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Bank Mergers in Chile: A Profit Efficiency Assessment*

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(Very Incomplete and Preliminary)

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Bank Mergers in Chile: A Profit Efficiency Assessment**Abstract**

During the last two decades, the Chilean banking industry has experienced a high concentration due to several mergers between its institutions. Among the reasons argued for these consolidations, a potential for substantial gains in efficiency is claimed. Recent studies suggest that the Chilean banking system indeed exhibits such a potential for the so-called X-efficiency, rather than for the traditional scale and scope economies. The aim of this study is to empirically evaluate the effects of the bank mergers materialized in Chile during the last 20 years on this class of efficiency. To this end, we apply a methodology based on the frontier profit function approach which allows us to compare previous and posterior scenarios to the merger. Our results show, in general, a positive effect of bank mergers on efficiency standards. This suggests that the reduction of inefficiencies X should be an important element to consider when evaluating these processes from both a private and an antitrust policy perspective.

Keywords: bank merger, X-efficiency, frontier profit function, financial regulation

JEL Classification Codes: L11, L41, L89, G21, G28 .

1. Introduction

Since the financial crisis of the early 1980s, important factors have affected the evolution of the Chilean banking sector, among which are the configuration of a new regulatory framework, the trend toward financial desintermediation, the banking internationalization and the increasing level of foreign investment in this industry. These factors have resulted in higher levels of operating efficiency, substantial technological improvements, loan portfolios with low overdue and default risk levels, and a reduction of bank spreads.

In particular, the decrease of profitability margins, mainly explained by financial desintermediation, has lead banks to introduce significant changes in their both mix and scale of production. Thus, banks have expanded their businesses beyond their traditional activities (core banking), and simultaneously have increased their market share, which has led to constitute large banks and with a tendency to the concept of universal banking. Consequently, during the last years it has been observed a process of big mergers which has strongly concentrated the loan system in a reduced number of banks (the 5 largest concentrate approximately the 67 % of it). This phenomenon was intensified during this decade due to the merger between the largest private banks in the system. All these events have even led to amendments to the General Banking Act (LGB) which grant more power to regulators in the process of approval/rejection of mergers that might generate an excessive concentration in the banking system.

Theoretically, banking mergers raise a trade-off between possible operating efficiency gains and social efficiency losses [Akhavain et al. (1997), Herring and Santomero (1990), Berger and Humphrey (1994)].¹ The theoretical discussion of this dilemma al-

¹Banking mergers through industrial concentration can also generate problems on the effectiveness

lows us to identify their costs and benefits, but the answer to the question whether mergers are desirable or not, requires ultimately of an empirical analysis that allows us to quantify the most possible number of positive and negative effects on the social welfare. Unfortunately, according to our literature review, there are not studies designed to explain and quantify the effects of the banking consolidation process in Chile.² In addition, the drawback of the few studies related to cost and efficiency is that they are very ambiguous in their results or do not consider the post-merger period of several of these processes.

Among the reasons given by financial institutions to justify these consolidation processes are the possible efficiency gains coming from scale and scope economies. Nevertheless, the previous empirical evidence has shown that these gains seem to be rather modest, which has led to question the validity of arguments in favor of mergers based on efficiency considerations. On the contrary, recent studies suggest that an effective source of large efficiency gains is the so-called X-efficiency (Carreño et al., 2010, [36]; Fuentes and Vergara, 2007, [26]).

This document is part of a project that intends to establish a more integral assessment of banking mergers. As a first step in this research agenda, the aim of this draft is to measure the effects of the banking mergers materialized in Chile during the last 20 years on X-efficiency. To this end, we apply an estimation methodology based on a frontier profit function, which allows us to quantify the magnitude of these effects by comparing previous and subsequent scenarios to each merger. It is worthy to note that of monetary policy and consequences on the regulatory framework of the financial system. Given that the scope of this study is rather microeconomic, these effects are not measured, but also should be considered in a more integral assessment of the phenomenon.

²Indeed, the empirical literature on cost, operating efficiency and industrial organization of the Chilean banking sector is very scarce as well.

by using a profit frontier instead of a cost frontier, one gets a more integral assessment of mergers as these processes often involve changes in the production mix that are only captured by the former approach.

Our results suggest that, in general, bank mergers have produced a favorable effect on X-efficiency. Hence, these findings suggest that a reduction of X-inefficiencies may constitute a new support –based on efficiency gains- for bank mergers, which should be taken into account when evaluating these processes from both a private perspective and a competition policy viewpoint. Nevertheless, it should be stressed that these results are partial and preliminary, as we require to perform several robustness exercises and to extend the analysis to measure possible market power effects.

The remainder of this draft is as follows. Section 2 discusses theoretical effects of bank mergers and the evidence available worldwide and locally. The next section presents the frontier profit function model and the econometric methodology used to evaluate the efficiency effects of bank mergers. Section 4 discusses the results, and finally, section 5 exposes the most relevant conclusions.

