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Bank Efficiency Dynamics and Market Reaction around Merger Announcement

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BANK EFFICIENCY DYNAMICS AND MARKET REACTION AROUND MERGER ANNOUNCEMENT

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ABSTRACT

We study, using the non-parametric data envelopment approach, we investigated the long-run profit efficiency dynamics and the short-run market reaction of nine pre-classified merger deals of merging and non-merging U.S. banks over the time period from 1992 to 2003. Our main results are as follows: First, merger deals that match least efficient acquirers with the least efficient targets could improve their profit efficiency four years following the merger event, unlike all other merger deals. Second, we find that mergers match least efficient acquirers with the least efficient targets could also achieve significant positive cumulative access returns (CARs) while all other deals were followed by significant negative CARs. Third, we find that, in general, that large-size acquirers have and maintain higher and efficiency scores than targets and non-merging banks. Finally, the value-maximizing mergers are mostly large in size and match banks with clear chances to increase their future efficiency rankings.

I. INTRODUCTION

The United States witnessed its fifth wave of banking industry consolidation during the 1990s, according to Moeller et al. (2005). This last consolidation wave was associated with "higher stock valuations, greater use of equity as a form of payment for mergers, and more takeover defenses in place than the merger wave of the 1980s." These changing merger characteristics were combined with serious wealth losses to acquiring firms' stockholders. Moeller et al. indicate that acquiring firms' stockholders lost as much as 50 times the amount they did in the 1980s ($216 billion in the 1990s versus $4 billion in the 1980s).

The 1990s merger wave was motivated, in part, by regulatory reforms and technology changes. The two primary regulatory influences were the enactment of the 1994 Riegle-Neal Interstate Banking and Branching Efficiency Act and the 1999 Graham-Leach-Bliley Act. Riegle-Neal removed the remaining geographic restrictions on branching. However, it was not fully effective until June 1, 1997 (Cornett, McNutt, and Tehranian, 2003). The Graham-Leach-Bliley Act repealed the Glass-Steagall Act of 1933 by allowing commercial banks to engage in other activities such as investment banking.[1] The result of these regulatory changes was a surge in bank merger activity that sharply reduced the number of operating banks, but led to an increase in the total number of bank branches. According to Berger, Delong, and DeYoung (2003), the merger wave of the second half of the 1990s produced the largest number and greatest value of banks acquired over any five-year period. Wang (2003) indicates that, during the 1990s, the average size of banking organizations increased by more than 35%. Some of these

[1] Ely and Robinson (1998) argue that the passage of Glass-Steagall came as result of the stock market crash of 1929 when it was enacted within the Banking Act of 1933. However, Glass-Steagall did not simply prohibit *most* banks from engaging in securities activities, but it also prohibited paying interest on demand deposits. Glass-Steagall remained active until the 1980s, when banks became more engaged in underwriting and dealing with U.S. government securities. In 1987, banks were allowed, on a case-by-case basis, to engage in securities activities if the

mergers resulted in the emergence of banks with assets exceeding $50 billion. The fact that the banking industry is getting more concentrated was acknowledged by the chairman of the Federal Reserve Board of Governors, Alan Greenspan,[2] who stated that, "If all the mergers that have been announced are completed, the ten largest banking organizations in the United States will account for about 51% of all domestic banking assets, almost double their share in 1995. Consolidation has not been a phenomenon involving only large banks. Roughly 45% of the mergers involved an acquirer and a target each of which had less than one billion dollars in assets."

The existing literature proposes two main motives for consolidation: value-maximization motives and non-value maximization motives. Value-maximization motives for mergers, according to Akhavein et al. (1997), include at least three possible motives. The first is increasing cost efficiency through improving economies of scale. Akhavein et al. argue that consultants and managers are motivated more often by cost efficiency improvement than any other motive. This argument is further supported by Rhoades (1997), who showed that the primary reason for the nine mergers in his study was to achieve higher cost efficiencies in the intermediate time horizon. The second value-maximizing motive is profit efficiency improvement, which implicitly includes cost efficiency improvement. The goal in this case is to increase revenues and to decrease costs simultaneously. The third value-maximizing motive for bank mergers is the pursuit of market power in setting prices. In this case, the merger is motivated by achieving higher market share.

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volume of these activities did not exceed 5% of a bank's total revenues. In 1989, the percentage was raised to 10%. In 1997, forty-five banks representing 48% of all banking assets were allowed to engage in securities activities.

[2] Remarks by chairman Alan Greenspan, Federal Reserve Board of Governors, at the American Bankers Association Annual Convention, New York, New York, October 5, 2004.

Berger et al. (2000) supports the increasing market power motive. Their findings show that 50% of merger and acquisition activities (M&A) were in-market mergers. Akhavein et al. (1997) found that changes in prices after mergers are found to be very small and not statistically significant. This result, according to Akhavein et al., is consistent with the hypothesis that antitrust policy has been successful in preventing mergers that would result in increased market power. However, their findings show significant profit efficiency gains due to shifts in output from securities to loans. Wang (2003) argues that antitrust policies were balanced enough to permit efficiency gains to be achieved through mergers, and regulators generally sanction mergers that can concretely achieve such potential. Shafer (1993) shows that if the best practice banks acquired the least efficient banks, efficiency gains should be expected. Berger and Humphrey (1992) find that, for the most part, acquiring banks tend to be more efficient than targets. They argue that the acquirer needs sufficient time to improve the efficiency of the target.

The non-value maximization motive, on the other hand, is represented by the free cash flow hypothesis (Jensen, 1986). According to Jensen, managers with access to a large surplus of cash tend to engage in value destroying investments (i.e., adding negative net present value projects to the investment portfolio of the bank) that diminish stockholders' returns. The free cash flow theory implies that acquirers with surplus cash will pay in cash for merger transactions, while acquirers with no surplus cash will use stock-for-stock deals. If these explanations are accurate, the free cash flow hypothesis can explain both the motive of mergers and the method of payment to be used in merger transactions. Myers and Majluf (1984) proposed the information asymmetry hypothesis to explain the method of payment used in merger deals. According to this hypothesis, if the acquirer is more informed about the real value of the company than the general public, it will use cash if the bank is undervalued and will use stock if the bank is overvalued. Rhoades et al. (2004) argue that firms whose stocks are overvalued should use stock to buy firms, especially if the whole sector is overvalued.

To understand the motivations behind mergers, researchers have examined the post-merger performance of the acquirers and targets in two ways. The first way is the operating performance approach, which analyzes changes in profit, cost, and other performance measures around a merger. For example, Rhoades (1986, 1990), Spendt and Terhan (1991), Linder and Crane (1993), Peristiani (1993), and Rose (1987) indicate no performance improvement after a merger. Cornett and Tehranian (1992), and more recently, Cornett, McNutt, and Tehranian (2003), find an increase in post-merger operating performance, while Berger and Humphrey (1992), Piloff (1996), and Berger (1997) do not. However, operating performance studies have two main weaknesses: 1) they use simple ratios that depend on accounting data; and 2) there are methodological problems with using performance ratios to measure cost and profit efficiencies because ratios do not control for differences in input prices and output mix.

Due in part to these weaknesses, the focus in the research has switched recently to another more comprehensive aspect of efficiency, X-efficiency (cost, revenue, and profit efficiencies). Unlike efficiency ratios, the frontier X-efficiency concerns a bank's use of inputs.[3] Akhavein et al. (1997) argue that there are methodological problems with using performance ratios to measure cost and profit efficiencies because ratios *do not* control for differences in input prices and output mix. Berger and Humphrey (1992) use the frontier efficiency methodology to show no cost efficiency improvement post-merger. These findings are similar to those of Rhoades (1993), DeYoung (1996), and Akhavein et al. (1997), although Akhavein et al. find that merged banks experience a statistically significant 16% improvement in the profit efficiency of large banks, especially those with the lowest efficiency scores, before merger.

The second way of examining post-merger performance has been the event study method. These studies measure the reaction of the stock prices of acquirers and targets around a merger announcement. Lobue (1984), Desai and Stover (1985), Pettway and Trifts (1985), and James and Wier (1987) find that acquiring and target banks have positive abnormal returns following a merger announcement. Neely (1987) and Trifts and Scanlon (1988) find that the acquiring banks do not have abnormal returns for either intrastate or interstate merger proposals, although their findings show that targets experience positive significant abnormal returns in both cases. In another study, Delong (2001) highlights the asymmetry of the value reduction and finds that a merger destroys value if the outcome results in activity and/or geographic diversification, and enhances value if it results in activity and/or geographic focusing. Cornett and Tehranian (1992) compare the results of operating performance and event study methodologies. Their findings show no improvement in efficiency ratios, but acquiring banks experience negative significant cumulative abnormal returns and targets experience positive significant cumulative abnormal returns. Event studies also have problems which mainly come in two forms: 1) the period specification around merger announcements varies greatly from study to study, making it difficult to compare results; and 2) sample differences between studies and sampling errors within studies produce conflicting findings. Recently, some studies have introduced the technique of sub-sampling the population of merging banks according to specific characteristics in order to overcome sampling effects.

This dissertation examines the wealth effects of bank mergers by distinguishing pair-wise between efficiency types of mergers. Specifically, each merger transaction is classified according to the efficiency of both acquirers and targets. We argue that the market reaction will depend on two simultaneous pieces of information included in the merger announcement:

[3] The frontier efficiency approach is discussed in detail in the methodology section.

