Assessing the Efficiency Effects of Bank Mergers in Sweden
A panel-based Stochastic Frontier Analysis[#]

Matilda Gjirja[1]

Department of Economics
Göteborg University
Sweden

Abstract

It is often argued that bank consolidation waves generate substantial efficiency gains associated with reduced operating costs, enhanced diversification of risks, and better management quality. In Sweden, as in many other European countries, banks have been involved in acquisitions in an attempt to exploit potential synergies, economies of scale, and other benefits. This paper aims at assessing the efficiency effects of bank mergers in Sweden utilizing an unbalanced panel of savings banks for the period 1984 to 2002. A frontier cost function with a time-varying stochastic efficiency term is estimated in order to find empirical support for an efficiency-enhancing role of bank mergers. The results suggest that there is no strong evidence in favour of the hypothesis that inefficient banks are likely to be acquired by more efficient ones. Furthermore, the post-merger analysis shows no remarkable improvements in bank technical efficiency after consolidation. These findings imply that decision-makers ought to be more cautious in promoting mergers as a means to enjoying efficiency gains.

Key words: Technical efficiency, Mergers and acquisitions, Banking industry.

JEL classification: G21, L29

---

[1] I would like to thank Lennart Hjalmarsson, David Humphrey, Subal Kumbhakar, Tomas Andrén, participants at the Second North American Productivity Workshop 2002 in Schenectady, and conference participants at the 2003 Applied Business Research Conference in Acapulco for valuable comments. Financial support from the Swedish Competition Agency and from Stiftelsen Ekonomisk Forskning i Västsverige is gratefully acknowledged.

This paper was awarded The Best Paper Award at the ABR Conference in Acapulco, Mexico.

1. Introduction

Financial sectors worldwide have been undergoing a remarkable restructuring and consolidation process. In the U.S. the elimination of different interstate restrictions has given rise to a wave of mergers and acquisitions. The existence of such restrictions was considered to be one of the most important factors hindering the consolidation of the financial services in the U.S. A similar consolidation process of the banking industry is also noticed in Europe. The number of bank mergers and acquisitions within the European countries has increased leading to a leaner banking sector. Furthermore, the introduction of the euro and the common financial market has facilitated the cross-border mergers of banks within the EU. The threat of competition forces banks to focus on their effectiveness in providing financial services and in meeting the increasing demands for better and customer adopted products. This requires an appropriate assessment of efficiency in banks, which reflects among other things, their ability to survive the ongoing wave of mergers and acquisitions.

The banking sector in Sweden is of course no exception or in any way immune to the consolidation process present in many countries worldwide. Sweden has a tradition of bank mergers, albeit they have concerned rather small size banks. It is first after the deregulation process of the mid-1980s and the beginning of the 1990s that we come across the merging of banks into really big entities. Such examples include the merging of twelve regional savings banks into Sveriges Sparbank in 1992, the merging of the regional cooperative banks into Sveriges Föreningsbank in the same year, as well as the merging of these two banks in turn creating Swedbank in 1997. Sweden has been in the front wave even with regard to cross-border mergers and acquisitions. The merger of Nordbanken and the Finish Meritabanken is one example as are the acquisitions of a number of banks in Germany and the Baltic states on the part of SEB bank.

In addition to measuring the overall cost efficiency of banks, the purpose of this paper is to analyse the merging activity among Swedish savings banks seen from an efficiency perspective. Mergers between entities are often motivated with arguments on cost reduction, input savings, better management and therefore efficiency enhancement. This study aims to investigate whether bank mergers and acquisitions in Sweden have

indeed led to increased efficiency and whether these mergers have been a success or a failure.

Initially the purpose is to look at the efficiency of the involved entities, whether acquired or acquiring, to see whether it is true that the most efficient units are the ones that acquire the less efficient ones. Theoretically, the most efficient banks also have a higher management quality. The goal is to transfer this advantage in management to the less efficient unit thereby leading to a more efficient merged entity. In the post-merger analysis the efficiency of the new entity is evaluated in order to quantify the difference in technical efficiency after merger. This is also a way to evaluate the success in the transfer of the better management.

The rest of the paper is organised as follows. Section 2 gives the definition of mergers and identifies various motives that drive the consolidation process. Section 3 describes in short the measures and the evidence of success and/or failure in mergers and acquisitions. The methodology utilised in the paper as well as the data used are presented in the subsequent sections 4 and 5, respectively. The empirical results are reported in section 6. Finally, in section 7 some general conclusions are drawn upon the findings.

2. Merger Definition and Motives

According to Gaughan (1996), a merger is a combination of two corporations in which only one corporation survives and the merged corporation goes out of existence. In a merger, the acquiring company assumes the assets and liabilities of the merged company. A merger differs from a consolidation, which is a business combination whereby two or more companies join to form an entirely new company. All of the combining companies are dissolved and only the new entity continues to operate. Despite the differences between them, the terms merger and consolidation are sometimes used interchangeably. In general, when the combining firms are approximately the same size, the term consolidation applies whereas when the two firms differ significantly by size, merger is the more appropriate term.

There are several possible motives or reasons that banks engage in mergers and acquisitions. Synergy is one of the most common motives. Synergy effects are realized

when two companies combine to produce a greater effect together than what the sum of the two operating independently could account for. That is, the operation of a corporate combination is more profitable than the individual profits of the firms that were combined. Merger deals are often justified based on the anticipated synergy effects.

According to the efficiency theory, there are two types of synergies, operating and financial synergy. The operating synergy, including both economies of scale and economies of scope, has the most economically sound basis. One of the main sources of operating synergy is the cost reduction that occurs as a consequence of economies of scale, which implies a decrease in per-unit costs that result from an increase in the size or scale of a company's operations. Therefore, an expansion through the horizontal acquisition[2] of a competitor may increase the size of the acquiring firm's operations and lower per-unit costs. On the other hand, the concept of economies of scope relates to the ability of a firm to utilize one set of inputs to provide a broader range of products and services. A good example of scope economies arises in the banking industry. When financial institutions merge, they can share inputs to offer a broader range of services such as a trust department or an economic analyses unit. Smaller banks may not be able to afford the costs of these departments.