2. Bank Mergers: Theory and Evidence

Theoretically, bank mergers pose a potential trade-off between possible operating efficiency gains and social efficiency losses (Akhavain et al., 1997; Hering and Santomero, 1990; Berger and Humphrey, 1994). Operating efficiency gains would come from the exploitation of scale economies and scope economies by larger banks and from achieving substantial improvements of the so called X-efficiency or managerial efficiency. First, the scale economies are related with the possibility that banks would reduce the average costs as they increase their production scale, then larger banks could access this

advantage through a process of consolidation. Second, scope economies have relation with the possibility that consolidated banks could take advantage of the complementarities among their outputs, by the side of costs (scope economies in production), and the side of incomes (scope economies in consumption). Third, X-efficiency of a company refers to how close is to the frontier of efficient cost, i.e., where the mix of outputs is produced at minimum cost given the prices of the inputs it faces. In this sense, X-efficiency of a company differs from scale economies and scope economies as the scale economy takes the package of outputs as given, taking for granted that companies are above the efficient frontier. Finally, even though in the case of the financial system generally X-efficiency is only restricted as a measure of the skill of the bank management to control costs, this concept may also be extended to both revenue and profits, exercise precisely undertaken in this study.

International evidence suggests that X-efficiency differences among banks far exceed the differences in scale economies (see Berger and Humphrey, 1997, [19] for U.S. and Altunbas et al., 2001, [3] for Europe). These results have changed the focus of empirical literature on mergers toward X-efficiency. Among others in this line, Akhavein et al. (1997, [6]), Berger (1998, [14]) and Al-Sharkas, Hassan y Lawrence (2008, [2]) use a frontier profit function approach to measure the effects of mergers on revenues and cost efficiency. Their findings suggests that in average the bank megamergers materialized in U.S. during the last 20 years...

For the Chilean case, similar results on the source of a potential for substantial efficiency gains have been found for its banking industry. Indeed, whereas previous studies show ambiguous and contradictory results to the presence of scale economies and/or scope economies (Budnevich et al., 200, [23]; Cáceres, 2004, [25]), recent works

confirm that X-efficiency offers an important source of efficiency improvements in the Chilean banking system (Carreño et al., 2010, [26]; Vergara, 2006, [57]; Fuentes and Vergara, 2007, [36]; and Vergara (2007, [58]).

On the other hand, the social efficiency losses from bank mergers are associated to inefficiencies in the allocation of resources generated by banks that hold a dominant position in a highly concentrated industry. These inefficiencies are of different nature, and can be classified in two main sources: inefficiencies associated to the possible exercise of market power and inefficiencies associated to the potential excessive risk taking by large banks⁴.

According to the above mentioned, the theory suggests that bank mergers entail a dilemma between private efficiency gains and social efficiency losses that can only be resolved by an empirical assessment. Given the scarce empirical evidence for the Chilean case, it requires of an analysis that allows us to quantify most of these effects, so as to be able to compare them and recognize some predictive conditions of successful mergers on social welfare.

As a first step for this integral evaluation, this study provides a measure of the effects of bank mergers on efficiency. Within this class of effects, we focus specifically on X-efficiency, because the available evidence suggests that it provides a superior source of gains to the scale and scope economies. Given that these efficiency improvements can affect both revenues and costs, it is imperative to address this study through a methodology that measures both effects. Consequently, we adopt the frontier profit function approach in the present work as it provides us with this class of assessment.

3. The Empirical Evaluation Model

3.1. General Aspects

The need to have a methodology to evaluate the effects of bank mergers of diverse nature makes more appropriate the use of a profit frontier instead of a cost function –traditionally used in these evaluations– for several reasons.

First, given that it requires measuring whether mergers produce higher levels and more combinations of inputs and outputs, the best is to evaluate the efficiency on profits, which becomes a broader concept than efficiency on costs. This is due to that efficiency on profits considers the effects on revenues and costs from the choice of outputs vector, which is considered as given in the assessment of the efficiency on costs. In this way, a merger could improve the efficiency on profits without improving the efficiency on costs, if the reconfiguration of outputs associated with the merger generates a bigger increase in incomes than the increase in costs, or if this produces a greater reduction in costs than a reduction in incomes. Then, given that mergers generally produce substantive changes in the mix of outputs, it would seem more appropriate to assess their effects under the concept of efficiency on profits than under the concept of efficiency on costs. Additionally, as we are interested in measuring the effects on the profits of the consolidated firms arising from the possible exercise of market power as a result of mergers, it is also more convenient to work with a profit frontier, when this considers the possible effects on prices. Finally, in the case of bank industry, a profit frontier also becomes a useful tool to evaluate the effects of mergers on the adoption of risk by banks considered TBTF (Too Big Too Fail), when considering the changes in the composition of their asset portfolio (mix of outputs) and their capacity to diversify risk.