1. The efficiency evaluation of each of the two parties engaged in a merger transaction before the merger is announced. Most previous literature analyzed the market reaction to geographic diversification, in-market or vertical merger, etc. We argue that all of the previous literature analyzed the means of efficiency, but missed the efficiency itself as a determinant of the combined bank's future efficiency. While there is voluminous literature concerned with the effect of the pre-merger efficiency scores on the post-merger operating performance (e.g., Berger and Humphrey, 1992; Shafer, 1993; Rhoades, 1997; and Rhoades et al., 2004), there are no studies on the market reaction to the acquirer and target efficiencies. In this dissertation, we propose a unique match between the pre-merger operating efficiency scores of both the acquiring and target bank and the consequent market reaction.
2. The method of payment used to accomplish a merger transaction can signal important information on the fair value of the acquiring firm under asymmetric information (Myers and Majluf 1994) and the free cash flow hypothesis (Jensen 1986).

II. LITERATURE REVIEW

Cornett, McNutt, and Tehranian (2003) find that industry-adjusted operating performance of merged banks increases significantly after a merger. Other results from their work include: large bank mergers produce greater performance gains than small bank mergers, activity focusing mergers produce greater performance gains than activity diversifying mergers, geographically focusing mergers produce greater performance gains than geographically diversifying mergers, and performance gains are larger after the implementation of full nationwide banking in 1997 via the Riegle-Neal Act. Further, they find the improved performance is the result of both revenue enhancement and cost reduction activities. Additionally, the revenue enhancement opportunities appear to be greatest in those mergers that offer the most opportunity for cost cutting activities (i.e., activity focusing and geographically focusing mergers).

By employing a pair of truncated regressions conditioned on managerial objectives, Gupta and Misra (2004) find that the marginal valuation impact of the relative size of the merger partners, the premium paid for target shares, and inter- versus intra-state transactions is asymmetric across deals made by good versus bad managers. In particular, they document that in deals made by good (bad) managers, merger gains are increasing (decreasing) in the relative size of the transaction and in the premium paid for target shares. The latter finding suggests that in bids made by good managers, the premium paid may serve as a signal of deal quality and yield larger value gains. They also find that within the set of good mergers, interstate transactions have a negative impact on merger gains.

DeYoung et al. (2004) provide a first step in a large research agenda by describing how the geography of the U.S. banking industry has changed in the 1990s in response to deregulation and technological advancement. They explore three facets of the geography of the banking industry: headquarters location, branch office locations, and deposit collection. They find that mergers and acquisitions have allowed banks to move their company headquarters from smaller cities to larger cities, consistent with the existence of agglomeration economies available to banking companies. They also demonstrate that bank branches have moved substantially farther away from bank headquarters, evidence that banking organizations have become less geographically centralized.

Bouwman (2004) attributes the holding of excess capital by banks to regulation. He argues that if banks hold more capital, they impose a smaller threat on the deposit insurance fund, and hence, the regulator gives these banks more leeway and allows them to engage in more activities. If they keep less capital, the regulator becomes more intrusive. The area where this link between bank capital and regulation is most likely to manifest itself is mergers and acquisitions. Acquisitions may change the risk profile of the acquirer in a way that is unacceptable to the regulator. Given that the regulator must grant approval for an acquisition, she may be inclined to approve acquisitions when acquirers are well capitalized. This suggests a link between the level of capital of the acquirer and the types of acquisitions undertaken, and hence the post-acquisition performance of the acquirer. Bouwman (2004) builds a simple theoretical model based on this link, which establishes testable predictions regarding the relationship between acquirer capitalization and post-merger performance. In a model extension, he examines how concentrated ownership impacts this relationship. He finds that at the time of the announcement, the market believes that capitalization is irrelevant. However, consistent with his model, he finds that highly capitalized acquirers show the worst performance in the long run, and they consistently underperform acquirers with lower capitalizations. This result holds regardless of the method used to estimate abnormal returns.

Consistent with the model proposed by DeYoung, Hunter, and Undell (2003), Carter and McNulty (2004) find that, after controlling for market concentration, cost of funds, and a variety of other factors that might influence yields, smaller banks perform better that larger banks in the business lending market. This result is not due to differences in the composition of business loan portfolios at small and large banks since the ratio of small business loans to total business loans is held constant throughout their analysis.

Elyasiani and Deng (2004) study the value and risk effects of diversification. They find that asset diversification, international diversification, and banking activity diversification lead to reductions in bank returns. The negative impact of diversification on bank returns is consistent with the so-called consensus of value reduction in corporate finance. They also find that all three methods of diversification lead to an increase in bank risk and a reduction in the equity-to-asset ratio. The finding is consistent with the view that deviations from core competencies will result in increased risk and also with the view that increased distance between headquarters and branches magnify agency problems and their consequences. This finding is also consistent with empirical findings of Demsetz and Strahan (1997) and Stiroh (2002).

Rose (1987) finds that the operating performance of merging banks as measured by return on assets and return on equity does not improve after a merger if compared with non-merging control banks. Rose used a sample of 106 merging banks and the same number of control group banks matched according to size and geographic market. The results show no improvement on either efficiency proxies.

Rhoades (1990) analyzes the performance changes before and after 68 mergers between 1981 and 1987. To compare the performance of merging and nonmerging banks, Rhoades selected 322 peer banks matched by size. Rhoades' analysis is based on average performance over the period from three years before the merger to three years after. The results show no improvement in either profit or noninterest expenses.

Berger and Humphrey (1992) study 57 U.S. mergers from 1981 to 1989. They use the X-efficiency and technical efficiency scores in addition to return on assets, total revenues to average assets and noninterest expense to total assets. Their findings show a 5% X-efficiency improvement relative to the peer group. They also find that some mergers improve efficiency, while others worsen it. Berger and Humphrey argue that mergers in which the acquiring firms are more efficient than the targets do not lead to efficiency improvement when compared with other mergers.

Akhavein et al. (1997) applied the profit efficiency concept to the sample of merging banks used by Berger and Humphrey (1992). Their findings indicate a 16% average increase in acquiring banks profit efficiency when compared to control banks. Most of the improvement, they argue, comes from the output mix changes (from securities to loans). Inconsistent with Berger and Humphrey, they indicate that the banks with the lowest profit efficiencies prior to the merger achieved the greatest improvement after the merger. Sharkas and Kabir (2004) use parametric and non-parametric approaches to estimate frontier efficiency scores before and after a merger using a U.S. banking data set from 1986 to 2000. Consistent with Akhavein et al., the results show that mergers improved cost and profit efficiencies and that both the acquirer and the target have lower efficiency levels relative to their peer after merger.

Cornett, Hovakimian, Palia, and Tehranian (2003) examine whether corporate governance mechanisms reduce the managerial incentive to enter value-destroying bank acquisitions. They look at announcement period abnormal stock returns for diversifying (interstate or activity) acquisitions versus focusing (intrastate or activity) acquisitions. They find that the announcement period excess returns earned by the bidder banks are significant and negative for diversifying bank acquisitions, but not for focusing acquisitions. Further, they find that corporate governance mechanisms that reduce the manager-shareholder conflict are not as effective in diversifying acquisitions as they are in focusing acquisitions. If corporate governance mechanisms used to control the manager-shareholder conflict are less effective in interstate diversifying acquisitions, these acquisitions are less likely to be value maximizing. Thus, shareholders and bank regulatory agencies should be more vigilant of interstate or activity diversifying acquisitions, given that banks' internal governance mechanisms are not as effective at encouraging value maximization.

Recently, some studies have subsampled the population of banks engaged in merger activities according to their shared characteristics. Subsampling allows researchers to analyze whether these shared characteristics create or destroy shareholder wealth as well as whether these characteristics affect the performance of the target or acquirer. By examining bank mergers within the context of the focusing versus diversification debate, DeLong (1999) finds that the market does distinguish among various types of mergers. Degree of diversification, however, is not the sole influence on returns to merger partners. Her analysis reveals that the cumulative abnormal returns (CARs) increase in relative target to bidder size and decrease in the pre-merger performance of targets. Further dimensions, such as the type of corporate governance (Brickley and James, 1987; Hubbard and Palia, 1997) or agency costs (Cornett, Hovakimian, Palia, and Tehranian, 1998) could also influence the return on bank mergers.

DeLong (2001) shows that long-term performance is enhanced when mergers involve inefficient acquirers, when earnings streams are not diversified, and when payment is not made solely in cash. Upon announcement, the market reacts positively to mergers that are both activity and geography focusing. Although the long-term benefits accrue to mergers that focus managerial efficiency and revenue streams as well as reduce overinvestment, the market reacts to more tangible aspects of focusing, namely activity and geography. The market seems to understand that focusing is beneficial, yet it does not seem to know what aspects of focusing are worthwhile. Amihud et al. (2002) examine the effects of cross-border bank mergers on the risk and abnormal returns of acquiring banks. Generally, they find that neither the total risk nor the systematic risk of the acquirer falls relative to other banks in the acquirer's home market. The abnormal returns to acquirers are negative and significant, but the abnormal returns are somewhat less negative when their risk increases relative to other banks in their home country.