In light of the discussion above on operational synergies, Milborn et al. (1999) point out two striking aspects of the global consolidation of financial services. One is the ever-escalating scale of mergers in banking. The other aspect is the expanding scope of banks. The questions raised are why banks are so interested in increasing their bank size and why do banks expand the scope of their activities. Frequent answers to these questions include among other things the claim that banking is becoming more competitive. Banks need to improve their cost efficiencies to compete more effectively. This leads them to grow bigger in order to exploit economies of scale. Moreover, competition squeezes margins in traditional commercial banking, making it attractive for banks to look for other sources of profitability. Many of these sources are perceived

[2] Mergers are often categorised as horizontal, vertical or conglomerate mergers. A horizontal merger occurs when two similar organisations in the same industry combine. Vertical mergers are combinations of companies that have a buyer-seller relationship. Horizontal and vertical mergers usually lead to an increase in industrial competition. Finally, a conglomerate merger occurs when the companies are not competitors and do not have a buyer-seller relationship. That is, companies are in different lines of business. The degree and extent to which the activities of the acquired company are related to those of the acquirer have been found to be an organizational factor affecting the success of mergers and acquisitions.

to be outside commercial banking, leading thus to scope expansion. Expanding scope, in turn, means banks can offer customers a greater diversity of financial services under one roof, possibly at lower costs, that is scope economies. However, from a theoretical standpoint, the cost efficiency arguments are difficult to reconcile with the expansion of scope because such expansion is incompatible with sticking to one's core competencies.[3]

Financial synergy is a more questionable motive for a merger or acquisition. It refers to the impact of a corporate merger or acquisition on the costs of capital to the acquiring firm or the merging partners. If financial synergy exists in a corporate combination, the costs of capital should be lowered. Financial economies of scale are also possible in the form of lower flotation and transaction costs. A larger firm enjoys better excess to financial markets and it tends to experience lower costs of raising capital, presumably because it is considered to be less risky than other firms. Whether financial synergy actually exists, is a matter of dispute within corporate finance.

The focus of this study is the cost side of mergers among Swedish savings banks, which fall under the definition of in-market (horizontal) mergers. A widespread view is that in-market bank mergers have the greatest potential for yielding efficiency gains because they provide the opportunity for closing overlapping and directly competing offices as well as permitting, like other mergers, the combining of back-office operations, computer systems, and administrative functions. Companies experience greater success with horizontal combinations, which result in an increase in market share. However, the mere fact that the industry structure becomes more concentrated need not imply that competition has declined. The final outcome might be a number of strong competitors who engage in a state of competition characterized by competitively determined prices and differentiated products.

A form of horizontal integration is geographic expansion. This refers to acquiring a similar firm which operates in a different geographical region that the buyer currently does not market to. This might occur if a company believes that it has saturated its current market region. One solution then is to expand the market. The

[3] Diversifying mergers and acquisitions may also improve efficiency in the long run through expanding the skill set of managers. However, studies outsides of financial services suggest that diversifying mergers are generally value-reducing and that increases in corporate focus are value-enhancing. See for instance Hamel and Prahalad (1990), Berger and Ofek (1995), and John and Ofek (1995).

acquiring firm is faced with the choice of setting up its own operations in that region or buying a company that already operates there. This is a common motive for bank acquisitions.

Mergers may also be the outcome of some other motives, which are not necessarily optimal from a social point of view. The hubris hypothesis implies that managers seek to acquire firms for their own personal motives and that the pure economic gains to the acquiring firm are not the sole or even the primary motivation in the acquisition. Such incentives would for instance include the quest for a bigger market power and the expense-preference behaviour of bank managers who consider size as an intangible perk. Furthermore, takeovers could be a mean to achieve bigger size as a way to acquire a too-big-to-fail status.

As for the improved management argument, it holds that some takeovers are motivated by a belief that the acquiring firm's management can better manage the target's resources. The bidder may feel that its management skills are such that the value of the target would rise under its control. It is, however, difficult to isolate the effect of the improved management and to explain its role in the bidding process.

Finally, tax gains can be an important motive for certain takeovers. A target can become valuable, for example, if it has transferable tax losses that an acquirer can use to offset income. Other sources of income can be investment tax credits, which can also be used to offset income.

3. Literature Review

The success of mergers and acquisitions (M&As) results from the sum of effects of many different factors. Vaara (1992) divides those factors having an impact on the success of M&As into three sets; (1) environmental factors including economic conditions, demand fluctuations, technological changes, changes in laws and regulations and competitor moves; (2) organizational factors including business relatedness, cultural differences, differences in the relative size, the performance of an acquiree prior to an acquisition; and (3) managerial factors. The latter relates to the possible in-optimal decisions made in managing the acquisition process, decisions which may be the result of two different phenomena. First, managers make mistakes. This is only natural

considering the difficulties of making decisions under uncertainty, fast pace and high pressure often experienced in mergers and acquisitions. Second, as mentioned before, the efforts of the managers are, at least to some extent, made to maximize their own well-being, not necessarily the wealth of the owners or the welfare of other constituencies.

The increasing pace of bank mergers and acquisitions has given rise to an extensive economic research and today there is quite an abundance of literature available on the subject. A comprehensive review of studies evaluating mergers and acquisitions has been provided by Berger et al. (1999). Particularly, the authors conclude that the evidence suggests little or no cost efficiency improvements on average due to mergers.

There are basically two different research methods that are used in gauging the success of mergers and acquisitions. One is the operational performance approach, which comprises studies dealing with the link between mergers and the productive efficiency of the banks involved, either measured through accounting data or through the estimation of cost and profit functions. The other approach includes studies dealing with the impact of merger announcements on the price of publicly-listed banking companies.