3.2. The Profit Frontier Model

The specification of the profit frontier and the estimate of efficiency on profits follow the procedure described by Berger, Hancock and Humphrey (199, [16]). The model to be estimated includes the function of profits and a set of equations for supply/demand of netputs (outputs or inputs) which incorporate crossed restrictions between equations that help to its identification. In this way, the model of profits is described by the following system of equations:

$$\begin{aligned} \frac{\pi(p, z, \tau, \xi)}{p_n} &= \sum_{i=1}^{n-1} (\alpha_i - \xi_i) \frac{p_i}{p_n} + \sum_{i=1}^{n-1} \sum_{j=1}^{n-1} \phi_{ij} \left(1 - \frac{1}{2} \tau_i\right) \tau_j \frac{p_i p_j}{p_n^2} \\ &+ \sum_{r=1}^k \beta_r z_r + \frac{1}{2} \sum_{r=1}^k \sum_{s=1}^k \theta_{rs} z_r z_s + \sum_{i=1}^{n-1} \sum_{r=1}^k \gamma_{ir} \frac{p_i}{p_n} z_r \\ &+ \epsilon_n - \xi_n \end{aligned} \quad (3.1)$$

$$q_i = \alpha_i + \sum_{j=1}^{n-1} \phi_{ij} \tau_j \frac{p_j}{p_n} + \sum_{r=1}^k \gamma_{ir} z_r + \epsilon_i - \xi_i, \quad (3.2)$$

for all $i = 1, \dots, n-1$, where π are the profit variable $p \cdot q$; p is the vector of prices for n variable netputs (outputs and inputs); q is the vector of quantities offered of each netput (with the inputs measured as negative netputs); z is a vector of k fixed netputs; α , β , θ , and γ are the regression coefficients with symmetry imposed ($\phi_{ij} = \phi_{ji}$, $\theta_{rs} = \theta_{sr}$); and the ϵ 's represent random errors. Besides, vectors τ and ξ are used to measure assignable and technical inefficiencies, respectively, according to the procedure described in the next subsection.

According to this formulation, it is assumed that in general all the parameters to be estimated are the same among banks and over time, for which the estimated model is a kind of pooled nonlinear system. In the case of parameters related with measuring the inefficiencies, it is assumed that: (i) coefficients τ 's associated with the assignable inefficiencies vary between netputs, but not among banks, and (ii) coefficients ξ 's associ-

ated with technical inefficiency vary between netputs and banks (through the respective residues), but not over time. Even though it would be preferable estimating separate values for these parameters in terms of cross section and time series, these assumptions seek to impose a structure to keep the model manageable and can preserve a reasonable number of degrees of freedom. This last point is particularly relevant considering the severe nonlinearity of the model and the big number of parameters that must be estimated versus the size of the sample available.

Note that error terms ϵ_i are correlated by construction, in such a way that when some q_i is affected by a shock equal to ϵ_i , the profits normalized π/p_n and, therefore also ϵ_n , are affected by a magnitude equal to $(p_i/p_n)\epsilon_i$. Consequently, the model composed by the equations (3.1) and (3.2) is estimated using the techniques of a Nonlinear Iterative Seemingly Unrelated Regression (NITSUR) model.

3.3. Measures of profit efficiency

The allocative inefficiency is defined as losses produced by a sub-optimal production plan. This class of inefficiency is modeled as if the bank would respond to relative shadow prices instead of relative real prices. That is, as if the bank would maximize its profits considering that the relative price of the netput i were $\tau_i(p_i/p_n)$ rather than p_i/p_n . The allocative inefficiency is then measured as the losses of profits because τ is different from the vector of 1's, which is equivalent to:

$$\pi(p, z, \mathbf{1}, \mathbf{0}) - \pi(p, z, \tau, \mathbf{0}) = \sum_{i=1}^{n-1} \sum_{j=1}^{n-1} \phi_{ij} \left[\frac{1}{2} - \left(1 - \frac{1}{2}\tau_i \right) \tau_j \right] \frac{p_i p_j}{p_n}.$$

From this definition, the *level of allocative efficiency* E_{ASG} corresponds to:

$$E_{ASG} = \frac{\pi(p, z, \tau, \mathbf{0})}{\pi(p, z, \mathbf{1}, \mathbf{0})}.$$

On the other side, the technical inefficiency is defined as the losses by failures to accomplish the production plan. This class of inefficiency is modeled as if the bank would offer (outputs) or contract (inputs) for a quantity different from that of the profit frontier. Therefore, this inefficiency arises when the quantity of a output is too low or the quantity of an input is too high. The technical inefficiency is then measured as losses of profits because ξ differs from the vector of 0's, or equivalently:

$$\pi(p, z, \tau, \mathbf{0}) - \pi(p, z, \tau, \xi) = \sum_{i=1}^n \xi_i p_i.$$

Consequently, the *level of technical efficiency* E_{TEC} is defined by:

$$E_{TEC} = \frac{\pi(p, z, \tau, \xi)}{\pi(p, z, \tau, \mathbf{0})}.$$

Lastly, let us define the *level of total efficiency* E_{TOT} as the ratio between *predicted* profits and *optimal* profits, that is

$$E_{TOT} = \frac{\pi(p, z, \tau, \xi)}{\pi(p, z, \mathbf{1}, \mathbf{0})}. \quad (3.3)$$

In all these efficiency measures, both the numerator and denominator are calculated through the prediction of the values resulting from the estimation of the econometric model, which of course, excludes the random errors. Note that the total efficiency level varies over the range $(-\infty, 1]$. This is because whereas the best performance of a bank is to attain the optimal profits ($E_{TOT} = 1$), its worst performance has no limit ($E_{TOT} \rightarrow -\infty$). The last fact occurs because a financial institution can always incur arbitrarily in greater losses, using more inputs without producing more outputs.