In this dissertation, we subsample merging banks according their profit efficiency scores and then measure and compare the operating performance changes and market reactions of these efficiency subgroups. This idea is motivated by Delong (1999, 2001), who classified banks by geographic and activity diversifications. In this dissertation, we argue that the variables used in Delong's papers are proxies of the *means of efficiency*, but missed the efficiency itself as a determinant of the combined bank's future efficiency. While there is voluminous literature concerned with the effect of the pre-merger efficiency scores on the post-merger operating performance (e.g., Berger and Humphrey, 1992; Shafer, 1993; Rhoades, 1997; and Rhoades et al., 2004), this work is the first to discuss the market reaction to bank mergers classified by acquirer and target pre-merger efficiency scores. Tables 1 and 2 summarize the analytical approaches used in the previous literature, including the advantages and the disadvantages of these approaches.

III. METHODOLOGY

3.1. Methodology Used to Estimate Efficiency Scores

Modern efficiency measures began with Farrell (1957), who drew upon the work of Debru (1951) and Koopmans (1951) to define a simple measure of firm efficiency that can account for multiple inputs. Farrell was able to break down the total efficiency concept into two components: technical efficiency, which shows the firm's ability to maximize its outputs from a given set of inputs; and allocative efficiency, which shows the firm's ability to use the inputs in optimal proportions, given their respective prices. However, the efficiency measures, according to Farrell, assume that the production function of the fully efficient firm is known. In practice, this cannot be the case, and the efficient isoquant must be estimated from sample data. Farrell suggests two ways to extend his work. One is by developing a non-parametric, piecewise-linear convex isoquant. The other is by using a parametric function, such as the Cobb-Douglas form. While most of the literature that has been produced since Farrell's work has used a parametric function, the piecewise-linear convex hull approach to frontier estimation has been considered by only a handful of researchers in the two decades following Farrell's paper.

3.1.1. The Parametric Stochastic Frontier Approach

The parametric stochastic frontier approach, in general, specifies a production function and recognizes that deviations away from this given technology can be broken down into two components: statistical noise due to events outside the firm's control and inefficiency. A potential problem with this model is that the error term may cause a misspecification of the production function. This has led to the development of the stochastic frontier approach (SFA), which takes into account external factors when estimating efficiency. The SFA imposes specific assumptions about the distribution of both the error term and sources of inefficiency. Aigner et al. (1977) employ a composed error model in which inefficiencies are assumed to follow a symmetric distribution, usually the standard normal distribution. Greene (1990), among others, has argued that alternative distributions for inefficiency may be more appropriate than the normal distribution (e.g., truncated normal, gamma, and exponential distributions).

3.1.2. The Non-parametric Data Envelopment Analysis

Chranes, Cooper, and Rhodes (1978) coined the term data envelopment analysis (DEA). There has since been a multitude of works that have applied and extended the DEA methodology. DEA constructs a frontier based on the sample data rather than using an assumed production function. This non-parametric approach shows how a particular decision making unit (DMU) operates relative to other DMUs by providing a benchmark for the best practice technology based on the DMUs in the sample. Because DEA makes no assumptions about inefficiency distributions, it is subject to data problems and inaccuracies created by accounting rules (Isik, 2000). However, DEA works better than the parametric approach when the sample size is small.

Following Rangan et al. (1988), Berger et al. (1992), Elyasiani and Mehdian (1992), Fare et al. (1994), Grabowaski et al. (1994), Leightner and Lovell (1998), Wheelcock and Wilson (1999), Isik and Kabir (2003), and others, we use DEA to measure U.S. banks' efficiency scores. This choice is motivated by the small sample size during some years of our data set. Some other reasons for this choice are: 1) most studies that have used both SFA and DEA have found that both approaches preserve the efficiency ranking of the DMUs (see Isik and Kabir, 2002, 2003; and Sharkas and Kabir, 2004). Since the purpose of this dissertation is to use the efficiency scores to rank merging banks according to their efficiency characteristics, we use DEA rather than SFA; 2) the non-parametric DEA is the better choice when the industry has experienced a series of reforms and/or shocks because we can assume variable returns to scale (which is not an option in SFA); and finally, and most importantly, 3) under DEA, profit efficiency scores can be broken down into more basic components (cost efficiency, revenue efficiency, etc.). This point is crucially important in this dissertation because the explanatory power of these variables (efficiency scores) is used to explain the market's reaction.[4]

3.1.2.1. Definition of Efficiency Measures Under DEA

Farrell (1957) decomposes the overall cost efficiency (CE) of each DMU into two components: a) technical efficiency (TE), which shows the ability of a DMU to achieve the maximum output for a given production set, and b) allocative efficiency (AE), which shows management's ability to construct an optimal product mix, given their respective prices. Assuming constant returns to scale (CRS), CE is decomposed as follows:

$$CE = TE \times AE \qquad (1a)$$

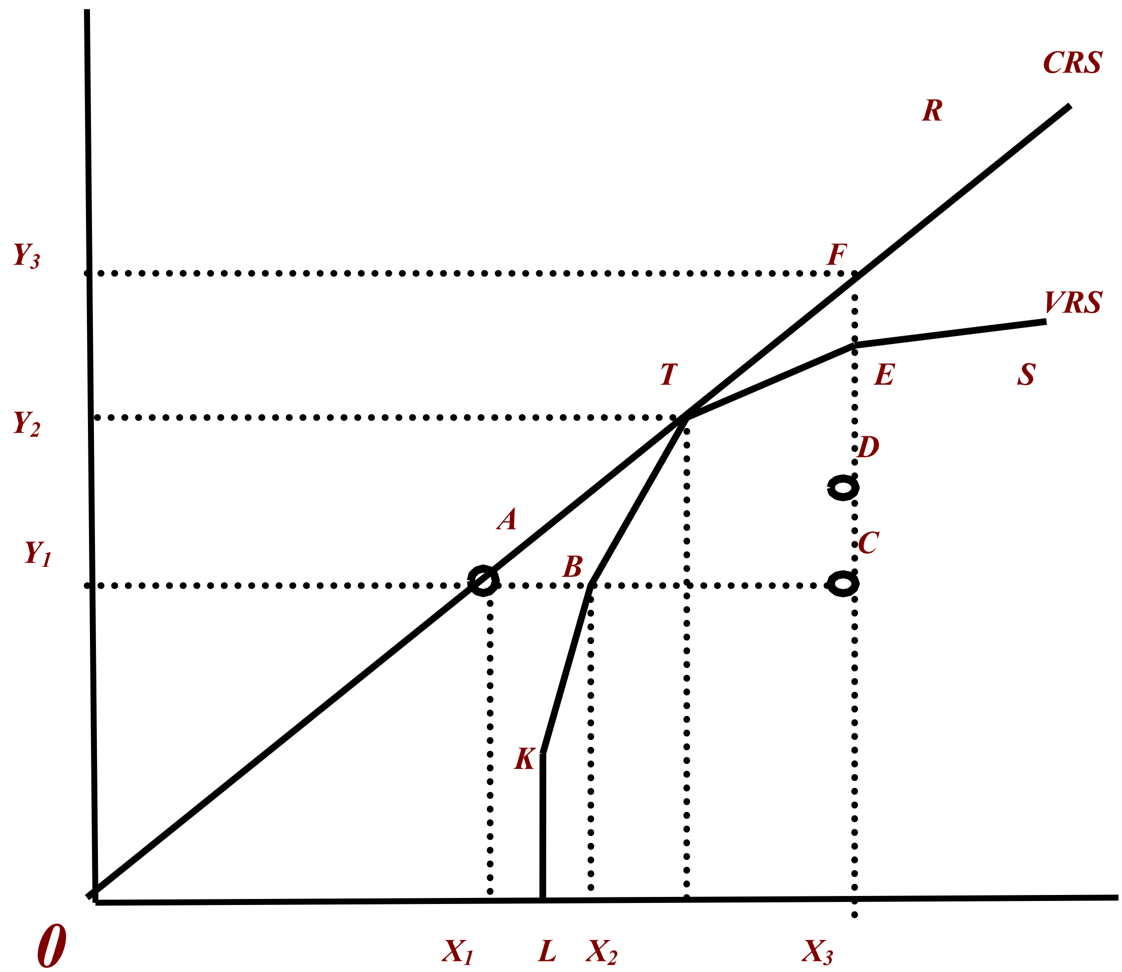
Banker et al. (1984) proposed the variable returns to scale frontier (VRS), in which the frontier changes over time due to technological progress, financial crises, higher industry concentration due to mergers and acquisitions, and financial deregulation (Isik and Kabir 2003). However, Banker et al. further decompose TE into two components: a) pure technical efficiency (PTE), which indicates the proportional reduction in input usage if inputs are not wasted; and b) scale efficiency (SE), which represents the proportional output reduction if the bank achieves CRS. So, equation 1a can be re-written as follows:

[4] This is discussed in detail in the regression framework section 3.2, page 32.

$$CE = PTE \times SE \times AE \qquad (1b)$$

The decomposition of efficiency measures is shown graphically by Isik (2000). Figure 1 presents a simple case of a single input (x) and single output (y).

Figure 1: Efficiency and Productivity Concepts



Source: Isik and Kabir (2003).

