Explaining Bank Efficiency: Bank Size or Ownership Structure?*

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Abstract

This paper uses cost and profit functions to estimate efficiency at the bank level for the 90s in Chile. Using these measures we explained cross-bank differences over time, which are related to bank size, ownership structure and other relevant variables. Our main findings are 1) banks that are established as open corporations in Chile tend to show higher level of efficiency compared to offices of international banks. These banks have higher probability of takeover in Chile since the ownership structure is known and thus managers act in the best interest of stockholders. An alternative hypothesis is that the mix of output is different for the two groups of banks. Branches of international banks tend to intermediate instruments rather than acting as loan-deposit institutions, which is the case of banks that are open corporations. 2) Banks that have higher property concentration show higher level of efficiency. These differences are statistically significant at the conventional level of significance. The two results point in the direction that principal-agent problem mitigation is the key to explain bank efficiency.

Key words: Cost efficiency, profit efficiency, ownership structure, and principal agent problem

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1. Introduction

The Chilean banking industry has become stronger after the deep crisis of the eighties and it has been experiencing an increasing concentration through mergers of large and medium size banks. As it is today we found five large banks (with a market share of 10% and above), eight banks with a market share between 2% and 6% and twelve small banks (with a market share below 1%). Several of these banks are established as open corporations (54% of total banks) in Chile while others remain as branches of international banks.

Another characteristic of the banking industry is the adequate level of solvency and the good supervision and prudential regulation from the economic authority. The strength of the banking system was tested with the "tequila effect" in 1994 and the recent Asian crisis. Until today the system is working and all the banks have fulfilled the liquidity, solvency and capitalization requirements. Nevertheless, there is always a concern related to the efficiency reached by the banks. Especially when one of the reasons given by the owners to merge two banks is efficiency.

This paper analyzes the bank efficiency and its determinants using both profit and cost function. Several papers have analyzed indirectly different concepts of bank efficiency for Chile. For instance, Basch and Fuentes (1998) and Brock and Franken (2002) studied the determinants of banking spreads as a measure of social efficiency of the banking industry. Budnevich, Franken and Paredes (2001) investigated the existence of economies of scale and scope using data on individual banks, finding that there is little space to gain scale economies through merges and it happens only when small banks merge, but not in large banks mergers. Loyola (2000) analyzes the effects of bank merges on bank efficiency, finding some evidence of the relationship between these two variables. Finally Chumacero and Langoni (2001) studied the relationship between risk, size and market

concentration in the banking sector, finding that larger banks and bank concentration do not increase the systemic risk.

This paper searches for the determinants of bank efficiency. Specifically, it explores how the ownership structure affects the bank efficiency controlling for size, risk and macroeconomic variables. In our study, the type of bank ownership, i.e. public company or international branch, and property concentration characterizes ownership. We expect that structure of ownership be the driving force of bank efficiency rather than other variables in a sense that this variable could solve the principal agent problem of manager and stockholders.

To test our hypothesis we use cost and profits frontiers to estimate efficiency at the bank level for the 90s in Chile. Using these measures we explained cross-bank differences over time, which are related to bank size, ownership structure and other relevant variables. We found evidence that banks that are established as open corporations in Chile tend to show higher level of efficiency compared to branches of international banks. We have two interpretations for this finding. The first one is related to a principal agent problem. Banks established as open corporations have higher probability of takeover in Chile, since the ownership structure is known and thus managers act in the best interest of stockholders. We can say that the market will discipline the managers. An alternative explanation is that the mix of output is different for the two groups of banks. Branches of international banks are involved in instrument intermediation (investment) rather than acting as loan-deposit institutions, which is the case of banks that are open corporations. In the latter group banks behave as universal banks.

In a second exercise using data available on banks that are open corporations we found that banks with higher concentration of ownership show higher level of efficiency. These differences are statistically significant at the conventional level of

significance. The two results point in the direction that principal-agent problem mitigation is the key to explain bank efficiency.