The operating performance approach studies the merged companies before and after the merger and examines the development of the financial indicators, such as profitability, costs and efficiency measures, based on accounting data[4]. The primary methods used have been statistical analyses of the performance of the involved companies and have reflected the point of view of managers or shareholders. The operating performance methodology has been utilised frequently in bank merger studies[5]. The increased interest in cost cutting and efficiency in the banking industry, particularly through acquisitions, has rendered this approach attractive since this methodology permits the researcher to focus specifically on costs and efficiency.

[4] It is acknowledged that accounting data is characterized by inherent deficiencies since they can be affected by managerial decisions. Nevertheless, the impact of bank mergers on the operational efficiency of the merging entities is bound to appear in the published accounts.

[5] See for instance Rhoades (1994), and Berger and Humphrey (1994) for comprehensive surveys of U.S. studies.

Most studies of efficiency performance are based strictly on expense ratios, but there are studies like Berger and Humphrey (1992), DeYoung (1993), Rhoades (1998) and Peristiani (1997), that estimate translog production functions to measure technical efficiency, scale efficiency, and an efficiency frontier for evaluating expense ratios or efficiency rankings of merged firms. The findings of the operating performance approach studies are generally consistent. Almost all the studies that find no gain in cost efficiency also find no improvement in profitability if they include both measures. The findings point strongly to a lack of improvement in efficiency or profitability as a result of bank mergers. These findings are robust within studies, across studies, and over time. Thus, Berger and Humphrey (1994) conclude that although mergers have the potential to improve X-efficiency, this potential is generally not realized, resulting in no significant merger cost efficiency gains on average. A more recent paper by Lang and Welzel (1999), analyzing the merger activity of cooperative banks in Germany, finds no evidence for efficiency gains from merging. Instead, the empirical results show a levelling off of differences among the merging units. Similarly to the aforementioned studies, this paper deals with the estimation of a translog frontier cost function, which gives a description of the cost side of the banking activity. The estimated parameters are then used to derive values of technical efficiency for all the observed banks. These efficiency scores are further used when analysing the efficiency consequences of bank mergers and acquisitions.

Event studies constitute another research method applied in analysing mergers and acquisitions. They study the reaction of the stock market when information on a planned merger is released. Stock market studies examine the development of the stock prices of companies involved in mergers and acquisitions and reflect the point of view of shareholders. These studies have usually adopted a performance indicator developed from the capital asset pricing model. An indicator of this kind is calculated by regressing over time a company's appreciation in stocks plus dividends, adjusted for stock splits and additional stock offerings, against a similarly computed measure for the overall market portfolio[6]. Analysts conducting such studies often find that the

[6] Differences in the stock returns between acquiring banks or target banks and the market are used as estimates of "abnormal" or "excess" returns using the following model: $AR_{it} = R_{it} - (a_i + b_i R_{mt})$, where AR_{it} are abnormal returns to bank stock i at time t, R_{it} are actual returns to bank stock i at time t, and R_{mt} are actual returns to a market portfolio of bank stocks at time t.

shareholders of the target firms rather than those of the acquiring companies are the ones that usually benefit from the announcements of merger deals.

4. Methodology

In order to assess the efficiency effects of mergers and acquisitions in the Swedish banking sector, a translog cost function[7] is utilized and estimated. Differences in the ability of bank managers to control costs are captured in the efficiency term in the cost frontier function. This term is bank specific and measures the distance between an individual bank's actual cost position and the best-practice cost frontier. Overall cost efficiency of a bank is then determined by its size efficiency, that is output levels and mixture, and by its technical efficiency. More specifically:

$$\begin{aligned}\ln C_{it}\,(y_{it}, w_{it}, br_{it}, t) \;=\; & \alpha_0 + \sum_{m=1}^{4}\alpha_m \ln y_{mit} + \sum_{j=1}^{3}\beta_j \ln w_{jit} + \\ & + \frac{1}{2}\sum_{m=1}^{4}\sum_{n=1}^{4}\alpha_{mn} \ln y_{mit} \ln y_{nit} + \frac{1}{2}\sum_{j=1}^{3}\sum_{k=1}^{3}\beta_{jk} \ln w_{jit} \ln w_{kit} + \\ & + \sum_{j=1}^{3}\sum_{m=1}^{4}\delta_{jm} \ln w_{jit} \ln y_{mit} + \rho \ln br_{it} + \frac{1}{2}\varphi(\ln br_{it})^2 + \\ & + \sum_{j=1}^{3}\lambda_j \ln w_{jit} \ln br_{it} + \sum_{m=1}^{4}\theta_m \ln y_{mit} \ln br_{it} + \zeta\, t + \frac{1}{2}\tau\, t^2 + \\ & + \sum_{j=1}^{3}\omega_j \ln w_{jit}\, t + \sum_{m=1}^{4}\xi_m \ln y_{mit}\, t + \psi \ln br_{it}\, t + v_{it} + u_{it}\end{aligned} \tag{1}$$

where C_{it} is the total cost of bank unit i at time period t, y is a vector of bank output, w is a vector of factor prices, br is the number of branches and t is a trend variable. v_{it} is a standard noise component, which is assumed to follow a normal distribution with zero mean and variance σ_v^2 and is independent of the explaining variables. u_{it} is the inefficiency term that captures technical and allocative inefficiency.

[7] Some studies have recently utilized the Fourier flexible functional form. Berger and Mester (1997) find, however, that the translog and the Fourier flexible forms yield a small difference in average efficiencies, and very little difference in efficiency dispersion or rank of the individual banks.