Assuming CRS, we obtain a flat portion on the long-run average cost curve (the line OATFR). However, because of the structural changes mentioned earlier, the CRS assumption may no longer be accurate. Imposing the VRS assumption, we get a convex hull frontier (curve LKBTES). The VRS frontier shows that the whole industry is facing external factors that cause it to operate away from the full capacity utilization represented by the CRS frontier. To show the efficiency components, assume that DMU_1 is observed at point C in year t and at point D in year t+1. Both points are technically inefficient because both of them are interior to the CRS frontier. So, at time t, the output technical inefficiency (TIE_0) is represented by the distance CF. Point C represents the amount by which outputs could be proportionally increased (from y_1 to y_3) while holding the inputs fixed at x_3. So, TIE_0 is represented by AC/Y_1C, where $TE = 1 - TIE_0$, and TIE_0 may be shown graphically by Y_1A/Y_1C. Assuming VRS, the convex hull frontier, we can calculate the PTE of the output at point C, which is equal to Y_1B/Y_1C. DMU_1 could be more efficient if it moved closer to point B, which represents the best practice benchmark at the VRS frontier. However, point B is not scale efficient because DMU_1 can further reduce its input usage from x_2 to x_1 if it can achieve CRS. So, the SE of DMU_1 is represented by Y_1A/Y_1B, which depicts the distance of the DMU from the optimal "virtual" input-output mix.

3.1.2.2. The Model

3.1.2.2.1. Estimation of Technical Efficiency[5]

Consider N DMUs (banks), each using two inputs to produce one output. Assume that all DMUs are achieving CRS. Then, the technical efficiency can be estimated as follows:

$$\begin{aligned} &\min\ _{TE,\lambda} TE_i \\ &s.t. \\ &Y.\lambda_i \geq y_i \\ &X.\lambda_i \leq TE_i . x_i \\ &\lambda_i \geq 0 \end{aligned} \qquad (2)$$

where TE_i is the technical efficiency score of the i-th DMU. TE is the technical efficiency of benchmark DMUs. λ_i is a 1×N vector of intensity weights defining the linear combination of

[5] For simplicity, we assumed a DMU using two inputs to produce one output in this section. However, in subsequent sections of this dissertation, these constraints will be relaxed.

the efficient DMUs to be compared with the i-th DMU. The first constraint shows that the observed outputs of DMU_i must be less than or equal to a linear combination of outputs of the DMUs forming the efficient frontier. The second constraint places a restriction on the input side. It states that the use of inputs in a linear combination at the efficient frontier should be less than or equal to the use of the inputs by the i-th DMU. The PTE can be estimated by imposing the VRS assumption and simply adding the convexity constraint. Thus, the PTE can be solved with the following:

$$\begin{aligned} &\min_{TE,\lambda} TE_i \\ &s.t. \\ &Y.\lambda_i \geq y_i \\ &X.\lambda_i \leq TE_i . x_i \\ &\lambda_i \geq \frac{1}{N_1} \end{aligned} \tag{3}$$

where N_1 is a vector of ones, and consequently $\sum_{i=1}^{N} \lambda_i = 1 \ or \ \lambda = 1$. By adding this constraint, we expect to have fewer inefficiencies than with the TE estimates because VRS represent a convex hull combination of efficient DMUs in which the intensity weights will be less than when assuming CRS. Finally, SE can be easily estimated by rearranging equation (1b) as follows:

$$SE = \frac{TE}{PTE} \tag{4}$$

3.1.2.2.2. Estimation of Cost and Allocative Efficiencies

As shown in the previous section, cost efficiency can be estimated by summing input prices rather than output quantities. Consider n DMUs, where each DMU uses m inputs to produce s outputs. The general form of the cost minimization problem is then:

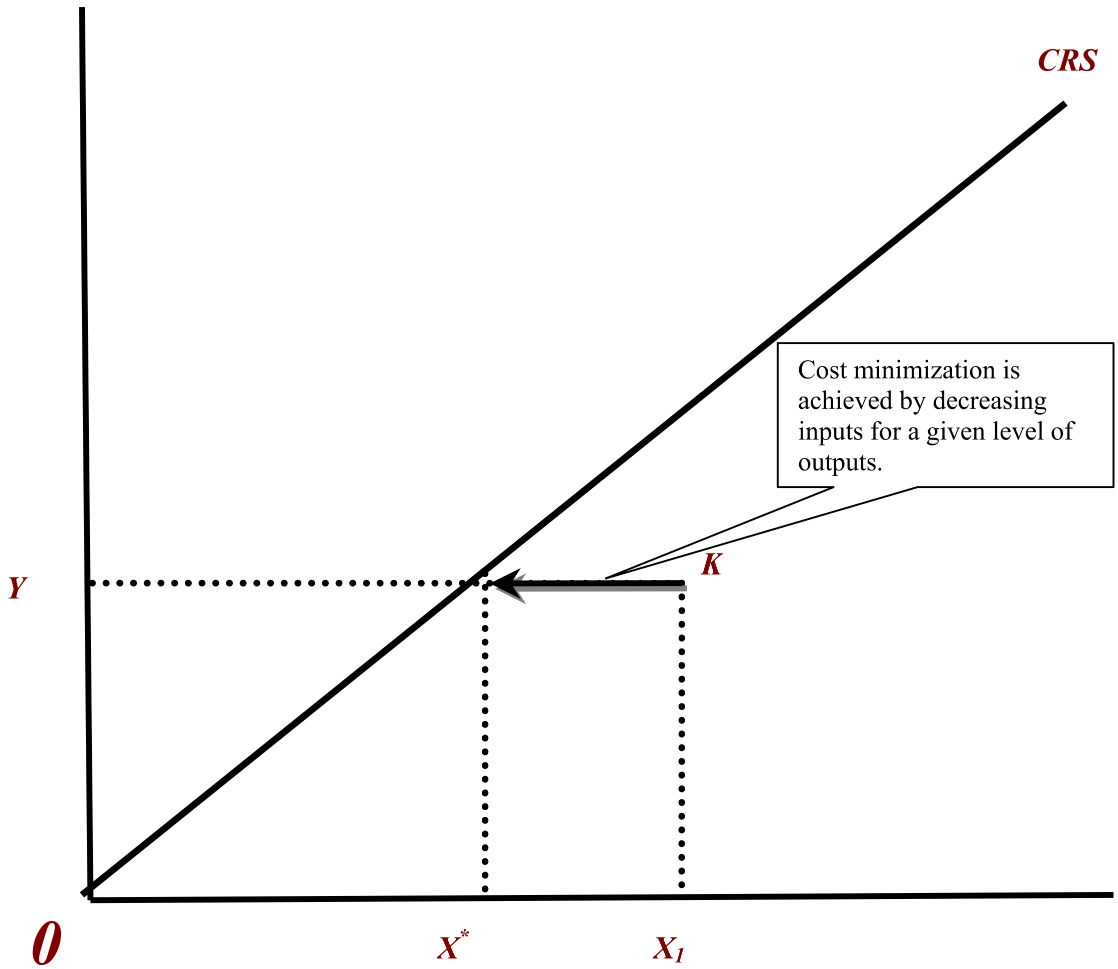
$$
\begin{aligned}
&\min \sum_{i=1}^{m} p_i x_i^* \\
&s.t. \\
&\sum_{j=1}^{n} \lambda_j x_{ij} \le x_i^* \qquad\qquad i = 1,2,........, m; \\
&\sum_{j=1}^{n} \lambda_j y_{rj} \ge y_r \qquad\qquad r = 1,2,........, s; \\
&\lambda_j, x_i^* \ge 0 \\
&\sum \lambda_j = 1 \qquad\qquad \text{Assuming (VRS).}
\end{aligned}
\tag{5}
$$

where p_i is a vector of input prices for the j-th DMU and x_i^* is the cost minimization vector of input quantities for the j-th DMU, given the input prices and the output levels.

The first constraint places a restriction on the input side, requiring the use of inputs in a linear combination at the efficient frontier to be less than or equal to the use of the inputs by the i-th bank. The second constraint shows that the observed outputs of DMU_j must be less than or equal to a linear combination of outputs, x_i^*, of the DMUs forming the efficient frontier. The third constraint assures the feasibility of the solution. The fourth constraint imposes the VRS assumption. Figure 2 shows the cost efficiency problem assuming CRS, where the point K represents a cost inefficient DMU. The only way to derive a more cost efficient DMU is by getting it closer to the efficient frontier. This can be achieved by using input equal to $X*$ rather than X_1, holding the output fixed (the bold horizontal arrow shows this choice). Finally, the cost efficiency of the each DMU can be obtained as follows:

$$
\frac{\sum_{i=1}^{m} p_i x_i^*}{\sum_{i=1}^{m} p_i x_i} = \frac{\text{Minimum virtual cost}}{\text{Observed cost}} \le 1,
$$

Figure 2: Cost Minimization Problem



Cost minimization problem is solved as follows:

$$\min \sum_{i=1}^{m} p_i x_i^*$$

$s.t.$

$$\sum_{j=1}^{n} \lambda_j x_{ij} \leq x_i^* \qquad i = 1,2,\ldots\ldots\ldots, m;$$

$$\sum_{j=1}^{n} \lambda_j y_{rj} \geq y_r \qquad r = 1,2,\ldots\ldots\ldots, s;$$

$$\lambda_j, x_i^* \geq 0$$

$$\sum \lambda_j = 1 \qquad \text{Assuming (VRS).} \qquad (5)$$

where the cost efficiency value will be equal to one for the DMUs that lie on the efficient frontier. The cost efficiency scores take values in the range (0,1).