The paper continues as follows. In the next section we present some stylized facts that motivate our empirical investigation. In section 3 we discussed the methodology and the data used. In section 4, we show the empirical result and section 5 concludes.

2. Stylized Facts of the Chilean Banking Industry

One of the characteristics mentioned in the introduction is the increasing concentration of the Chilean banking system. At the beginning of the nineties there were 36 banks (35 private and one state owned bank), while by the year 2000 there were only 28 banks. However, looking at different index of concentration one can see that there is almost no difference between 1990 and 2000 using the entire sample of banks (see Table 2.1). But when we drop the state owned bank, both the Herfindhal index and the C4-Private index show that concentration has increased over the time period.

Table 2.1 Concentration in the Chilean Banking System: Total and Private, 1990-2000

Year	Number of Banks	Herfindhal	H. Private	C4	C4-Private
1990	36	0.0944	0.0529	0.5173	0.3135
1991	36	0.0895	0.0499	0.4977	0.2987
1992	36	0.0840	0.0488	0.4793	0.2916
1993	34	0.0839	0.0511	0.4746	0.2934
1994	33	0.0846	0.0511	0.4698	0.2868
1995	31	0.0838	0.0526	0.4579	0.2814
1996	30	0.0874	0.0589	0.4875	0.3189
1997	29	0.0972	0.0729	0.5531	0.3972
1998	29	0.0974	0.0736	0.5513	0.3972
1999	29	0.0972	0.0742	0.5497	0.3979
2000	28	0.0957	0.0727	0.5418	0.3903

Source: Superintendence of Banks

Table 2.2 shows the data on ownership concentration and the number of banks that are open corporations. It is easy to see that while the share of international branches has not change very much; there is a tendency to increase ownership concentration. The four major stockholders of banks owned on average 71% of bank's property in 1990, but this figure reached a record high 0f 93% in 2000. Also the dispersion across banks of property concentration has decreased over time, showing that most banks have tended to concentrate their property. According to our hypothesis this evidence is suggesting that banks are mitigating the principal agent problem between stockholders and managers.

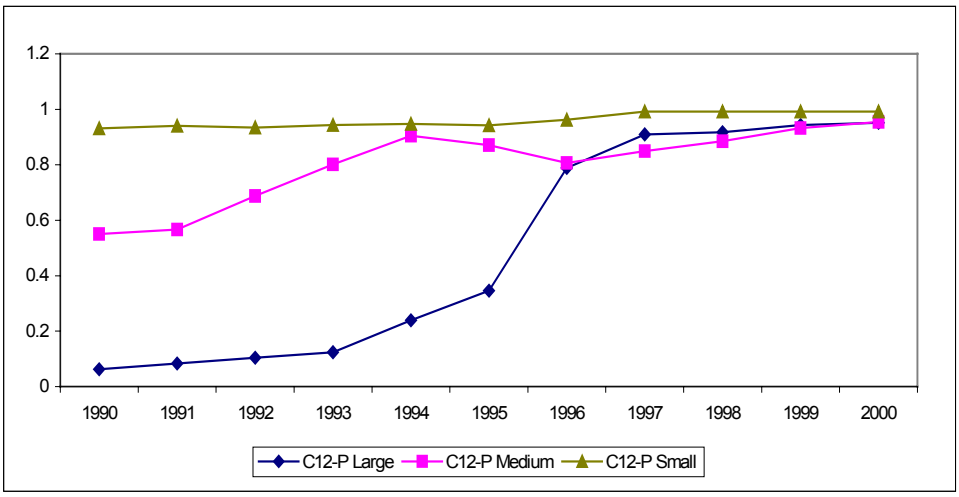
Table 2.2. Bank Ownership Concentration: 1990-2000