The usual parameter restrictions are assumed in order to ensure symmetry and linear homogeneity in input prices:

$$\alpha_{mn} = \alpha_{nm} \qquad m, n = 1, \ldots, 4 \qquad \beta_{jk} = \beta_{kj} \qquad j, k = 1, \ldots, 3$$

$$\sum_{j=1}^{3} \beta_j = 1 \qquad \sum_{j=1}^{3} \beta_{jk} = 0 \quad k = 1, ..., 3$$

$$\sum_{j=1}^{3} \delta_{jm} = 0 \quad m = 1, ..., 4 \qquad \sum_{j=1}^{3} \lambda_j = 0 \qquad \sum_{j=1}^{3} \omega_j = 0 \tag{2}$$

As for the specification of the efficiency term u_{it}, we follow the stochastic frontier approach originally introduced by Aigner et. al. (1977) and Meeusen and van den Broeck (1977). To ensure high flexibility and to make full use of the information in our panel, the Battese and Coelli (1992) model is used. The model proposed by them allows for time-varying technical efficiencies in an unbalanced panel. This latter aspect is particularly important in the framework of this study since mergers and acquisitions imply that banks disappear from the sample over time. Battese and Coelli (1992) have suggested the following pattern of temporal variation for the inefficiency term u_{it} :

$$u_{it} = \{\exp[-\eta(t-T)]\}u_i \tag{3}$$

where T is the panel length, u_i are positive firm effects assumed to follow a half-normal distribution[8], i.e., $u_i \sim N(0, \sigma_u^2)$, and are independent from v_{it}, and η is a parameter to be estimated. Given the exponential specification of u_{it}, the parameterisation in (3) implies that the time path of technical efficiency is monotonic, in the sense that technical efficiency increases, is constant and decreases when η is greater, equal and less than zero, respectively. It should be noted that η is assumed to be identical for all banks, leaving u_i to capture efficiency differences.

[8] This is a special case of the approach of Battese and Coelli (1992) who assume that the positive firm affects u_i follow the non-negative truncation of the normal distribution.

To allow for efficiency consequences of merging, the merged unit has to be defined as a new entrant in the market. Otherwise, no jump in cost efficiency would be possible. The analysis treats acquiring and acquired units as separate entities before merger and as a combined entity after merger. Furthermore, the jump to a new efficiency path has to be corrected by the trend variable η. Multiple acquisitions in one year by a bank are treated as a single merger.

The maximum likelihood estimation of the cost function defined in (1) generates estimates of all parameters of the frontier cost function as well as estimates of the unknown parameters σ, η and γ. After solving the maximum likelihood problem, aggregate residuals ε can be derived by substituting the estimated parameter vector β into the cost function (1). Battese and Coelli (1992) have shown that an estimate of firm-specific efficiency is given by:

$$TE_{it} = E\left[\exp(-u_{it})\middle|\varepsilon_i\right] = \frac{\Phi(\mu_i^*/\sigma_i^* - \eta_{it}\sigma_i^*)}{\Phi(\mu_i^*/\sigma_i^*)} \exp\left(-\eta_{it}\mu_i^* + \frac{1}{2}\eta_{it}^2\sigma_i^{*2}\right) \tag{4}$$

where

$$\mu_i^* = \frac{-\eta_i'\varepsilon_i\sigma_u^2}{\sigma_v^2 + \eta_i'\eta_i\sigma_u^2} \qquad \text{and} \qquad \sigma_i^{*2} = \frac{\sigma_v^2\sigma_u^2}{\sigma_v^2 + \eta_i'\eta_i\sigma_u^2} \tag{5}$$

$\Phi(\cdot)$ denotes the cumulative distribution function of the standard normal distribution. TE_{it} can be interpreted as the cost ratio of a fully efficient bank to the observed unit, i.e., $TE_{it} = (\exp(\beta' x_{it}) / \exp(\beta' x_{it} + u_{it})) \in]0,1]$. An efficient bank lies on the frontier and has an efficiency score of one. A value of 0.9, on the other hand, indicates that the bank could reduce its costs by 10 percent, given the output produced.

5. Data and Variables

This study focuses on the efficiency effects of mergers between savings banks in Sweden. The data needed to apply the analysis are yearly and were collected from annual bank account reports. The period of observation lies between 1984 and 2002, a total of 19 years. The panel data is unbalanced, this for the simple reason that banks

disappear and new units come into existence during the process of mergers and acquisitions. Due to the fact that some mergers involved more than two units, the number of banks leaving the panel exceeds the number of merger cases. The maximum number of banks participating in one single merger is 6. Furthermore, the merged unit is assumed to represent a new independent bank, in order to allow for jumps on the efficiency path as a consequence of merging. The analysis is applied on an unbalanced panel of 157 banks and a total of 28 bank mergers are studied. The panel comprises 1531 observations.

To select the relevant variables, we follow the asset approach proposed by Sealey and Lindley (1977), which views the banking institutions as using labour, capital and deposits to produce earning assets. This approach is the most common in the conventional literature. Moreover, banking literature has found that different approaches to measuring output have generally lead to similar conclusions concerning the cost structures of financial firms.

More specifically, three different factor prices and four different outputs are included in the analysis. The factor prices are price of labour (w_1), defined as personnel expenses divided by the number of employees, price of capital (w_2), defined as the sum of a bank's depreciation rate and its opportunity cost, where the latter is the firm specific interest rate for loans, and price of funds (w_3), defined as the ratio of interest expenses on deposits and other loanable funds to total loanable funds. The bank outputs comprise loans to non-banks (y_1), loans to banks (y_2), guarantees (y_3), and fees and commissions (y_4) . Using the last output goes beyond the assets approach as commonly modelled. Fees and commissions are included as non-interest income in an attempt to capture off-balance-sheet activities such as securitization, brokerage services, and management of financial assets for customers, which are becoming increasingly important for Swedish banks. Due to their small size, some banks report zero values for variables such as loans to banks, guarantees, and fees, which in turn implies that the translog function is not defined. To get around this problem, a substitute value of 1000 Swedish kronor is used in these cases. A summary of the descriptive statistics of these variables can be found in Table 1. All monetary variables are measured in million of Swedish kronor and expressed in 2002 real terms.