We can also obtain the allocative efficiency using equation (1a) as follows:

$$CE = TE \times AE \Rightarrow AE = \frac{CE}{TE}$$

3.1.2.2.3. Estimation of Revenue Efficiency

Using the same considerations as in the previous section, we can obtain the revenue efficiency (RE) scores for each DMU. The revenue maximization problem maximizes the vector of output quantities, y^*, in the first step. Then, the revenue-maximizing problem is calculated as follows:

$$\begin{array}{ll}
\max \sum_{r=1}^{s} q_r y_r^* & \\
s.t. & \\
\sum_{j=1}^{n} \lambda_j x_{ij} \leq x_i & i = 1,2,........, m; \\
\sum_{j=1}^{n} \lambda_j y_{rj} \geq y_r^* & r = 1,2,........, s; \\
\lambda_j \, , y_i^* \geq 0 & \\
\sum_{j=1}^{n} \lambda_j = 1 & \text{Assuming (VRS).}
\end{array} \qquad (6)$$

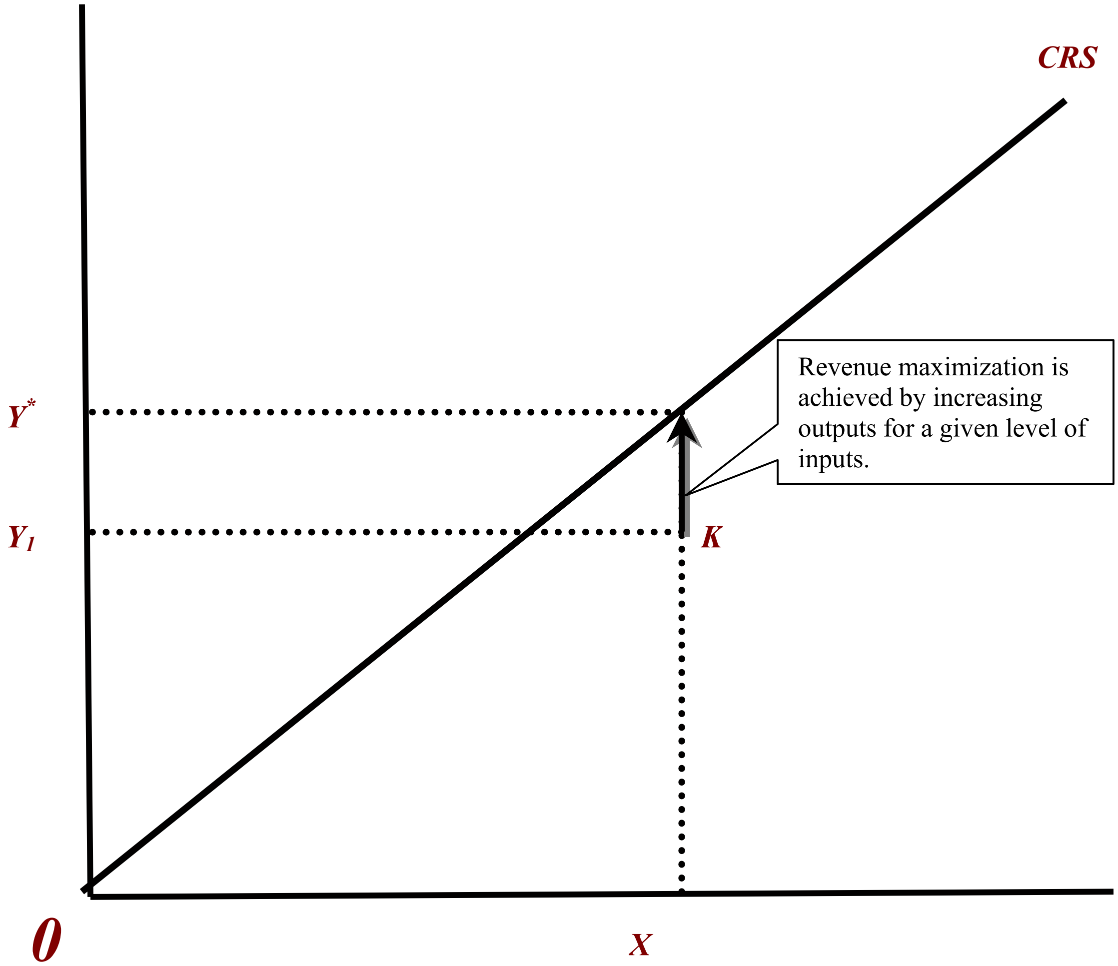
where q_r is a vector of output prices for the j-th DMU, and y_r^* is the maximization vector of output quantities of the DMUs forming the efficient frontier. The first constraint indicates that the use of the inputs in a linear combination of efficient DMUs must be less than or equal to the use of inputs of the j-th DMU. The second constraint shows that the observed outputs of the j-th DMU must be less than or equal to the linear combination of the DMUs forming the efficient frontier. Figure 3 shows the revenue efficiency problem assuming CRS where the point K represents a revenue inefficient DMU. The only way to derive a more revenue efficient DMU is by getting it closer to the efficient frontier. This can be achieved by producing input equal to $Y*$ rather than Y_1, holding the input level fixed. The bold upward arrow represents this choice.

The last two constraints are well defined in the previous section. After solving the above problem, we can obtain RE as follows:

$$RE = \frac{\sum_{r=1}^{s} q_r y_r}{\sum_{r=1}^{s} q_r y^*} \qquad (7)$$

where $\sum_{r=1}^{s} q_r y_r$ is the observed/actual revenue of the DMU, and $\sum_{r=1}^{s} q_r y^*$ is the virtual efficiency profit that could be achieved if the DMU were situated on the efficient frontier. The value of the profit efficiency scores will always fall in the range (0, 1).

Figure 3: Revenue Maximization Problem



Revenue maximization problem is solved as follows:

$$\max \sum_{r=1}^{s} q_r y_r^*$$

$$s.t.$$

$$\sum_{j=1}^{n} \lambda_j x_{ij} \leq x_i \qquad i = 1,2,........,m;$$

$$\sum_{j=1}^{n} \lambda_j y_{rj} \geq y_r^* \qquad r = 1,2,........,s;$$

$$\lambda_j , y_i^* \geq 0$$

$$\sum_{i=1}^{n} \lambda_j = 1 \qquad \text{Assuming (VRS).} \qquad (6)$$

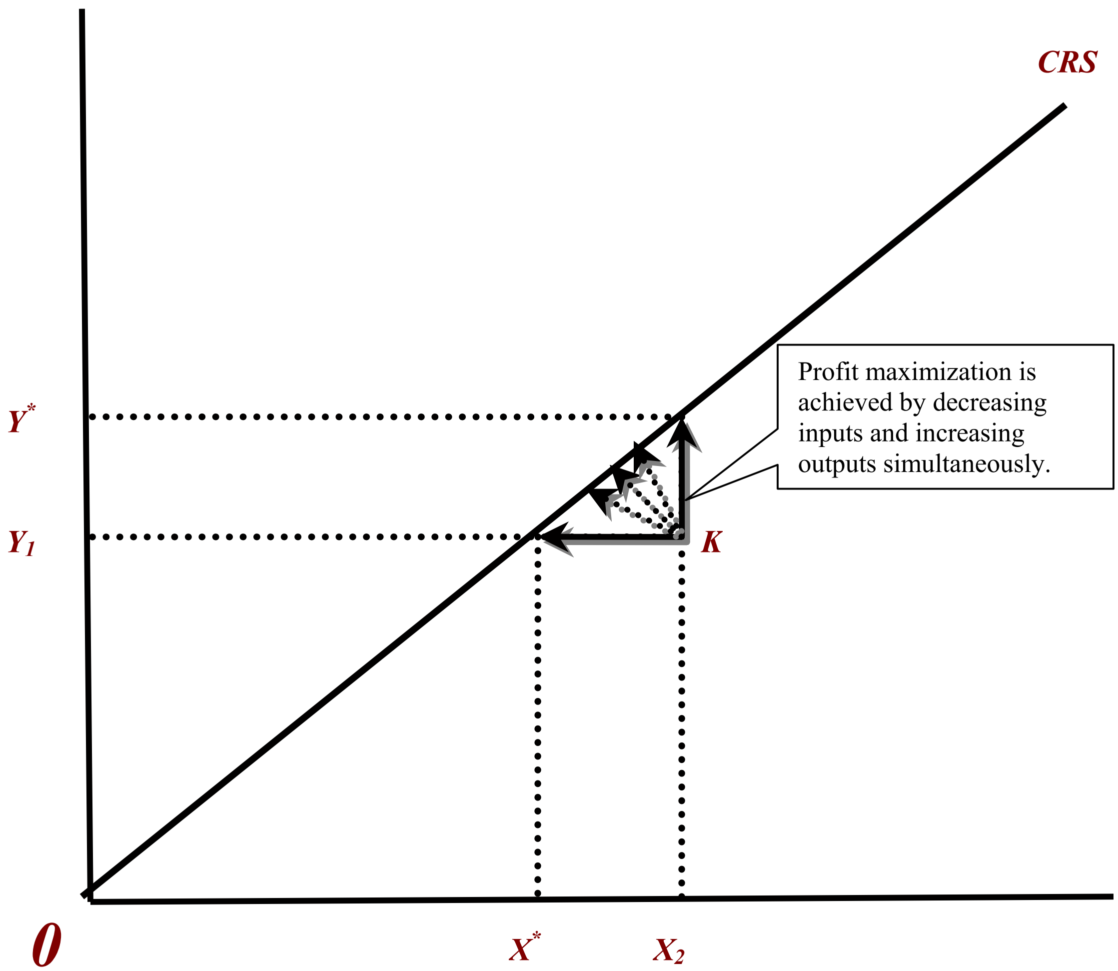
3.1.2.2.4. Estimation of Profit Efficiency