Year	Banks that are Open corporations	% of Total Banks that are Public	C4-P Average	C4-P Std. Deviation	C12-P Average	C12-P Std. Deviation	Herfindhalf Private Average	Herfindhalf Private Std. Deviation
1990	18	50%	0.712	0.325	0.820	0.289	0.477	0.484
1991	19	53%	0.733	0.316	0.836	0.272	0.455	0.396
1992	19	53%	0.731	0.304	0.839	0.253	0.406	0.353
1993	19	56%	0.741	0.296	0.848	0.247	0.483	0.487
1994	19	58%	0.762	0.276	0.859	0.235	0.568	0.594
1995	18	58%	0.748	0.268	0.848	0.211	0.586	0.609
1996	16	53%	0.795	0.200	0.879	0.132	0.555	0.454
1997	15	52%	0.843	0.177	0.926	0.082	0.547	0.402
1998	15	52%	0.864	0.167	0.938	0.074	0.575	0.400
1999	15	52%	0.920	0.085	0.960	0.044	0.633	0.366
2000	15	54%	0.933	0.073	0.968	0.038	0.658	0.357

Source: Superintendence of Banks

This property concentration has been especially important for large banks, while small banks always exhibited a high concentration of ownership. The reason for this movement could be found in the solution of the 1982-banking crisis, when several banks were intervened and others liquidated. Intervened banks were privatized later using the so-called popular capitalism, which consisted in selling the property of the banks to a large number of small new owners. After a few years there was an increasing interest for large investor to concentrate the ownership of these banks, probably because that was the most efficient way to manage those firms.

Figure 2.1 Ownership Concentration by Bank Size



Source: Author's calculation based on information from Superintendence of Banks

The question is how this higher market and property concentration affects the return for bank's stockholders? In the first place let analyze market concentration and its relationship with return over equity. As Table 2.3 is showing there is a slight increase in concentration while the return over equity fluctuates apparently with no trend. However the average ROE on 1990-1995 period is 9.7% which is substantial smaller than the average of 1996-2000 period, which is equal to 13.5%.

Table 2.3 Return over equity, market and ownership concentration

Year	ROE	Market Concentration	Concentration of Ownership
		C4-private	C4
1990	15.8%	31.4%	71.2%
1991	6.2%	29.9%	73.3%
1992	3.4%	29.2%	73.1%
1993	9.8%	29.3%	74.1%
1994	9.9%	28.7%	76.2%
1995	13.0%	28.1%	74.8%
1996	16.8%	31.9%	79.5%
1997	14.7%	39.7%	84.3%
1998	12.1%	39.7%	86.4%
1999	9.4%	39.8%	92.0%
2000	14.8%	39.0%	93.3%

Source: Author's calculation based on information from Superintendence of Banks

Table 2.3 also shows the relationship between concentration of ownership measured as C4 and the return over equity. As noticed earlier there is a steadily increase in the measure of concentration that has been accompanied by an increase in the average return over equity. However the measure of ROE is much more volatile.

3. Empirical Model and Data

The concept of efficiency applied in this paper is economic efficiency. The three measures of economic efficiency are cost efficiency, standard profit efficiency and alternative profit efficiency. In this paper we estimate the cost and the alternative profit efficiency, and how different macro and bank specific variables affect these measures. It is important to notice that the two measures may not yield the same result[1]. In fact Berger and Mester (1997) found that cost efficiency and profit efficiency are negatively correlated. Akhavein et al (1997) reports that merges improve benefit efficiency but not cost efficiency. It is important to notice that cost efficiency answers the question of what is the minimum cost to produce a certain mix of product, it does not take into account if there is a mistake in choosing the mix of output given the market prices of products. On the other hand profit efficiency does take into account, as a decision variable, the mix of product.

The measure of efficiency is the actual level of cost (profit) relative to an efficient cost (profit) frontier. The efficiency frontier can be estimated using parametric and non-parametric techniques. Among the first one we found Stochastic Frontier Approach, Distribution Free Approach and Thick Frontier Approach. On the other hand Data Envelopment Analysis is the traditional non-parametric technique used.