The terms of technical inefficiency can be estimated for each individual bank, as these terms enter the equations of profits and netputs in an easier way. To estimate these terms, we apply the Distribution Free Approach (DFA) of Berger and Humphrey (1993, [13]), which is based on Sickles and Schmidt (1984 [53]). Each of the equations

in (3.1) and (3.2) contain a term of compound error ($\epsilon_i - \xi_i$), i.e., a random error minus the technical inefficiency in the netput for each bank to an individual level. The DFA allows us to separate the technical inefficiency from the random error by assuming that the inefficiency is constant over the period under study, while random error tends to average zero over time. Therefore, the term ξ_i ($i = 1, \dots, n$) of each bank is estimated by the difference between the maximum average residual and the average residual of the bank itself. In this way, technical inefficiencies can be interpreted as *deviations* of the average practices of a bank from the frontier containing best average practices of the industry.

3.4. Specification of variables and data source

Our specification of the profit model in (3.1) and (3.2) include four variable netputs ($n = 4$). Loans (q_1) and investments (q_2) are the outputs, while deposits (including bank's borrowing, q_3) and labor (q_4) are the inputs. Capital (z_1) is the only fixed netput. The quantities of the first three netputs are computed as the sum of a set of accounting balances related to each concept at the end of each period. In the case of labor, the number of workers is considered by the end of the exercise. The prices of variable outputs (inputs) are calculated as the total annual income (expenses) for this concept divided by the quantity of the corresponding output (inputs) by the end of each period.³

The choice of outputs and inputs is consistent with the Approach of Asset Intermediation by Sealey and Lindley (1977, [51]), under which assets intermediated are the outputs and the funding sources are the inputs of a financial institution. This means

³The detail of the accounting items that compose each variable of inputs and outputs, and the estimation of their prices, is contained in Carreño et al. (2010) and can be obtained from the authors.

that our specification can be globally understood as the efficiency evaluation regarding how a bank is able to earn a return on capital, using deposits and labor to produce loans and investments.

3.5. Periods of study: complete, pre and post-merger

The sample comprises a panel (unbalanced) of 36 banks over the period 1987-2007, which gives a total of 683 observations. This panel was elaborated from the information contained in the annual financial statements (balance sheets and income statements) of each entity, published by the Superintendency of Banks and Financial Institutions (SBIF), the regulatory authority of the Chilean banking industry.

With the aim of evaluating the effect of bank mergers on X-efficiency, we proceed in three stages. In the first stage a profit frontier is estimated based on the unbalanced panel of banks for the period 1987-2007. At this point, data from consolidated banks for the year when the merger took place are eliminated, as it is likely that this information may contain high transitional costs.

In the second stage, it is computed from equation (3.3) the level of efficiency for each of the three entities involved in a merger, namely: (i) for the acquiring bank during the available years before the merger, (ii) for the acquired bank during the years before the merger, and (iii) for the consolidated bank during the available years after the merger.

In the third stage, and based on the ratios constructed in the second stage, it is measured the change in efficiency associated to the merger using two criteria. The first criterion is the *change in the efficiency level* between the pre and post merger period properly weighted by bank assets. The second criterion is the *change in the efficiency rank*, i.e., the position of efficiency held by the consolidated bank after the merger minus the weighted average position between the acquiring and acquired banks

before the merger. When applying both criteria, the change in efficiency is calculated relative to the set of all banks with available data on exactly the same period for the consolidated bank as well as for the banks involved in the merger. This procedure requires tracking separately the groups of comparable banks for each merger (the *peer* banks), which allows us to control for changes in profits or efficiency that might have happened to any level in the industry, and therefore, to isolate the specific effects of a merger.

4. Results

4.1. Changes in the Profit Efficiency Level

We first discuss the results related to levels of profit efficiency. Table 1 shows the results about the changes in this level of efficiency for the seven bank mergers occurred in the Chilean banking system during the period under analysis.

We can see that the changes in the level of profit experienced by the merging institutions between the period previous and posterior to the merger are, in general, favorable. In fact, from the seven mergers, five of them resulted in substantial improvements of efficiency, while the two remaining had a marginal decrease in this matter. When considering the results adjusted by performance of the peer group of banks, we notice that the effect attributable to the merger itself is also positive: five cases present increases in their levels of efficiency which, according to our methodology, represent the net effect of mergers: 37.6 % in the case of merger BHIF-Nacional, 28.4 % for BHIF-Banesto, 62.6 % for Santander-Osorno, 21.8 % for Banco de Chile-A. Edwards, and a 50 % for Santander-Santiago. On the contrary, a similar analysis indicates that two consolidations generated an adverse effect on the efficiency level of merging banks: a reduction

of 3.3 % for the merger O'Higgins-Centrobanco and, in the case of Santiago-O'Higgins, a 9.3 %.⁴

As discussed in Section 3, the changes in profit efficiency of merging banks can be divided into allocative and technical components. In Table 2 we can see that changes at efficiency levels due to mergers are mainly concentrated on a technical component, with rather modest changes in allocative efficiency. This result is consistent with our findings in the case of the whole banking system (not reported in this paper), according to which technical inefficiencies dominate widely allocative inefficiencies. Hence, it is reasonable to expect that a larger proportion of the merger efficiency improvements comes from a component of technical nature.⁵