Summing the cost and revenue efficiencies generates the profit efficiency (PE) concept, which seeks to minimize costs and maximize revenue simultaneously. Unlike cost and revenue efficiencies, PE is obtained by allowing inputs and outputs to vary. Figure 4 shows the PE problem assuming CRS where the point K represents a profit inefficient DMU. To derive a more profit efficient DMU, managers have many choices that can manipulate the DMU so that it will lie on the efficient frontier. They may decrease inputs, increase outputs, or both. The multiple arrows in Figure 4 show these choices. The bold upward arrow represents one extreme choice that is equivalent to the revenue maximization solution, and the horizontal bold arrow represents the other extreme, the solution to the cost minimization problem. The profit maximization problem can be described as follows:

$$\begin{aligned}
&\max \sum_{r=1}^{s} q_r y_r^* - \sum_{i=1}^{m} p_i x_i^* \\
&s.t. \\
&\sum_{j=1}^{n} \lambda_j x_{ij} \le x_i^* && i = 1,2,........,m; \\
&\sum_{j=1}^{n} \lambda_j y_{rj} \ge y_r^* && r = 1,2,........,s; \qquad (8) \\
&x_i^* \le x_i, y_r^* \ge y_r \\
&\lambda_j \ge 0 \\
&\sum_{j=1}^{n} \lambda_j = 1 && \text{Assuming (VRS).}
\end{aligned}$$

where the first constraint indicates that the use of the inputs in a linear combination of efficient DMUs must be less than or equal the use of inputs of the j-th DMU. The second constraint shows that the observed outputs of the j-th DMU must be less than or equal to the linear combination of the DMUs forming the efficient frontier. However, the two constraints in this

Figure 4: Profit Maximization Problem



Profit maximization problem is solved as follows:

$$\max \sum_{r=1}^{s} q_r y_r^* - \sum_{i=1}^{m} p_i x_i^*$$

$$s.t.$$

$$\sum_{j=1}^{n} \lambda_j x_{ij} \leq x_i^* \qquad i = 1,2,........,m;$$

$$\sum_{j=1}^{n} \lambda_j y_{rj} \geq y_r^* \qquad r = 1,2,........,s;$$

$$x_i^* \leq x_i, y_r^* \geq y_r$$

$$\lambda_j \geq 0$$

$$\sum_{j=1}^{n} \lambda_j = 1 \qquad \text{Assuming (VRS).} \qquad (7)$$

problem are solved simultaneously. The third constraint is imposed to assure that the revenue maximization and cost minimization are both achieved. This constraint requires that the inputs of the j-th DMU must be greater than or equal to the output of the DMUs on the efficient frontier, and it indicates that the output of the j-th DMU must be less than or equal to the outputs of the DMUs on the efficient fronteir. This constraint is important because it is possible to maximize profit efficiency by minimizing costs only. In this case, profit maximization will be equivalent to cost minimization. The same argument is valid for the revenue efficiency. Finally, the profit efficiency can be obtained using the following equation:

$$\frac{\sum_{r=1}^{s} q_r y_r - \sum_{i=1}^{m} p_i x_i}{\sum_{r=1}^{s} q_r y_r^* - \sum_{i=1}^{m} p_i x_i^*},$$

where $\sum_{r=1}^{s} q_r y_r - \sum_{i=1}^{m} p_i x_i$ represents the observed profitability of DMU_i. This value could be negative for DMUs with losses. $\sum_{r=1}^{s} q_r y_r^* - \sum_{i=1}^{m} p_i x_i^*$, on the other hand, represents the virtual profitability that could be achieved if the DMU is located on the efficient frontier. Accordingly, the profit efficiency values must lie in the range $(-\alpha,1)$.

3.1.2.2.5. Malmquist Total Productivity Index

Presented by Fare et al. (1994), Malmquist total productivity index is a product of two sources: the efficiency gain or loss (known as the catch-up effect[6]) and technological changes caused by innovations or shocks. The efficiency changes, according to Fare et al., show how close the DMU gets to the efficient frontier. In other words, it shows managers' ability to

[6] The catch-up effect represents the technical efficiency of section 3.1.2.2.1.

improve efficiency internally. The external or technology effect shows how much the efficient frontier itself shifts at each DMU input mix. The Malmquist index is represented by the following equation :

$$\underbrace{M = \frac{D_{t+1}^{CRS}(x_{t+1}, y_{t+1})}{D_{t}^{CRS}(x_{t}, y_{t})}}_{\text{Efficiency change}} \times \underbrace{\left[\frac{D_{t}^{CRS}(x_{t+1}, y_{t+1})}{D_{t+1}^{CRS}(x_{t+1}, y_{t+1})} \times \frac{D_{t}^{CRS}(x_{t}, y_{t})}{D_{t+1}^{CRS}(x_{t}, y_{t})} \right]^{1/2}}_{\text{Technologi cal change}} \qquad (9)$$

The Malmquist index is normally used to analyze the effect of economic shocks on the whole economy or the whole sector (Isik, 2000; Isik and Hassan, 2003). In this dissertation, we are utilizing this index to follow the post-merger changes relative to the year of the merger event.

We apply the DEA methodology to the universe of U.S. commercial banks to obtain technical, scale, allocative, and X-efficiency scores (using SIC codes 6021, 6022, 6035, and 6036). One problem in the efficiency literature is that the efficient frontier is generated using samples of merging and/or peer banks only (see Burger and Humphrey, 1992; DeYoung, 1993; and Rhodes, 1997). However, this sampling method may cause results to vary from one study to another. We attempt to rectify this problem by using the entire universe of U.S. commercial banks. Our next step is to classify each merger according to the efficiency characteristics of the acquirer and the target. We choose profit efficiency to separately classify acquirers and targets into three groups since profit efficiency is the most conservative and demanding efficiency measure. The three groups are high efficiency banks, medium efficiency banks, and low efficiency banks. So, our sample consists of the following nine merger classifications (acquirer/target): low efficiency/low efficiency (LELE); low efficiency/medium efficiency (LEME); low efficiency/high efficiency (LEHE); medium efficiency/low efficiency (MELE); medium efficiency/medium efficiency (MEME); medium efficiency/high efficiency (MEHE);

high efficiency/low efficiency (HELE); high efficiency/medium efficiency (HEME); and high efficiency/high efficiency (HEHE). To get these classifications, we allowed one standard deviation around the annual mean to get the average bank's efficiency range/bounds. Any bank with an efficiency score higher than the upper bound is considered a high efficiency bank. Any bank with an efficiency score less than the lower bound is considered a low efficiency bank. The classifications are performed one time period before a merger to reflect the latest efficiency signal perceived by the market. Akhavein et al. (1997) indicate that the average profit efficiency scores of U.S. banks range from 25% to 65%, although cost and revenue efficiencies are significantly higher.

Our sample of acquirers and targets are matched when the merger is announced. Based on our classification scheme, our final sample consists of nine merger combinations. We expect each combination to cause the market to react in a unique way.[7] To examine if the market is reacting to the merger announcement, we match our sample of merging banks to a control group of non-merging banks according to size as measured by total assets. Following Healy et al. (1992), we match the non-merging (control) bank sample with the merging bank sample one year after the merger. According to Healy, this will ensure a fair future comparison with the control group. Efficiency scores will be compared before and after the merger.

[7] Acquirers' and targets market reactions are fully discussed in chapter six of this work.

Table 1: Summary of Operating Performance Studies

Panel A: Advantages and disadvantages of traditional operating performance studies.

Approach	Benefits	Shortcomings
Operating Performance Studies	-Compares the operating performance before and after mergers.	- Use accounting data.
- Cornett, McNutt, and Tehranian (2003); Gupta and Misra, (2004); DeYoung, et al. (2004); Bouwman (2004); DeYoung, Hunter, and Undell (2003), Carter and McNulty (2004); Rose (1987); Rhoades (1990).		- There are methodological problems with using performance ratios to measure cost and profit efficiencies because ratios do not control for differences in input prices and output mix.

Panel B: Advantages and disadvantages of improved operating performance studies.

Approach	Benefits	Shortcomings
Operating Performance Studies, using efficiency measures (DEA approach). Berger and Humphrey (1992); Rhoades(1997); Akhavein et al. (1997); Sharkas and Kabir (2004).	-Compares the operating performance before and after mergers. - The solution is derived from within the sample. - Controls for differences in input prices and output mix. - The efficiency measures can be broken down into more specific efficiency measures.	- Does not control for sample errors.

Table 2: Summary of Event Studies

Panel A: Advantages and disadvantages of traditional event studies.

Approach	Benefits	Shortcomings
Event Studies	-The methodology used is more standardized than the methodologies used in operating performance studies.	- Period specification around merger announcements vary greatly from study to study.
- Cornett, Hovakimian, Palia, and Tehranian (2003); Elyasiani and Deng (2004).	- Used mainly to analyze the stock return reaction (of acquiring and target firms) to merger announcements.	-The mixed/puzzling findings (which are generally due to sampling errors).

Panel B: Advantages and disadvantages of improved event studies.