Table 1. Descriptive statistics of selected variables on Swedish savings banks, 1984-2002

Variable[a]	*Mean*	*Standard Deviation*	*Minimum*	*Maximum*
Total assets	3,180	17,432	5.9	309,281
Total cost	299	1,672	0.6	32,209
Loans to non-banks	2,009	9,839	2.3	196,888
Loans to banks	334	2,768	0.001	63,004
Guarantees	241	1,102	0.004	18,727
Fees & Commissions	28	135	0.001	2,853
Price of labour	0.396	0.078	0.116	1.230
Price of capital	0.231	0.080	0.096	0.914
Price of deposits	0.062	0.027	0.011	0.116
Branches	10.7	40.9	1	700
Year of Obs.	8.9	5.6	1	19

a The monetary variables are measured in million of Swedish kronor (SEK), expressed in 2002 values.

6. Empirical Results

The parameters of the translog stochastic cost function are estimated by the maximum likelihood method of estimation using the computer program FRONTIER Version 4.1 developed by Coelli (1996). Table A1 in the appendix reports the maximum likelihood estimates for the parameters of the translog cost function.

6.1 Tests, estimates and overall bank efficiency

Apart from the basic model, a number of alternative specifications were estimated in order to test whether a restricted form of the error term or of the cost function could have been used. The generalised likelihood ratio tests for these models are presented in Table 2. First we test whether the Cobb-Douglas technology or the translog stochastic frontier function better represent the data on Swedish banks. With a value of the generalised likelihood-ratio statistic calculated to be 531.27, much larger than the critical value of 57.81, the null hypothesis is rejected. Thus the translog stochastic frontier function applies. The null hypothesis of neutral and no technical change are also

rejected, implying that there is non-neutral technical change in bank costs and that there are shifts in the cost frontier over time. Moreover, we also test whether branches have an effect on the costs of the banking unit and the answer to that is affirmative. Thus branches should be included in the estimation of the model. Finally, we also conduct a test on the restriction of the error term, whereby we check whether the efficiency scores are time invariant. This null hypothesis is rejected as well and we conclude that the inefficiency of the banking units varies with time. Overall, the test results indicate that the complete model of the cost function with time-varying efficiency is the most appropriate and can adequately represent the data.

Table 2. Generalised likelihood-ratio tests of null hypothesis for parameters in the translog stochastic frontier model for costs in Swedish savings banks.

Null Hypothesis, H_0	**Test statistic**	**Critical value[a]**	**Conclusion**
H_0: *Cobb-Douglas*	531.27	57.81	Reject H_0
H_0: *Neutral technical change*	65.42	18.48	Reject H_0
H_0: *No technical change*	164.21	21.67	Reject H_0
H_0: *No effect of branches*	178.28	21.67	Reject H_0
H_0: *Time invariant inefficiency*	23.64	6.63	Reject H_0

a 1% level of significance

The efficiency scores are calculated for all banks and the full range of observed periods. The overall cost efficiency of Swedish savings banks is estimated to be 80 percent. This implies that banks can reduce their costs by 20 percent and still be able to produce the observed levels of output, without any adjustment in input prices, output volumes, or the branching network. This result is in line with previous studies conducted on Swedish banking data, including Gjirja (2001), Heshmati (1997), and Mlima (1999). The parameter η of the exponential function explaining u_{it} is estimated to have a negative value of –0.077 with a standard error of 0.015. This suggest a decreasing trend in bank efficiency for the period of observation. Average values of the efficiency scores for ten size[9] classes are given in Table 3.

[9] The size intervals contain 10 classes divided in such a way that the number of banks within each interval constitutes about 10% of the data.

Table 3. Mean technical efficiency by bank size

Bank Size[a]	Technical efficiency
1	0.93
2	0.91
3	0.87
4	0.87
5	0.81
6	0.79
7	0.80
8	0.74
9	0.67
10	0.80

a Size is measured by total assets

It is observed that, in terms of technical efficiency, larger banks are lagging behind smaller ones. The optimal size for a firm would be at a point where it reaches constant returns to scale. A company operating under increasing returns to scale needs to expand its operations, while operating under decreasing returns to scale would on the contrary lead to downsizing. Perhaps the reason why larger banks are underperforming in comparison to their smaller peers could be that their size has become more of a burden than an advantage. There are considerable costs associated with the management of a large organization and making sure that these costs do not outweigh the size benefits is of great importance. Moreover, a considerable number of banks that are defined as large have grown in size through mergers and acquisitions. The findings above could be reflecting the belief that scope economies, rather than economies of scale, are often seen as the main benefit banks derive by merging.

6.2 Cost efficiency and mergers

Now we turn to the assessment of the merging activity and how such a consolidation process has affected the cost efficiency of the involved banks. First, we analyse the pre-merger performance of the banks concerned. Theoretically, the more efficient units should acquire the less efficient ones. A more efficient unit is better organised and has a more capable management. The idea is that, since there is room for improvement concerning the performance of the less efficient unit, a takeover by a more efficient firm will lead to a transfer of the better management quality to the inefficient firm. This will

in turn lead to a more efficient and better performing merged unit. In order to see whether indeed it is the case that more efficient banks acquire the inefficient ones, we calculate the difference in technical efficiency between an acquiring and an acquired bank. This efficiency difference is measured as the technical efficiency of the acquiring bank minus (mean) technical efficiency of the acquired bank(s) for the last observation period before consolidation. These differences are plotted against the acquiring firm's efficiency score in Figure 1 below.

