordinated Debt on the Risk Level of the Banks, Dependent Variable: volatility of net income (1986-1993)

	Model 1	Model 2	Model 3
constant	0.05*** (0.005)	0.06*** (0.009)	0.05*** (0.005)
dummy	0.02 (0.18)		
subordinated debt to equity capital		-0.003 (0.003)	
shares of Central Bank on profits			0.03 (0.02)
R^2	0.02	0.02	0.02

Note: The volatility of the net income is the variance in the period 1986-1993. Each column reports the regression coefficients with robust variance estimate. The standard deviation is in parenthesis.
*** significant at the 1% level.
** significant at the 5% level.

Table 15

Effects of the Subordinated Debt on the Bank Risk, Long-Term Relationship Dependent Variable: total assets to equity capital

(between estimator, 1986-1998)

	Model 1	Model 2	Model 3
Dummy	9.7 *** (2.8)		
Subordinated debt to equity capital		1.4** (.7)	
Share of Central Bank on profits			13.3 *** (3.5)
Constant	10.6 *** (1.2)	11.8*** (1.2)	10.4*** (1.1)
R^2	0.3	0.2	0.4

Table 16

Effects of the Subordinated Debt on the Bank Risk, Long-Term Relationship Dependent Variable: bad loans to total loans

	Model 1	Model 2	Model 3
Dummy	.013*** (.003)		
Subordinated debt to equity capital		.002*** (.0007)	
Share of Central Bank on profits			.02*** (.004)
Constant	.006*** (.001)	.008 (.001)	.007*** (.002)
R^2	0.4	0.3	0.4

Note: Each column reports the regression coefficients with robust variance estimate. The between estimator is a regression of the average of the dependent and independent variables for the period. The standard deviation is in parenthesis.
*** significant at the 1% level.
** significant at the 5% level.

Table 17
Cost Efficiency Function
(1986-1993)

	Cost of production model		Cost of intermediation model	
Models	Fixed effects	Random effects	Fixed Effects	Random effects
Constant	6.5 (5.2)	7.8*** (1.4)	6.5 (5.3)	3.5*** (1.3)
Total loans plus demand saving and time deposits (Y1)	-1.6** (0.8)	-1.6*** (0.3)		
Total loans (Y2)			-1.6** (0.8)	0.5** (0.25)
Cash and bonds (Y3)	1.2** (.5)	.8*** (.24)	1.2** (.5)	-0.4* (0.21)
Y1^2	.4*** (0.08)	.4*** (.05)		
Y2^2			.4*** (.08)	.14 (0.04)*** *
Y3^2	.1*** (.03)	.11*** (.03)	.1*** (.03)	.23 (0.03)*** *
Y1*Y3	-.2*** (.05)	-.2*** 0.03		
Y2*Y3			-.2*** (0.05)	-.2*** (0.03)
R2	.97	.91	.97	.92
F test	22***		3.4***	
Breusch Pagan test		329***		7.7***
Hausman specification test		56***		39.1***

Note: Each column reports the regression coefficients with robust variance estimate. The standard deviation is in parenthesis.
*** significant at the 1% level.
** significant at the 5% level.

Table 18

Cross Classification of Types of Banks by Level of Efficiency, Indicator of Efficiency: cost of production model

(Contingency Table)

	Subordinated Debt		
Efficiency Level	Yes	No	Total
High	1 12.5%	14 66.8%	15
Low	7 87.5%	7 33.2%	14
Total	8	21	29

Pearson Chi2 (1) = 6.8 ***

Note: This table classifies banks according to their level of efficiency (indicator of efficiency from the cost of production model). A bank is considered to be high efficient if its indicator of efficiency is above the median and low risk if it is below the median.
*** significant at the 1% level.

Table 19

Cross Classification of Types of Banks by Level of Efficiency, Indicator of Efficiency: cost of production model

(Contingency Table)

	Subordinated Debt		
Efficiency Level	Yes	No	Total
High	0 0%	7 35%	15
Low	8 100%	13 65%	13
Total	8	20	

Pearson Chi2 (1) = 9.7 ***

Note: This table classifies banks according to their level of efficiency (indicator of efficiency from the cost of intermediation model). A bank is considered to be high efficient if its indicator of efficiency is above the median and low risk if it is below the median.
*** significant at the 1% level.

Table 20

Effects of Subordinated Debt on the Efficiency of the Banks:
Dependent Variable: efficiency level

(average, 1986-1993)

	Model 1	Model 2
Subordinated debt to equity capital	-0.06*** (.01)	
Share of Central Bank on profits		-.3*** (.1)
Constant	.56*** (.05)	.63 *** (.06)
R^2	0.18	0.24

Note: Each column reports the regression coefficients with robust variance estimate. The standard deviation is in parenthesis.
*** significant at the 1% level.
** significant at the 5% level.

Appendix A

Cross Classification of Types of Banks by Level of Risk:
bank's probability of being high risk

	total assets to equity capital			bad loans to total loans		
	Subordinated Debt		Chi2 (1)	Subordinated Debt		Chi2(1)
Bank probability of being high risk	Yes	No		Yes	No	
1986	74%	30%	7.4***	84%	20%	16***
1987	89%	15%	22***	84%	20%	16***
1988	94%	19%	20***	88%	24%	15***
1989	100%	27%	18***	92%	31%	12***
1990	100%	32%	15***	100%	32%	15***
1991	100%	34%	13***	100%	34%	13***
1992	90%	34%	8***	100%	33%	13***
1993	88%	41%	5.4**	75%	44%	2.3
1994	86%	42%	4.2*	57%	50%	.11
1995	60%	48%	.2	80%	48%	1.7

Note: (1) Pearson test of independence.
The table shows the probability that a bank with and without subordinated debt is classify as a high risk bank.
*** significant at the 1% level.
** significant at the 5% level.
* significant at the 10% level.

Appendix B

Cross Classification of Types of Banks by Level of Risk:
bank's probability of being high risk

	total loans growth			liquidity ratio		
	Subordinated Debt		Chi2	Subordinated Debt		Chi2
Bank probability of being high risk	Yes	No		Yes	No	
1986				53%	50%	.02
1987	58%	45%	.7	63%	40%	2.1
1988	56%	48%	.3	81%	29%	10***
1989	17%	69%	9.1	83%	35%	8***
1990	46%	57%	.4	91%	36%	10***
1991	50%	52%	.01	90%	38%	8***
1992	20%	63%	5.4**	90%	37%	8.2***
1993	13%	63%	6.3**	88%	41%	5.4**
1994	43%	54%	.3	86%	42%	4.2**
1995	60%	52%	.11	80%	44%	2.1

Note: (1) Pearson test of independence.
The table shows the probability that a bank with and without subordinated debt is classify as a high risk bank.
*** significant at the 1% level.
** significant at the 5% level.
* significant at the 10% level

Appendix C

Correlation of the Indicator of Cost Efficiency

	Cost of production model		Cost of intermediation model	
	fixed effects	random effects	fixed effects	random effects
Cost of production				
fixed effects	1			
random effects	0.97	1		
Cost of intermediation				
fixed effects	0.77	0.63	1	
random effects	0.57	0.57	0.70	1

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