Approach	Benefits	Shortcomings
Event studies with sub-sampling: DeLong (1999); DeLong (2001); Amihud et al. (2002).	- Sub-samples the population of merging banks according to specific characteristics in order to overcome puzzling effects that may due to mixing the samples.	- Period specification around merger announcements vary greatly from study to study.

IV. DATA, SAMPLE CHARACTERISTICS AND VARIABLE DEFINITIONS

4.1. Data and Sample Characteristics

We examine a sample of successful domestic public mergers occurring during the period 1992-2003. The sample of cash, mixed, and stock-for-stock mergers comes from the Securities Data Company's (SDC) U.S. Merger and Acquisition database. We select a sample of mergers and acquisitions with announcement dates between 1992 and 2003 and eliminate those with effective dates outside this period. All mergers in the sample were completed by December 2003. We consider only mergers where acquiring firms attain 100% of the shares of the target firm to enable the acquirer to re-allocate resources more efficiently, i.e., the target is de-listed after merger and is no longer a decision making unit. Further, we require that: (1) the acquirer and the target have SIC codes 6021 (banks, commercial: national), 6022 (banks, commercial: state), 6035 (banks, savings: federal), or 6036 (banks, savings: not federally chartered); (2) the transaction is completed; and (3) the acquirer and the target are both public firms with data available in the Center for Research in Security Prices data base (CRSP) for at least one year prior to the merger announcement date. The resulting sample includes some banks that engaged in multiple acquisitions during the sample period. We required that accounting and stock market data for both firms be available from the Compustat database and from CRSP. Also, the firms had to be in existence for at least one year prior to the merger announcement. This requirement is important for us to be able to classify mergers according to their efficiency scores achieved one year before the merger.

The data extracted from CRSP consists of market capitalizations of the acquirers and targets in addition to other variables used to obtain the efficiency scores. The market capitalization of a firm is the product of the total number of shares outstanding and the closing price per share as measured at the end of the year prior to the stock-for-stock merger announcement. The relative size is then measured as the ratio of the market capitalization of the acquirer to the market capitalization of the target bank.

Since the main purpose of this dissertation is to study the market reaction to merger announcements, we construct a set of control banks to which the acquiring banks are compared. For each bank in the sample, we find a control bank by searching the Compustat database for all firms with SIC codes 6000-6999. From this list of firms, we exclude the acquirers and targets that appear in any year of the sample period. We select a firm for the control group that has the same 4-digit SIC code as that of the acquiring bank with a market value greater than the acquirer's market value but not exceeding it by more than 25%. The final sample consists of 359 mergers. Table 3 shows the distribution of mergers over the study period.

Table 3: Summary Statistics of Cash, Stock, and Combination Mergers

	SDC				Final Sample			
Year	**Stock**	**Cash**	**Combination**	**Total**	**Stock**	**Cash**	**Combination**	**Total**
1992	7	1	1	**9**	5	1	1	**7**
1993	25	43	6	**74**	9	39	2	**50**
1994	31	1	6	**38**	24	0	3	**27**
1995	26	3	3	**32**	23	3	4	**30**
1996	25	9	7	**41**	21	8	6	**35**
1997	52	0	6	**58**	46	0	4	**50**
1998	38	2	2	**42**	31	1	2	**34**
1999	47	0	2	**49**	31	0	2	**33**
2000	23	1	5	**29**	17	1	4	**22**
2001	15	16	10	**41**	14	11	7	**32**
2002	3	0	11	**14**	1	0	10	**11**
2003	12	0	20	**32**	10	0	18	**28**
Total	**304**	**75**	**79**	**458**	**232**	**64**	**63**	**359**

As the table shows, most of the merger deals were accomplished by using the stock-for-stock method of acquisition, especially during the 1992-1997 period. Using a combination of stocks and cash has become more favorable since that time. Cash-only financing, however, is relatively rare. In fact, there were no cash deals in the last two years of the sample. The method of using a cash and stock combination, on the other hand, increased substantially in 2002 and 2003. In general, 65% of merger deals were stock-for-stock, 17.5% used cash only, and 17.5% used a combination of cash and stock, with stock accounting for a greater percentage of the total transaction value. One reason for the extensive use of stocks is suggested by the information asymmetry theory discussed in chapter two where acquirers use stock for stock financing when they believe that their stocks are over valued.

4.2. Bank Efficiency Variables

DEA needs a set of inputs and outputs in order to measure efficiency, and therefore, relative productivity. There are two main approaches to measure efficiency: the production approach and the intermediation approach (see Sealy and Lindley, 1997). In the production approach, outputs are measured as number of bills or processed transactions, and inputs are measured as capital or labor force, but not as interest expense. In contrast, the intermediation approach assumes that banks are considered brokers who transform financial resources into profits. This approach is more commonly used in the study of banking efficiency, and so, we adopt the intermediation approach in this study. Accordingly, we model commercial banks as multi-product firms, producing two outputs and employing three inputs. All variables are measured in millions of U.S. dollars except prices, which are measured as ratios.

The outputs include (1) net loans and (2) other earning assets, which consist of loans to special sectors, interbank loans, and investment securities (Treasuries and other securities). All output prices are estimated as proxies. These are calculated as follows: 1) the price of loans is defined as total interest income to net loans, and 2) the price of other operating income is defined as other operating income to other earning assets weighted by the proportion of other earning assets over the total of other earning assets plus off balance sheet items.

Inputs include (1) personnel expenses; (2) book value of premises and fixed assets; and (3) loanable funds, which is defined as the sum of demand and time deposits and non-deposit funds as of the end of the respective year. Also inputs prices are estimated as proxies. The price of labor is calculated as personnel expenses over total assets. The price of capital is calculated as non-interest expense over total assets. Finally, the price of funds is calculated as total interest expense over loanable funds.

Table 4 shows the summary statistics for the total input and output variables of targets, acquirers, and control banks. Panel A of Table 4 shows the absolute dollar value of input and output variables. To make the comparison easier, we divided each of the variable values in 2003 by its respective value in 1992. The results are shown in Panel B of Table 4. The results indicate that loans by acquirers had increased by 1300% when compared with 1992. This huge growth was complimented by an 800% growth in deposits. Loans by targets, on the other hand, had increased by 317%. This growth was complimented by a 228% increase in targets' deposits. Loans by control banks increased by 252% combined with a 221% increase in their deposits. This result is interesting because it clarifies that acquirers usually depend more on equity in running their businesses. The same result is indicated for the other earning assets where acquirers had increased their investment by 900%, while targets and control banks had increases in this category of only 255% and 501%, respectively. This result is also interesting because it shows that some banks (acquirers and control banks) were able to take advantage of the Graham-Leach-Bliley Act of 1997, which allowed banks to engage in investment banking activities.

Table 4: Summary Statistics of Input and Output Variables

Panel A: Summary Statistics of Input and Output Variables (millions of U.S. dollars)

		Net Loans	Other Earning Assets	Personnel Expenses	Fixed Assets	Deposits
1992	**Targets**	32384.140	11361.026	1441.619	864.699	45348.602
	Acquirers	44359.672	16461.305	2220.966	1759.355	72166.153
	Control	2057746.360	628092.757	68667.917	52293.037	2539060.872
1993	**Targets**	59781.355	28179.600	2478.037	1668.731	78995.545
	Acquirers	237504.823	102354.905	9210.410	6036.420	301744.604
	Control	2560273.104	840796.135	81624.213	66345.998	3059650.457
1994	**Targets**	41162.852	23749.576	1368.739	972.653	51658.306
	Acquirers	181032.243	68647.585	6035.107	4041.123	211192.288
	Control	2988152.657	1021552.537	94122.283	77881.755	3512706.621
1995	**Targets**	18811.355	13424.110	498.997	385.468	24880.870
	Acquirers	202753.427	70654.547	6214.644	4446.527	215269.891
	Control	3272007.679	1157550.794	107068.139	79979.061	3813369.289
1996	**Targets**	88730.843	35638.934	2395.439	1940.206	97764.289
	Acquirers	193673.264	66535.024	6002.423	4376.765	215995.052
	Control	3620418.362	1237120.741	115848.839	89019.018	4181415.349
1997	**Targets**	43604.598	17240.162	1142.941	1075.261	47444.579
	Acquirers	354143.964	127520.879	9333.761	6931.249	353955.770
	Control	3727177.084	1406157.121	122230.720	89656.356	4402039.543
1998	**Targets**	62638.931	28086.753	2002.851	1675.659	75350.127
	Acquirers	421257.069	171160.366	10918.988	7929.734	419583.190
	Control	4399297.518	1766488.944	150118.578	108159.536	5191643.304
1999	**Targets**	179861.811	45227.159	5646.307	3290.196	178630.942
	Acquirers	380657.756	123247.374	14144.422	8185.844	395635.367
	Control	5068112.369	2140701.645	165753.043	118986.177	5562257.267
2000	**Targets**	31815.567	10418.180	875.138	578.257	33335.930
	Acquirers	575776.255	184908.732	20127.919	10883.778	531828.528
	Control	6184481.320	2751574.055	200821.779	143506.611	6599088.928
2001	**Targets**	4940.826	1792.615	133.534	138.638	5684.517
	Acquirers	407663.966	149410.529	14109.019	8015.609	433553.386
	Control	7092299.308	3343526.371	219634.852	166213.983	7838389.165
2002	**Targets**	2300.901	2563.388	73.569	39.247	4091.785
	Acquirers	49744.381	14549.194	2034.203	1384.693	58407.713
	Control	8065761.963	3899872.141	235989.85	185364.577	9154674.014
2003	**Targets**	134904.236	40346.902	4635.848	2533.303	148895.093
	Acquirers	616983.024	160988.827	22199.200	9699.117	631671.542
	Control	7264942.840	3775541.920	220142.046	171644.621	8144540.172

table continued

Panel B: Growth Rates of Input and Output Variables for the Study Period, 1992-2003 (times)

		Net Loans	Other Earning Assets	Personnel Expenses	Fixed Assets	Deposits
(1992-03)	**Targets**	4.170	3.550	3.22	2.930	3.280
(1992-03)	**Acquirers**	13.9100	9.780	10.00	5.510	8.750
(1992-03)	**Control**	3.530	6.010	3.21	3.280	3.210

Inputs include: (1) personnel expenses; (2) book value of premises and fixed assets; and (3) loanable funds, which is defined as the sum of deposit (demand and time) and non-deposit funds as of the end of the respective year. The outputs include (1) net loans; and (2) other earning assets, which consist of loans to special sectors, interbank loans, and investment securities (Treasuries and other securities).