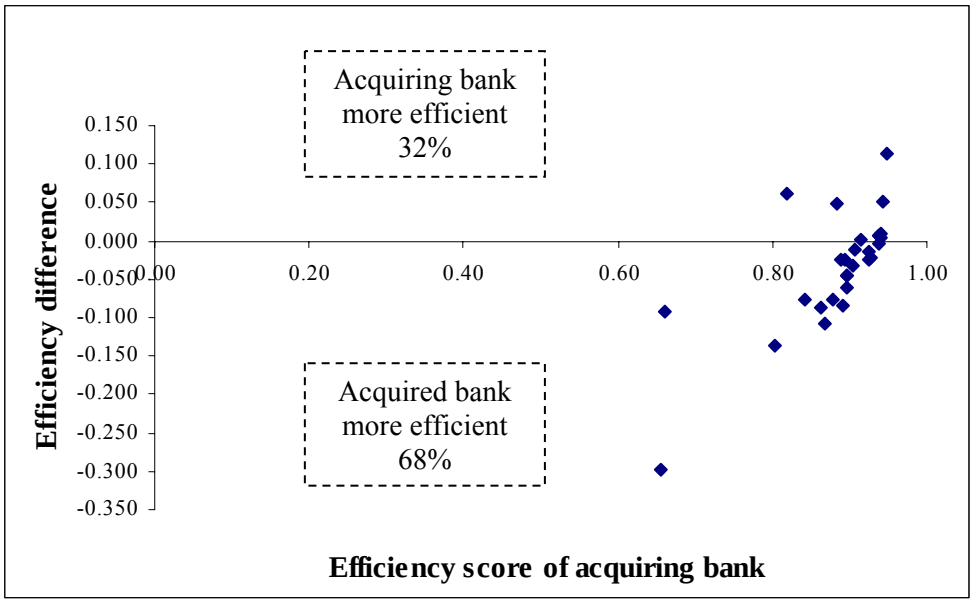

Figure 1. Ex-ante differences in technical efficiency

A positive efficiency difference is interpreted as an indicator of an ex-ante incentive for merging, because the advantage in management should to some extent be transferable to the acquired banking unit. This in turn would lead to a reduction in cost for the merged institution in the post-merger period[10]. However, it seems that such an ex-ante advantage in the efficiency of the acquiring unit versus the acquired one is not a major factor for mergers between Swedish savings banks. Only about a third (32%) of the mergers analysed constituted combinations where the acquired bank was more efficient than the acquired unit. This finding contradicts the incentive hypothesis above. Thus, motives other than efficiency considerations can drive bank mergers. As mentioned

[10] See Berger and Humphrey (1992)

previously, a less noble motive such as hubris or pride of the management of the acquiring firm might be one of them.

Next, we turn to the ex-post performance of merged banks. Here the issue at hand is whether there exists a positive relationship between the difference in technical efficiency before the merger and the performance of the institutions after the consolidation. In other words, we want to find out whether there has been any transfer of the better management quality from the acquiring bank to the one acquired. This is done by calculating the efficiency growth, whereby we estimate the change in technical efficiency from the acquiring unit to the merged bank. In Figure 2, the pre-merger difference in technical efficiency (efficiency difference calculated previously) for all observed merger cases is plotted against the change in technical efficiency or efficiency growth.

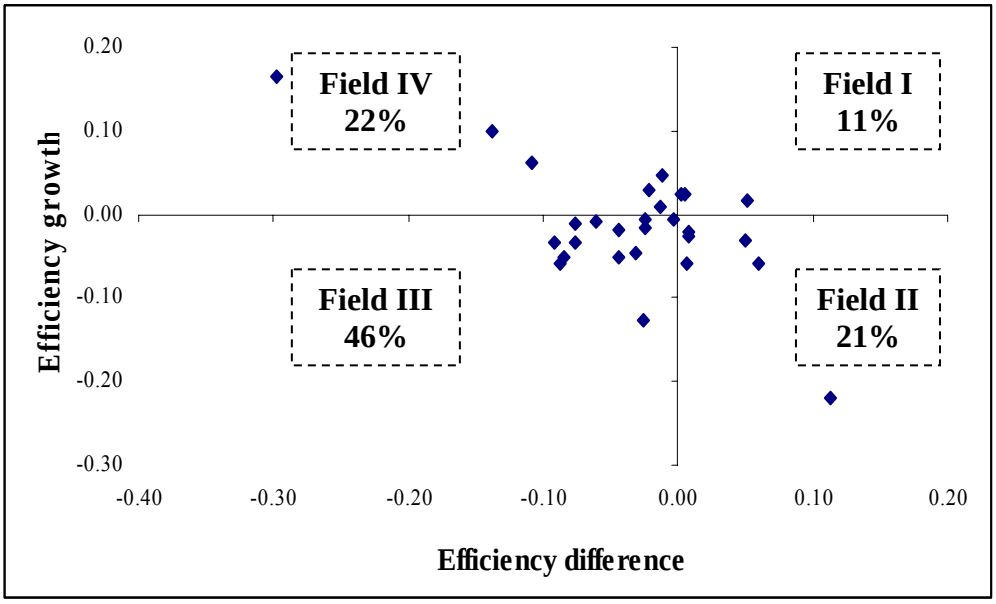

Figure 2. Ex-post performance of mergers

As figure 2 illustrates, about 33% (the sum of Field I and Field IV) of the merged banks showed an outperforming improvement in technical efficiency. The rest of the merged banks enhanced their technical efficiency by less than the trend or reached even lower efficiency levels. Furthermore, comparing Field I to Field II and Field IV to Field III, the following can be deduced. Out of the 32% share of the mergers in which a technical

efficiency advantage of the acquiring bank existed, only one third could sustain or increase the advantage of the acquiring bank. The rest experienced a regress or a worsening in cost efficiency after consolidation. This result suggests that the transfer of superior management quality to a badly managed part of a newly merged bank does not work well or at least does not work quickly enough. Taking a look at the cases where instead the acquired unit was more efficient than the acquiring one, we see that 22% of the merged institutions managed to improve and increase efficiency whereas 46% of these cases experienced a deterioration in efficiency growth. Thus, underperforming efficiency growth was more frequent than outperformance. Overall, the findings imply that whatever advantages there might exist in the technical efficiencies of the acquiring banks, they do not materialize in any substantial technical efficiency improvement for the merged banking institutions. These results seem to go opposite the belief or notion of dominance of the acquiring firm for the management quality of the merged unit.