[1] See Berger and Humphrey (1997)

Each approach has advantages and disadvantages for analyzing bank data[2]. In this paper we use the Stochastic Frontier Approach to estimate cost and profit efficiency.

The Model

The cost efficiency relates the actual cost of a bank with the minimum cost that will allow the bank to produce that mix of output under the actual conditions. The measure of efficiency is the relative effective cost of bank to the frontier. Following Berger and Mester (1997), this cost function can be written for bank j as:

$$\ln C_j = f(w_j, y_j, z_j) + \ln v_{jc} + \ln u_{jc} \qquad (1)$$

Where C represents cost, *f* is certain functional form, w_j is a input price vector, y_j is the variable output vector, z_j is the fixed netputs vector, v_{jc} is a random variable that denotes inefficiency that increase cost and u_{jc} is the traditional random error term. In this case the random term $v_c + u_c$ is treated as an error component.

The cost efficiency (CE) for bank j is defined as the ratio between the minimum cost, given by a bank in the frontier (we are assuming $v_j^{\min} = 0$), and the actual cost for bank j, given the same exogenous variables (*w, y, z, x*).

$$CE_j = \frac{\hat{C}_{\min}}{\hat{C}_j} = \frac{\exp[\hat{f}(w_j, y_j, z_j)] \times \exp[\ln \hat{u}_{jc}]}{\exp[\hat{f}(w_j, y_j, z_j)] \times \exp[\ln \hat{v}_{jc} + \hat{u}_{jc}]}$$

$$CE_j = \frac{1}{\hat{v}_{jc}} \qquad (2)$$

[2] See Berger and Humphrey (1997) for a summary of the main caveats and goodness of each approach

The range for the index CE is [0,1]. CE=1 means that the bank is 100% efficient.

The profit frontier to estimate profit inefficiency is defined in the usual way as a function of input and output prices. But under certain circumstances like unmeasured differences in quality of banking services, output is not completely variable, banking industry not perfectly competitive or output prices not accurate measured the alternative profit function may be helpful[3]. The alternative profit function uses the same dependent variable as the standard profit function, but the right hand side variables of the cost function as independent variables.

$$\ln \pi_j = g(w_j, y_j, z_j) + \ln u_{j\pi} - \ln v_{j\pi} \qquad (3)$$

Where π represents the variable profits, v_π is a random variable that denotes the inefficiency that reduces profits and u_π is the traditional random error term. Note that output level replace output price in the profit function. In this case the alternative profit efficiency (APE) is defined as the ratio of the actual profits to the predicted profits by the efficient frontier. In other words the number represents the percentage of the maximum profits that bank j is earning:

$$APE_j = \frac{\hat{\pi}_j}{\hat{\pi}_{\max}} = \frac{\exp[\hat{g}(w_j, y_j, z_j)] \times \exp[\ln \hat{u}_{j\pi}]}{\exp[\hat{g}(w_j, y_j, z_j)] \times \exp[\ln \hat{u}_{j\pi} - \ln \hat{v}_{j\pi}]}$$

$$APE_j = \frac{1}{\hat{v}_{j\pi}} \qquad (4)$$

[3] See Berger and Mester (1997) for a complete discussion of the standard and the alternative profit function.

Thus, a APE_j equal to 0.85 means that a bank is losing 15% respect to the bank of best practice. Note that this ratio could be positive or negative since a bank can give away more than 100% of its profits.

Method of estimation

There are two important assumption that we need to make, the probability distribution of the inefficiency and the functional forms *f* and *g*. This paper assumes that the inefficiency is a sequence of random variables i.i.d. as truncated normal at zero, $N(\mu_{jt}, \sigma_v^2)$. The mean of this distribution depends on those factors that affect inefficiency, i.e. $\mu_{jt} = x_{jt}\delta$; where x_{jt} is a vector of the determinants of inefficiency and δ is a vector of parameters to be estimated.