Moreover, the profit efficiency can also be separated into *input* and *output* efficiency. In the profit function, the output inefficiency includes technical inefficiencies by producing less output than the planned level and allocative inefficiencies by inadequate responses to the prices of outputs (including the effects on revenues and costs for deviating from the production plan which maximizes profits). Similarly, it is possible to compute the input inefficiency and the *mixed* input-output inefficiency. In this regard, Table 3 shows that all mergers exhibit favorable changes in input efficiency. However, the results are ambiguous in the case of output and mixed efficiency. Also, the evidence is not conclusive about which component dominates the efficiency improvements.⁶

⁴It seems interesting to analyze in detail the case of the two mergers with negative results, as in both was involved Banco O'Higgins.

⁵This finding also confirms that the assumption of no heterogeneity in the allocative inefficiency among banks (constant τ 's) should not have a major impact on final results.

⁶It must be noticed that an increase of input efficiency input does not necessarily implies some change in X-efficiency, as the changes in input efficiency incorporate part of the changes in the quantity and mix of outputs after the merger. For example, if the level of outputs planned is smaller and requires lower amounts of inputs, the latter may be closer to their optimal level and input efficiency can improve,

4.2. Changes in the Profit Efficiency Rank

In general, the efficiency rank is preferred to the efficiency level as the first indicator is neutral with respect to the changes in the distribution of the efficiency measured over time. In addition, the Distribution Free Approach adopted in this research introduces some bias on the measurement of the levels of relative efficiency, as a diverse number of observations is available for the different mergers. Fortunately, the expected value of the efficiency rank does not depend on the number of observations.

In order to perform this analysis, we compute the rank of a merging bank (buyer, acquired or consolidated) on its group of peer banks with contemporary data, as the proportion of peer banks with an efficiency level inferior to that of the merging bank. In this way, for example a merging bank with a total efficiency E_{TOT} better than the 80% of its comparable group is assigned a rank of 0.8. Table 4 present changes in the efficiency rank during the period under study, from which it can be verified that the results are relatively consistent with those found when using efficiency levels (i.e. Table 1). When comparing both tables, we can see that the sign of changes in the rank and changes in the level is similar for all cases, but for the merger O'Higgins-Centrobanco, which presents a net backward in the level (-3.3%) and a progress in the efficiency rank (+0,1). In the remaining cases, the results confirm the evidence established with the methodology based on the efficiency level, in the sense that mergers have generated a positive effect on profit efficiency.

Finally, it is worthy to highlight that both mega-mergers that involved Banco Santander show significant increases in the efficiency rank, which has positioned the con-

but X-efficiency in costs can keep unchanged as it takes the outputs as given. Therefore, only in the case that outputs remain constant after the merger, the changes in inefficiency input necessarily will reflect a change in the cost X-efficiency.

solidated bank as one of the most efficient institutions of the Chilean banking system. Related to this fact, it should be noted that the ranking of efficiency computed for the whole Chilean banking industry during the period 1987-2007 (not reported in this study) suggests that the most efficient banks are those of larger size. Hence, an interesting issue is until which extent the increase in the scale of operations of a merging bank would keep reporting improvements in the profit efficiency.

5. Concluding Remarks

The theoretical discussion of the bank mergers dilemma allows us to identify its benefits and costs, but the answer to the question whether mergers are desirable or not, requires ultimately of an empirical analysis that quantifies the most possible number of positive and negative effects on the social welfare.

The main objective of this study is to advance in this discussion by providing empirical evidence on the magnitude of the profit efficiency effect coming from bank mergers materialized in the Chilean financial system during the period 1987-2007. To this end, we adopt a methodology of estimation based on a profit frontier, which allows comparing scenarios before and after the merger.

Our results point out that the effects of mergers on both *efficiency levels* and *efficiency ranks* of merging firms are generally positive. By splitting up the results regarding the level of efficiency on profits, we find that these changes are mainly concentrated on a technical component, in general with very small changes in the allocative efficiency. Moreover, all the mergers evaluated exhibit favorable changes in the *input* efficiency, achieving ambiguous results regarding the *output* efficiency and about which of both components is higher in the observed efficiency improvements.

From these findings, our research suggests that reductions in X-inefficiency may constitute a novel and important argument to justify bank mergers. That argument should thus be properly weighed when evaluating these processes from a private perspective as well as from a competition policy viewpoint.