In the banking literature it is often argued that the adjustment period necessary for restructuring the merged unit must be taken into account when mergers and whatever improvements they might give rise to are gauged. Usually a period of at least three years is claimed to be needed for realising the synergy effects. Table 4 reports the evolution of efficiency growth results depending on the number of years since the merger occurred. Contrary to the belief that mergers lead to synergy effects, the obtained results show that there is a negative correlation between efficiency growth and the merger date. This means that the efficiency of the merged unit, relative to that of the acquiring bank in the period before consolidation, deteriorated with time. Even some units that initially experienced technical efficiency improvements worsened their performance during the subsequent years. There is thus no evidence that the synergy effects are realised even when a considerable amount of time has passed since the merger took place.

Table 4. Efficiency effects of mergers over time

	Efficiency Growth*		
Years since merger	Min	Mean	Max
1	-0.22	-0.01	0.16
2	-0.24	-0.02	0.15
3	-0.27	-0.04	0.13
4	-0.30	-0.06	0.11
5	-0.33	-0.07	0.09
6	-0.37	-0.11	0.07
7	-0.41	-0.15	0.04
8	-0.46	-0.20	-0.09
9	-0.51	-0.20	-0.11
10	-0.56	-0.23	-0.13
11	-0.63	-0.26	-0.15
12	-0.69	-0.29	-0.17
13	-0.32	-0.26	-0.20
14	-0.37	-0.30	-0.23
15	-0.42	-0.33	-0.26
16	-0.47	-0.38	-0.29
17	-0.52	-0.44	-0.33
18	-0.59	-0.53	-0.46

* Efficiency growth calculated as technical efficiency of merged bank minus technical efficiency of acquiring unit.

7. Concluding Remarks

The purpose of this paper has been to shed some light on the efficiency effects of mergers and acquisitions in the Swedish banking industry and in particular among savings banks. The overall efficiency for the period 1984-2002 is estimated to be 80%. Thus on average banks could decrease their total costs by 20%, while maintaining the same level of produced outputs, without any adjustment in input prices, output volumes, or the branching network. The negative sign of the estimated η parameter implies that the period of observation is characterised by a negative trend in bank efficiency.

The ex-ante analysis of the observed banks involved in mergers showed that there is no strong evidence in favour of the hypothesis that the more efficient banks acquire the less efficient ones. Therefore, the pre-merger technical efficiency advantages of the acquiring banking institutions are not the main driving force behind the mergers observed. As for the performance of the merged banks after the completion

of the consolidation process, the findings indicate no remarkable improvements. Although about a third of the merged banks managed to improve or maintain their cost efficiency, the majority of them failed to realise any efficiency gains. Thus, eventual ex-ante technical efficiency advantages did not transform into superior performance ex-post. These results suggest that the notion of dominance of the acquiring firm for the management quality of the merged unit does not seem very realistic.

Finally, there is no evidence that efficiency improves with time and thus no real support for the hypothesis that synergy effects are realised after some adjustment period. Many years after the acquisition process a considerable number of the merged banks did not experience any increase in efficiency relative to the efficiency of the acquiring unit.

Although the findings in this study do not speak in favour of mergers and acquisitions as a way to achieve synergies, they are in line with most of the findings in the banking literature on mergers. The expected synergies and benefits attributed to mergers are often not realised and no remarkable improvements are noticed in technical efficiency. Evidently, mergers and acquisitions constitute complicated processes that should be considered with great care. Very often the acquirers underestimate the task of integrating systems, closing branches and retraining staff. Moreover, the difficulties and the costs associated with merging different corporate cultures can hamper the management of the new organisation and lead to disappointing results. The implication is that decision-makers ought to be more cautious in promoting mergers as a means to enjoying efficiency gains.

References

Aigner, D., C.A.K. Lovell and P. Schmidt (1977), "Formulation and estimation of stochastic frontier production function models", *Journal of Econometrics* 6, 21-37.

Battese, G.E. and T.J. Coelli (1992), "Frontier production function, technical efficiency and panel data: With application to paddy farmers in India", *Journal of Productivity Analysis* 3, 153-169.

Berger, A.N., and D.B. Humphrey (1992), "Megamergers in banking and the use of cost efficiency as an antitrust defence", *Antitrust Bulletin* 37, 541-600.

Berger, A.N., and D.B. Humphrey (1994), "Bank scale economies, mergers, concentration and efficiency: The U.S. experience", *Working Paper* 94-25, Financial Institutions Centre, The Wharton School, University of Pennsylvania.

Berger, A.N. and L.J. Mester (1997), "Inside the black box: What explains differences in the efficiencies of financial institutions", *Journal of Banking & Finance* 21, 895-947.

Berger, A.N., R.S. Demsetz and P.E. Strahan (1999), "The consolidation of the financial services industry: Causes, consequences, and implications for the future", *Journal of Banking & Finance* 23, 135-194.

Berger, P.G., and E. Ofek (1995), "Diversification's effect on firm value", *Journal of Financial Economics*, 39-65.

Coelli, T. J. (1996), "A guide to FRONTIER Version 4.1: A computer program for stochastic frontier production and cost function estimation. *CEPA Working Paper* 96/07, Department of econometrics, University of New England, Armidale.

DeYoung, R. (1993), "Determinants of cost efficiencies in bank mergers", *Economic and Policy Working Paper* 93-1, Office of the comptroller of the currency, Washington.

Gaughan, P.A. (1996), *Mergers, acquisitions and corporate restructuring*, Wiley, New York.

Gjirja, M. (2001), "Effects of deregulation and banking crisis on the labour use efficiency in the Swedish banking industry", Paper presented at the Seventh European Workshop on Efficiency and Productivity Analysis *7EWEPA*, Oviedo, Spain.

Hamel, G., and C.K. Prahalad (1990), "The core competence of the corporation", *Harvard Business Review*, May-June, 79-91.

Heshmati, A. (1997), "Labour demand, labour use, efficiency and risk in Swedish savings banks", *Memorandum* No 243, Department of Economics, Göteborg University.

John, K., and E. Ofek (1995), "Asset sales and increase in focus", *Journal of Financial Economics* 37, 105-126.