The functional form for the cost and the alternative profit[4] function correspond to a translog. Some authors have found that a Fourier form provides better fit, since it adds trigonometric terms to the traditional translog terms. But in the case of frontier estimation, Berger and Mester (1997) found that the difference in the average efficiency is less than 1% between the translog standard and the Fourier form. They argue that there is no theoretical reason to choose one form respect to the other. We estimate equation (1) and (3) by maximum likelihood using the program Frontier by Tim Coelli.

Data

The data set used comes from the balance sheets reported by the banks to the Superintendence of Banks. We construct a panel data for the 1990-2000 period for all the banks in system. The dependent variables are variable cost, which includes

[4] See for instance Budnevich et al (2001) for an application to Chilean data and the references therein.

interest paid plus labor cost, and profits, which is defined as interest earned minus variable cost

The input prices are interest paid for deposit and other domestic and foreign obligation (w_1), and the wage bills (w_2). The definitions of outputs are loan (y_1) and investments (y_2). The netputs are fixed assets (z_1) and equity (z_2).

The variables used as a determinant of inefficiency are size, market concentration, bank ownership, economic activity and risk. The definitions of these variables are the following:

Size = log of interest earning assets, and market share of each bank

Market concentration = Herfindhal -Hirschman index and C4, which is the share of the four largest banks

Ownership = dummy variables DPC that takes value equal to 1 if the bank is a public company and zero everywhere else, and DFB that takes value equal to 1 if the bank is a foreign branch and zero everywhere else. Another proxies are C4 and C12, which is the share of the 4 and 12 largest shareholders, respectively; Herfindhal of property calculated over the entire group of stockholder for each bank. The last three indicators could be estimated only in the case of banks that are open corporations.

Economic activity = log of real GDP

Risk = loan losses over interest earning assets.

All these variables, size, market power, ownership, economic activity and risk, are part of the vector x_{jt}, as determinants of the average inefficiency.

4. Analysis of the Results

In this section we show the estimation results for inefficiency and we provide explanation for the observed differences in inefficiency across banks. In a first place we report the average efficiency across bank per year assuming that the mean of the truncated normal is constant (Table 4.1). The cost efficiency has been decreasing overtime, while the profit efficiency has remained relatively constant over the same period. The average cost efficiency is indicating that banks spend 9% more resources than a bank on the cost frontier for the same level of output. On the other hand, the average profit efficiency is telling that banks are earning 25% less than the bank of best practice.

These results are not different than those reported in the international literature. For instance, Berger and Humphrey (1997) report a range for profit efficiency between 0.61 and 0.95 with a median equal to 0.85, for US banks using parametric techniques. That range is equal to 0.3 and 0.75 for the European Union with a median equal to 0.63, as reported by Maudos and Pastor (2000). The same study found a range for cost efficiency of 0.8 to 0.96, for the same group of countries, where the median was 0.93. Notice that these studies serve only as references since they are measuring bank efficiency respect to their own frontier, thus we cannot conclude that Chilean banks are more efficient than European and less efficient than the Americans'.

Table 4.1 Estimated cost and profit efficiency.

Year	CE	APE
1990	0.95	0.76
1991	0.94	0.75
1992	0.93	0.76
1993	0.93	0.74
1994	0.92	0.74
1995	0.91	0.74
1996	0.90	0.74
1997	0.89	0.73
1998	0.88	0.72
1999	0.86	0.75
2000	0.86	0.76
Average	0.91	0.75

Cost Efficiency

What are the factors that explain efficiency across banks and overtime. In the next table we present the estimation result including explanatory variables for the mean of the truncated normal. In model 1 the only variable included is the dummy variable that controls for type of bank, i.e. that takes the value equal to 1 if the bank is a public company. The negative and statistically significant coefficient means that this group of banks is less inefficient than the international bank branches. This negative coefficient remain significant even in the case that we control for market concentration, credit risk, size and economic activity (models 2 and 3).