TABLA 1: EFECTO DE LAS FUSIONES SOBRE LOS NIVELES DE EFICIENCIA

Año	Fusión	Nivel de Eficiencia Pre-Fusión (*)	Nivel de Eficiencia Post-Fusión	Cambio en Nivel de Eficiencia
1989	Banco BHIF – Banco Nacional	0,23	0,534	0,304
	Grupo de Bancos Comparables	0,443	0,371	-0,072
1993	Banco O´Higgins – Centrobanco	3,7E-04	2,46E-04	-1,24E-04
	Grupo de Bancos Comparables	0,442	0,475	0,033
1995	Banco BHIF – Banesto	0,434	0,872	0,438
	Grupo de Bancos Comparables	0,529	0,683	0,154
1996	Banco Santander - Banco Osorno	0,328	0,973	0,645
	Grupo de Bancos Comparables	0,442	0,461	0,019
1997	Banco Santiago – Banco O´Higgins	1,3E-04	-7,46E-04	-8,76E-04
	Grupo de Bancos Comparables	0,529	0,622	0,093
2002	Banco de Chile – Banco A. Edwards	0,617	0,98	0,363
	Grupo de Bancos Comparables	0,529	0,674	0,145
2002	Banco Santander - Banco Santiago	0,452	0,968	0,516
	Grupo de Bancos Comparables	0,639	0,655	0,016

(*) : Nivel de eficiencia promedio del banco comprador y comprado ponderado por colocaciones más inversiones (q1+q2)

TABLA 2: CAMBIOS EN EFICIENCIA ASIGNATIVA Y TECNICA

Año	Fusión	Cambios en Eficiencia Asignativa (*)	Cambios en Eficiencia Técnica (**)
1989	Banco BHIF – Banco Nacional	-0,146	-0,575
1993	Banco O´Higgins – Centrobanco	3,67E-04	1,09E-04
1995	Banco BHIF – Banesto	0,227	0,263
1996	Banco Santander - Banco Osorno	0,093	0,555
1997	Banco Santiago – Banco O´Higgins	2,07E-05	-8,67E-04
2002	Banco de Chile – Banco A. Edwards	0,061	0,331
2002	Banco Santander - Banco Santiago	0,013	0,549

(*): La eficiencia asignativa es medida por el ratio (π deseados / π óptimos).

(**): La eficiencia técnica es medida por el ratio (π reales / π deseados).

TABLA 3: CAMBIOS EN EFICIENCIA INPUT Y EFICIENCIA OUTPUT

Año	Fusión	Cambios en Eficiencia Input	Cambios en Eficiencia Output	Cambios en Eficiencia In-Out
1989	Banco BHIF – Banco Nacional	0,246	-0,031	0,109
1993	Banco O´Higgins – Centrobanco	0	3,77E-04	-2,51E-04
1995	Banco BHIF – Banesto	0,399	0,137	0,185
1996	Banco Santander - Banco Osorno	0,918	0,126	-0,196
1997	Banco Santiago – Banco O´Higgins	1,19E-04	-9,02E-04	0
2002	Banco de Chile – Banco A. Edwards	0,029	0,366	-0,037
2002	Banco Santander - Banco Santiago	0,438	-0,051	0,058

TABLA 4: CAMBIOS EN EL RANKING DE EFICIENCIA EN BENEFICIOS DE LAS FUSIONES

Año	Fusión	Ranking de Eficiencia Pre-Fusión (*)	Ranking de Eficiencia Post-Fusión	Cambios en Ranking de Eficiencia
1989	Banco BHIF – Banco Nacional	0,61	0,85	0,24
1993	Banco O´Higgins – Centrobanco	0,46	0,56	0,1
1995	Banco BHIF – Banesto	0,62	0,71	0,09
1996	Banco Santander - Banco Osorno	0,7	0,95	0,25
1997	Banco Santiago – Banco O´Higgins	0,24	0,14	-0,1
2002	Banco de Chile – Banco A. Edwards	0,83	0,94	0,11
2002	Banco Santander - Banco Santiago	0,44	0,82	0,38

(*) : Ranking de eficiencia promedio del banco comprador y comprado ponderado por colocaciones más inversiones (q1+q2)

Referencias

- [1] Aguirre, M., R. Herrera y G. Bravo (2004). “Una Frontera de Producción para la Banca Chilena.” *Panorama Socioeconómico* 29, Universidad de Talca.
- [2] Al-Sharkas, A., M. Hassan y S. Lawrence (2008). “The Impact of Mergers and Acquisitions on the Efficiency of the U.S. Banking Industry: Further Evidence.” *Journal of Business Finance & Accounting* 35(1)&(2): 50-70.
- [3] Altunbas, Y., E. Gardener., P. Molyneux y B. Moore (2001). “Efficiency in European Banking.” *European Economic Review* 45(10): 1931-1955.
- [4] González, E. (2001). “La Estimación de la Eficiencia con Métodos No Paramétricos”. En *La Medición de la Eficiencia y la Productividad*, Editado por Antonio Álvarez. Ediciones Pirámide.
- [5] Aly, H., R. Grabowski, C. Pasurka y N. Rangan (1990). “Technical, Scale, and Allocative Efficiencies in U.S. Banking : An Empirical Investigation.” *Review of Economics and Statistics* 72(2): 211-218.
- [6] Akhavein, J., A. Berger y D. Humphrey (1997). “The Effects of Megamergers on Efficiency and Prices: Evidence from a Bank Profit Function.” *Review of Industrial Organization* 12(1): 95-139.
- [7] Akhavein J., D. Swamy y S. Taubman (1997). “A General Method of Deriving the Efficiencies of Banks from a Profit Function.” *Journal of Productivity Analysis* 8(1): 71-93.
- [8] Akhigbe, A. y J. McNulty (2003). “The Profit Efficiency of Small U.S. Commercial Banks.” *Journal of Banking & Finance* 27(2): 307-325.