Lang, G. and P. Welzel (1999), "Mergers among German cooperative banks: A panel-based stochastic frontier analysis", *Small Business Economics* 13, 273-286.

Meeusen, W., and J. van den Broeck (1977), "Efficiency estimation from Cobb-Douglas production functions with composed error", *International Economic Review* 18, 435-444.

Milbourn, T.T., A.W.A. Boot and A.V. Thakor (1999), "Megamergers and expanded scope: Theories of bank size and activity diversity", *Journal of Banking and Finance* 23, 195-214.

Mlima, A.P. (1999), "Labour-use inefficiency and bank heterogeneity: An application using panel data for Swedish banks", in *Ekonomiska Studier* 95 (PhD Thesis), Göteborg University.

Peristiani, S. (1997), "Do mergers improve the X-efficiency and scale efficiency of U.S. banks? Evidence from the 1980s", *Journal of Money, Credit, and Banking* 29, 326-337.

Rhoades, S.A. (1994), "A summary of merger performance studies in banking, 1980-93, and an assessment of the 'operating performance' and 'event studies' methodologies", *Staff studies* no. 167, Federal Reserve Bank, Washington.

Rhoades, S.A. (1998), "The efficiency effects of bank mergers: An overview of case studies of nine mergers", *Journal of Banking and Finance* 22, 273-291.

Sealey, C.W. and J.T. Lindley (1977), "Inputs, outputs, and a theory of production and cost at depository financial institutions", *Journal of Finance* 32, 1251-1266.

Vaara, E. (1992), *Mergers and acquisitions between Finland and Sweden 1981-1991*, Helsingin kauppakorkeakoulu, Helsinki.

Appendix

Table A1. Maximum likelihood estimates for parameters of the translog stochastic frontier cost function

Variable	Parameter	Coefficient	t-ratio
Constant	α_0	-0.0952**	-2.5411
ln y_1	α_1	0.6766***	21.522
ln y_2	α_2	0.0658***	6.2055
ln y_3	α_3	0.0028	0.2806
ln y_4	α_4	0.1750***	7.8311
ln w_1	β_1	0.1760***	2.9996
ln w_2	β_2	0.0911**	2.3148
ln w_3	β_3	0.7329***	11.442
½ ln y_1 ln y_1	α_{11}	0.0185	1.4384
½ ln y_2 ln y_2	α_{22}	0.0035***	7.1797
½ ln y_3 ln y_3	α_{33}	0.0021	1.5040
½ ln y_4 ln y_4	α_{44}	0.0255***	8.0426
½ ln y_1 ln y_2	α_{12}	0.0273***	3.8289
½ ln y_1 ln y_3	α_{13}	-0.0089	-1.1935
½ ln y_1 ln y_4	α_{14}	-0.0264**	-2.2709
½ ln y_2 ln y_3	α_{23}	-0.0002	-0.0826
½ ln y_2 ln y_4	α_{24}	-0.0217***	-3.5029
½ ln y_3 ln y_4	α_{34}	-0.0050	-1.0761
½ ln w_1 ln w_1	β_{11}	-0.0884***	-2.9281
½ ln w_2 ln w_2	β_{22}	-0.0999***	-3.8937
½ ln w_3 ln w_3	β_{33}	0.0217	0.7226
½ ln w_1 ln w_2	β_{12}	0.1750***	5.0565
½ ln w_1 ln w_3	β_{13}	-0.0331	-0.6178
½ ln w_2 ln w_3	β_{23}	-0.0102	-0.2498
ln w_1 ln y_1	δ_{11}	-0.0765***	-2.8387
ln w_1 ln y_2	δ_{12}	0.0266***	3.2916
ln w_1 ln y_3	δ_{13}	0.0259***	2.7017
ln w_1 ln y_4	δ_{14}	0.0271	1.5322
ln w_2 ln y_1	δ_{21}	0.0543*	1.7852
ln w_2 ln y_2	δ_{22}	-0.0086	-1.3270

Table A1. continues

Variable	Parameter	Coefficient	t-ratio
ln w_2 ln y_3	δ_{23}	-0.0172**	-2.1398
ln w_2 ln y_4	δ_{24}	-0.0029	-0.1462
ln w_3 ln y_1	δ_{31}	0.0222	0.8013
ln w_3 ln y_2	δ_{32}	-0.0179**	-2.2848
ln w_3 ln y_3	δ_{33}	-0.0088	-0.9833
ln w_3 ln y_4	δ_{34}	-0.0243	-1.1852
ln *br*	ρ	0.0562**	2.2355
½ ln *br* ln *br*	φ	0.0465***	4.0713
ln w_1 ln *br*	λ_1	-0.0222	-0.8579
ln w_2 ln *br*	λ_2	0.0149	0.6159
ln w_3 ln *br*	λ_3	0.0074	0.3396
ln y_1 ln *br*	θ_1	-0.0321	-1.5005
ln y_2 ln *br*	θ_2	-0.0155***	-2.9777
ln y_3 ln *br*	θ_3	0.0076	1.4516
ln y_4 ln *br*	θ_4	-0.0059	-0.3929
ln *t*	ζ	0.0179	0.2694
½ ln *t* ln *t*	τ	-0.1631***	-4.3016
ln w_1 ln *t*	ω_1	0.2268***	3.9956
ln w_2 ln *t*	ω_2	-0.0538	-1.4739
ln w_3 ln *t*	ω_3	-0.1730***	-2.9489
ln y_1 ln *t*	ξ_1	-0.0453*	-1.7544
ln y_2 ln *t*	ξ_2	-0.0292***	-3.2600
ln y_3 ln *t*	ξ_3	-0.0089	-1.0038
ln y_4 ln *t*	ξ_4	-0.0385**	-2.1805
ln *br* ln *t*	ψ	0.1177***	5.2857
Variance Parameters			
σ^2		0.1273**	2.4491
γ		0.9315***	31.711
η		-0.0768***	-4.9689
Log-likelihood		1313.57	

*** Significance at 1% level. ** Significance at 5% level. * Significance at 10% level.