The Herfindhal index enters with a positive sign, which means that the higher is market concentration the lower is cost efficiency, in other words in markets with higher concentration the banks have less incentive to control cost. Size, whether is measured as log of interest earning assets or market share, enters with a negative sign. Larger banks tend to be less cost inefficient. Credit risk also decreases

inefficiency. When the risk of the bank's portfolio increases, the bank's manager has incentives to control cost. The negative sign for log of GDP means inefficiency decreases when the economy is expanding.

Table 4.2 Determinants of the cost inefficiency

Variable	Model 1	Model 2	Model 3	Model 4
Constant	-1.19 (-2.41)**	10.3 (5.92)*	1.38 (1.41)	9.94 (8.42)*
Public company (DPC)	-3.19 (-3.25)*	-0.310 (-3.97)*	-0.201 (-3.95)*	
Herfindahl index		13.5 (4.42)*		12.4 (6.13)*
Market share			-8.52 (-3.86)*	
Credit risk		-16.2 (-13.6)*	-6.80 (-3.48)*	
Log (interest earning assets)		-0.300 (-12.0)*		
Log (GDP)		-0.662 (-5.42)*	-0.0693 (-1.12)	-0.632 (-7.81)*
DPC x Risk				-7.89 (-5.74)*
DFB x Risk				-16.5 (-10.1)*
DPC x Size				-0.484 (-29.5)*
DFB x Size				-0.288 (-11.0)*
log likelihood	252	270	257	270

t-test in parenthesis.
*, **, and *** correspond to 1%, 5% and 10% significance, respectively

When the dummy variables for the type of banks interact with size and risk the results remains qualitatively the same. Risk tend to affect more those banks that are international branches, while size is more important for banks that are open corporations.

How does ownership concentration affect cost efficiency? For those banks that are open corporations we can use the information reported by the Superintendence of Banks to construct a Herfindhal index, C4 and C12 using the share of each stockholders on total property. The higher is the concentration of ownership the higher is the efficiency level, using any measure of concentration. When the sample is divided using dummy variables for small, medium and large banks, concentration of ownership is statistically significant only in the latter group. The reason for this we could find it in figure 2.1, small banks have highly concentrated property compared to large banks. Thus the low standard deviation of this variable across small banks explain why this is not significant for that group.

Table 4.3 Cost Inefficiency and Concentration of Ownership

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Constant	0.0896 (2.72)*	0.276 (18.3)*	0.238 (0.0271)	0.281 (7.88)*	0.0491 (2.09)**	0.0777 (4.52)*
C4	-0.103 (-10.8)*					
C4-Large banks		-0.185 (-5.79)*				
C4-Medium size banks		-0.0413 (-1.25)				
C4-Small banks		-0.0170 (-0.585)				
C12			-0.127 (-4.01)*			
C12-Large banks				-0.178 (-4.58)*		
C12- Medium size banks				-0.0787 (-2.05)**		
C12- Small banks				-0.0559 (-1.53)		
Herfindahl (H)					-0.0623 (-4.50)*	
H- Large banks						-0.262 (-5.83)*
H- Medium size banks						-0.0146 (-0.473)
H- Small banks						-0.0570 (-5.83)*
log likelihood	226	228	218	230	225	231

t-test in parenthesis.
*, **, and *** correspond to 1%, 5% and 10% significance, respectively

Profit Efficiency

We use the same variables as determinants of the profit efficiency. Table 4.4 shows the estimation results. Again a bank that is a public company has higher profit efficiency, however the coefficient is significant only at 10% level. In the second model this variable is not significant and the only variable that matters for efficiency is size, measured as the log of interest earning assets. But in model 3 the variable for public company is statistically significant at 1% level and it has the expected negative sign. In this case market share is used as a proxy of size, and now credit risk, size, and log of GDP are statistically significant. The higher is the market share the lower is profit inefficiency, this may reflect some economies of scope in a sense that larger banks use to be involved with different types of customers. Credit risk is significant at 10% level only in model 3, with a negative sign.