- [9] Akhigbe, A. y J. McNulty (2005). "Profit Efficiency Sources and Differences among Small and Large U.S. Commercial Banks." *Journal of Economics & Finance* 29(3): 289-299.
- [10] Amel, D., C. Barnes, F. Panetta y C. Salleo (2004). "Consolidation and Efficiency in the Financial Sector: A Review of the International Evidence." *Journal of Banking & Finance* 28(10): 2493-2519.
- [11] Bauer, P., A. Berger, G. Ferrier y D. Humphrey (1997). "Consistency Conditions for Regulatory Analysis of Financial Institutions: A Comparison of Frontier Efficiency Methods." Finance and Economics Discussion Series, Washington: Board of Governors of the Federal Reserve System, Division of Research and Statistics and Monetary Affairs.
- [12] Bauer, P., A. Berger y D. Humphrey (1993). "Efficiency and Productivity Growth in U.S. Banking." En *The Measurement of Productive Efficiency: Techniques and Applications*, editado por H. Fried, C. Lovell y S. Schmidt, Oxford University Press.
- [13] Berger, A. (1993). "Distribution-Free Estimates of Efficiency in the U.S. Banking Industry and Tests of the Standard Distributional Assumptions." *Journal of Productivity Analysis* 4(3): 261-292.
- [14] Berger, A. (1998). "The Efficiency Effects of Bank Mergers and Acquisitions: A Preliminary Look at the 1990s Data." En *Bank Mergers and Acquisitions*, editado por Y. Amihud y G. Miller, Kluwer Academic.
- [15] Berger, A. (2007). "International Comparisons of Banking Efficiency." *Financial Markets, Institutions & Instruments* 16(3): 119-144.

- [16] Berger, A., D. Hancock y D. Humphrey (1993). "Bank Efficiency Derived from the Profit Function." *Journal of Banking & Finance* 17(2)&(3): 317-347.
- [17] Berger, A. y D. Humphrey (1991). "The Dominance of Inefficiencies over Scale and Product Mix Economies in Banking." *Journal of Monetary Economics* 28 (1): 117-148.
- [18] Berger, A. y D. Humphrey (1992). "Megamergers in Banking and the Use of Cost Efficiency as an Antitrust Defense." *Antitrust Bulletin* 37: 541-600.
- [19] Berger, A. y D. Humphrey (1997). "Efficiency of Financial Institutions: International Survey and Directions for Future Research." *European Journal of Operation Research* 98(2): 175-212.
- [20] Berger, A., W. Hunter y S. Timme (1993). "The Efficiency of Financial Institutions: A Review and Preview of Research Past, Present, and Future." *Journal of Banking & Finance* 17(2)&(3): 221-249.
- [21] Berger, A y L. Mester (1997). "Inside the Black Box: What Explains Differences in the Efficiencies of Financial Institutions." *Journal of Banking & Finance* 21(7): 895-947.
- [22] Bonin, J., I. Hasan y P. Wachtel (2005). "Bank Performance, Efficiency and Ownership in Transition Countries." *Journal of Banking & Finance* 29(1): 31-53.
- [23] Budnevich, C., H. Franken y R. Paredes (2001a). "Economías de Escala y Economías de Ámbito en el Sistema Bancario Chileno." *Economía Chilena* 4(2): 59-74.

- [24] Budnevich, C., H. Franken y R. Paredes (2001b). “Economías de Escala y Economías de Ámbito en el Sistema Bancario Chileno.” Documentos de Trabajo No. 93, Banco Central de Chile.
- [25] Cáceres, J. (2004). “Efficiency and Productivity in the Chilean Banking Industry.” Working Paper, Departamento de Economía, Universidad de Santiago de Chile.
- [26] Carreño, J.L., G. Loyola, and Y. Portilla (2010). “Chilean Banking Efficiency: A Frontier Profit Function Approach.” *Economía Chilena* 13(3): 33-65.
- [27] Carvallo, O. y A. Kasman (2005). “Cost Efficiency in the Latin American and Caribbean Banking Systems.” *Journal of International Financial Markets, Institutions and Money* 15(1): 55-72.
- [28] Cavieres, L. (1999). “La Función de Costos de la Industria Bancaria Chilena.” Tesis conducente al título de Ingeniero Comercial, Universidad de Chile.
- [29] Clark, J. (1988). “Economies of Scale and Scope at Depository Financial Institutions: A Review of the Literature.” *Federal Reserve Bank of Kansas City Economic Review* 73: 16-33.
- [30] Coelli, T. (2000). “A Guide to Frontier Version 4.1: A Computer Program for Stochastic Frontier Production and Cost Function Estimation.” Working Paper 07/96, University of New England, Department of Econometrics, Centre for Efficiency and Productivity Analysis (CEPA).
- [31] Coelli, T., A. Estache, S. Perelman y L. Trujillo (2003). *Una Introducción a las Medidas de Eficiencia: Para Reguladores de Servicios Públicos y de Transporte*. Alfaomega Colombiana S.A. y Banco Mundial.

- [32] Delis, M. y N. Papanikolaou (2009). "Determinants of Bank Efficiency: Evidence from a Semi-Parametric Methodology." *Managerial Finance* 35(3): 260-275.
- [33] Demirgüç-Kunt, A. y H. Huizinga (2000). "Determinants of Commercial Bank Interest Margins and Profitability: Some International Evidence." *World Bank Economic Review* 13(2): 379-408.
- [34] Ferrier, G. y C. Lovell (1990). "Measuring Cost Efficiency in Banking: Econometric and Linear Programming Evidence." *Journal of Econometrics* 46(1)&(2): 229-245.
- [35] Fries, S. y A. Taci (2005). "Cost Efficiency of Banks in Transition: Evidence from 289 Banks in 15 Post-Communist Countries." *Journal of Banking and Finance* 29(1): 55-81.
- [36] Fuentes, R. y M. Vergara (2007). "Is Ownership Structure a Determinant of Bank Efficiency?" Working Paper N° 456, Banco Central de Chile.
- [37] Huizinga, H., J. Nelissen y R. Vander Venet (2001). "Efficiency Effects of Bank Mergers and Acquisitions in Europe." Tinbergen Institute Discussion Paper 2001-088/3.
- [38] Kumbhakar, S. y C. Lovell (2000). *Stochastic Frontier Analysis*, Cambridge University Press.
- [39] Kyj, L. y I. Isik (2008). "Bank X-Efficiency in Ukraine: An Analysis of Service Characteristics and Ownership." *Journal of Economics and Business* 60(4): 369-393
- [40] Loyola, G. (2000). "Fusiones y Eficiencia X: El Caso de la Banca Chilena." *Estudios de Información y Control de Gestión* 2: 116-168.

- [41] Mamatzakisa, E., C. Staikouras y A. Koutsomanoli-Filippakib (2008). “Bank Efficiency in the New European Union Member States: Is There Convergence?” *International Review of Financial Analysis* 17(5): 1156-1172.
- [42] Maudos, J. y J. Pastor (2000). “La Eficiencia del Sistema Bancario Español en el Contexto de la Unión Europea.” *Papeles de Economía Española* 84&85: 154-168.
- [43] Maudos, J., J. Pastor, F. Pérez y J. Quesada (2002). “Cost and Profit Efficiency in European Banks.” *Journal of International Financial Markets, Institutions and Money* 12(1): 33-58.
- [44] McAllister, P. y D. McManus (1993). “Resolving the Scale Efficiency Puzzle in Banking.” *Journal of Banking & Finance* 17(2)&(3): 389-405.
- [45] Mester, L. (1987). “A Multiproduct Cost Study of Savings and Loans.” *Journal of Finance* 42(2): 423-445.
- [46] Micco, A., U. Panniza y M. Yáñez (2007). “Bank Ownership and Performance. Does politics matter?.” *Journal of Banking & Finance* 31(1): 219-241.
- [47] Mitchell, K. y N. Onvurall (1996). “Economies of Scale and Scope at Large Commercial Banks: Evidence from the Fourier Flexible Functional Form.” *Journal of Money, Credit, and Banking* 28(2): 178-99.
- [48] Nauriyal, B. (1995). “Measures of Cost Economies in Chilean Banking : 1984-1991.” *Revista de Análisis Económico* 10(1): 72-99.
- [49] Parisi, F. y A. Parisi (2005). “Ranking de Banca: 1995-2004.” *Mimeo*, Departamento de Administración, Universidad de Chile.

- [50] Rhoades, S.A. (1993). "The Efficiency Effects of Horizontal Bank Mergers." *Journal of Banking and Finance* 17(2)&(3): 299-326.
- [51] Sealey, C. y J. Lindley (1977). "Inputs, Outputs and a Theory of Production and Cost at Depository Financial Institutions." *Journal of Finance* 32(4): 1251-1266.
- [52] Shirota, R. (1996). "Efficiency in Financial Intermediation: A Study of the Chilean Banking Industry." Ph.D. Thesis, Ohio State University.
- [53] Sickles, R.C. y P. Schmidt (1984). "Production Frontiers and Panel Data." *Journal of Business and Economic Statistics* 2(4): 367-374.
- [54] Staikouras, C., E. Mamatzakisa y A. Koutsomanoli-Filippakib (2008). "Cost Efficiency of the Banking Industry in the South Eastern European Region." *Journal of International Financial Markets, Institutions & Money* 18(5): 483-497.
- [55] Vander Vennet, R. (1996). "The Effect of M&As on the Efficiency and Profitability of EC Credit Institutions." *Journal of Banking and Finance* 20(9): 1531-1558.
- [56] Vander Vennet, R. (2002). "Cost and Profit Efficiency of Financial Conglomerates and Universal Banks in Europe." *Journal of Money, Credit & Banking* 34(1): 254-282.
- [57] Vergara, M. (2006). "Nota Técnica para Estimar Fronteras Estocásticas: Una Aplicación a la Banca Chilena." *Estudios de Administración* 13(2): 47-66.
- [58] Vergara, M. (2007). "Eficiencia Bancaria: Una Aproximación Paramétrica y No Paramétrica." *Estudios de Información y Control de Gestión* 13(2): 5-30.
- [59] Zúñiga, S. y E. Dagnino (2003). "Medición de la Eficiencia Bancaria en Chile a Través de Fronteras Estocásticas (1990-1999)." *Abante* 6(2): 83-116.