In model 4 the interactive terms of being public company and size are the only coefficients that are significant. They have the same sign than in model 3, but the coefficient is large in absolute value for open corporations than for international branches.

Table 4.4 Determinants of Profit Inefficiency

Variable	Model 1	Model 2	Model 3	Model 4
Constant	-21,0 (-1,64)	45,6 (0,842)	13,3 (2,23)**	12,6 (1,30)
Public company (DPC)	-11,9 (-1,84)***	0,879 (0,857)	-3,31 (-3,74)*	
Herfindahl index		25,5 (1,14)		15,2 (1,43)
Market share			-74,0 (-2,26)**	
Credit risk		-1,31 (-0,0796)	2,43 (1,77)***	
Log (interest earning assets)		-3,20 (-2,98)*		
Log (GDP)		-3,15 (-0,868)	-1,17 (-2,28)**	-0,952 (-1,22)
DPC x Risk				39,7 (1,39)
DFB x Risk				-23,7 (-1,31)
DPC x Size				-3,13 (-2,14)**
DFB x Size				-2,26 (-2,17)**
log likelihood	-198	-180	-189	-178

t-test in parenthesis.
*, **, and *** correspond to 1%, 5% and 10% significance, respectively

In table 4.4 we analyze the relationship between profit efficiency and the concentration of ownership for those banks that are open corporations. Again as in the case of cost efficiency the concentration of ownership is important for large banks. The difference is given in the case when all the banks are aggregated, since in this case we find no statistically significant relationship.

Table 4.5 Profit Inefficiency and Concentration of Ownership

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Constant	-26,7 (-1,16)	-2,08 (-1,88)***	-20,3 (-1,45)	-0,329 (-0,763)	-14,1 (-0,475)	-2,30 (-2,78)*
C4	1,77 (1,14)					
C4-Large banks		-8,04 (-2,29)**				
C4-Medium size banks		-1,68 (-2,05)**				
C4-Small banks		0,125 (0,375)				
C12			-6,66 (-1,49)			
C12-Large banks				-9,04 (-2,91)*		
C12- Medium size banks				-2,93 (-2,93)*		
C12- Small banks				-1,35 (-2,36)**		
Herfindahl (H)					3,09 (0,554)	
H- Large banks						-10,7 (-7,93)*
H- Medium size banks						-0,756 (-0,923)
H- Small banks						0,798 (5,75)*
log likelihood	-52,0	-42,7	-48,7	-41,4	-45,9	-40,8

t-test in parenthesis.
*, **, and *** correspond to 1%, 5% and 10% significance, respectively

5. Concluding Remarks

This paper studies economic efficiency in the Chilean banking industry using a stochastic frontier approach. For measuring economic efficiency we used two indicators the cost and the alternative profit function. We found that banks that are open corporations tend to be more efficient in cost and profit than those banks that are branches of international banks. This result survives after controlling by size, market concentration, credit risk and economic activity.

This would suggest two alternative hypotheses. The first one is related to principal agent problem. Banks, which are open corporations, are being observed closely by the market and they could be subject to take over. Therefore managers carefully handle cost and profit. On the other side foreign owners of banks, which are branches of multinational banks, tend to exert less control over the managers, with the corresponding cost and profit inefficiency.

The second hypothesis is related to the type of business that these two groups are conducting. On the one hand, open corporations tend to be large banks that act as universal banks, by providing all the services permitted by the law. On the other hand, international branches tend to be small banks that are not involved in retailing banking and they are serving only to very large companies or they just do intermediate investment.

Another finding supports the fact that principal agent problem is important for cost and profit efficiency is the evidence presented here on the relationship between ownership structure and efficiency. Banks with higher ownership concentration show higher levels of cost and profit efficiency, showing that ownership concentration is used to mitigate principal agent problem.

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