Looking at the cost side (inputs side), acquirers had increased their personnel expenses by 900% when compared with 1992, which is tremendously higher than the growth rates of personnel expenses of targets and control banks (220% increases for each). Acquirers also had increased their fixed assets by 450%, which is considerably higher than targets and control banks, which increased by 190% and 220%, respectively. This result looks consistent with Akhavein et al. (1997) and Rhoades (1997), who argue that consultants and managers are motivated more often by cost efficiency improvement than by any other motive.

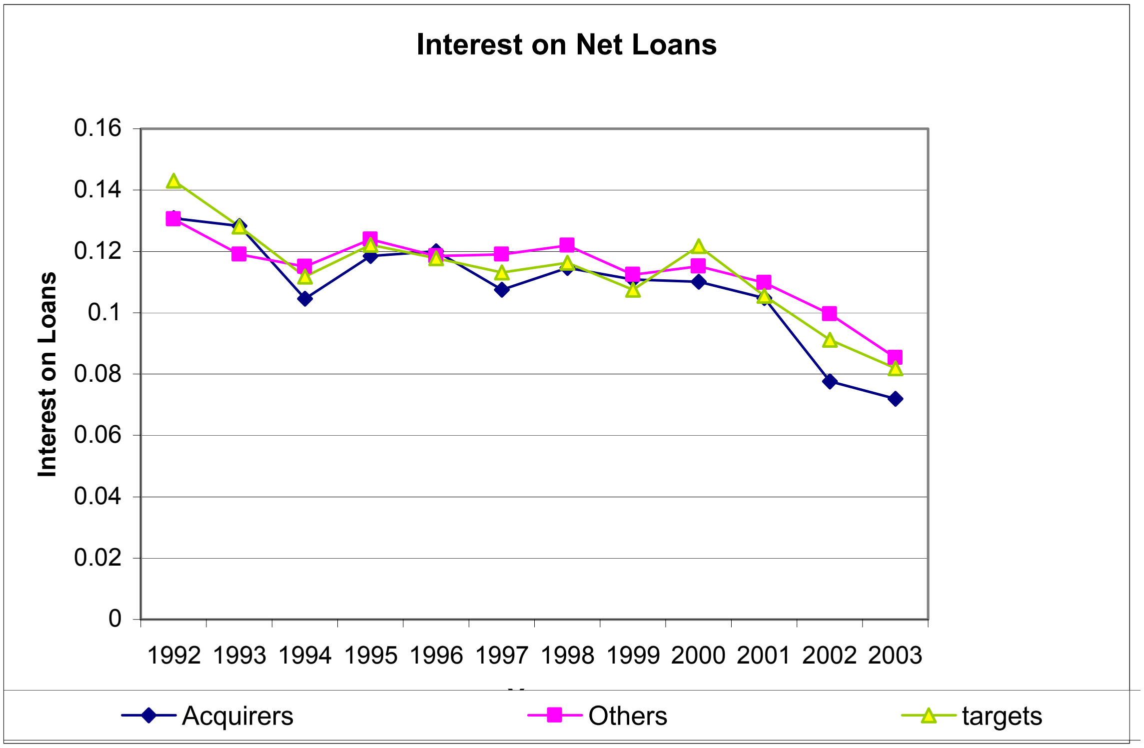
Table 5 shows the summary statistics of input and output prices. To make reading this table easier, we plotted all variables separately. In addition, we added an interest margin variable (interest on loans minus interest on deposits) to get a better grasp of each group's profitability from traditional banking activities. Starting with the price of loans, non-merging banks typically charged higher interest than acquirers and targets. This result appears for all years except 1992, 1993, and 1999 (see Figure 5). Ranked second, targets charged higher interest on loans than acquirers. This can be explained by the higher risk premium that smaller banks charge relative to larger banks. According to DeYoung, Hunter, and Udell (2003), small banks' access to "soft information" about their clients make them more accurate in determining customers' creditworthiness, especially in smaller communities where direct communication is more

Table 5: Summary Statistics of Input and Output Prices

		Loans	Other Earning Assets	Personnel Expenses	Fixed Assets	Deposits	Interest Margin
1992	**Targets**	0.143	0.020	0.026	0.013	0.060	0.083
	Acquirers	0.131	0.013	0.022	0.009	0.042	0.089
	Control	0.131	0.015	0.022	0.010	0.047	0.084
1993	**Targets**	0.128	0.010	0.017	0.010	0.044	0.085
	Acquirers	0.128	0.011	0.018	0.010	0.040	0.088
	Control	0.119	0.011	0.020	0.010	0.037	0.082
1994	**Targets**	0.112	0.008	0.017	0.008	0.042	0.070
	Acquirers	0.105	0.012	0.021	0.010	0.035	0.070
	Control	0.115	0.009	0.019	0.009	0.038	0.077
1995	**Targets**	0.122	0.007	0.018	0.008	0.046	0.077
	Acquirers	0.119	0.010	0.018	0.010	0.050	0.068
	Control	0.124	0.010	0.019	0.009	0.047	0.077
1996	**Targets**	0.118	0.008	0.017	0.008	0.050	0.068
	Acquirers	0.120	0.009	0.018	0.010	0.045	0.075
	Control	0.119	0.010	0.019	0.009	0.048	0.071
1997	**Targets**	0.113	0.007	0.016	0.009	0.051	0.062
	Acquirers	0.108	0.013	0.018	0.012	0.050	0.058
	Control	0.119	0.011	0.019	0.010	0.050	0.070
1998	**Targets**	0.116	0.010	0.019	0.010	0.045	0.071
	Acquirers	0.115	0.013	0.018	0.012	0.052	0.063
	Control	0.122	0.012	0.019	0.010	0.050	0.072
1999	**Targets**	0.108	0.010	0.019	0.011	0.046	0.062
	Acquirers	0.111	0.016	0.021	0.013	0.045	0.066
	Control	0.112	0.011	0.019	0.010	0.049	0.063
2000	**Targets**	0.122	0.004	0.018	0.007	0.052	0.070
	Acquirers	0.110	0.015	0.020	0.013	0.052	0.058
	Control	0.115	0.011	0.019	0.010	0.069	0.046
2001	**Targets**	0.106	0.007	0.017	0.009	0.048	0.058
	Acquirers	0.105	0.011	0.018	0.011	0.044	0.061
	Control	0.110	0.012	0.018	-0.004	0.054	0.056
2002	**Targets**	0.091	0.011	0.014	0.009	0.015	0.076
	Acquirers	0.078	0.020	0.023	0.011	0.019	0.059
	Control	0.100	0.013	0.019	0.010	0.037	0.063
2003	**Targets**	0.082	0.013	0.020	0.010	0.025	0.057
	Acquirers	0.072	0.014	0.018	0.010	0.023	0.049
	Control	0.085	0.014	0.020	0.015	0.026	0.059

The price of labor is calculated as personnel expenses over total assets. The price of capital is calculated as non-interest expense over total assets. The price of funds is calculated as total interest expense over loanable funds. The price of loans is determined as total interest income over net loans. The price of other operating income is defined as the ratio of other operating income to other earning assets. Interest margin is the difference between the interest paid on loans and the interest paid on deposits.

Figure 5: Interest on Loans of Targets, Acquirers, and Control Banks



feasible. On the other hand, they argue that large banks have better access to "hard information" and have a comparative advantage gained by the use of new technology in their operations. This advantage of capital intensity in banking operations allows large banks to gain more economies of scale in their operations while sacrificing accuracy in evaluating customers' creditworthiness.

On the other hand, interest paid on deposits is higher in non-merging banks than in either acquirers or targets for the period from 1999 to 2003. For earlier years, we find no clear difference between groups (see Figure 6). To have a more complete idea of the profits generated from traditional banking activities, we added an interest margin variable to our summary statistics variables (Column 6 of Table 5). Figure 7 shows that for the period 1999-2003, targets were achieving the highest interest margin. One explanation for this could be that the small banks tend to depend more on lending activities relative to other banks. Actually, the passage of Graham-Leach-Bliley Act in 1997 may have facilitated this result by enticing banks with

Figure 6: Interest Paid on Deposits of Targets, Acquirers, and Control Banks

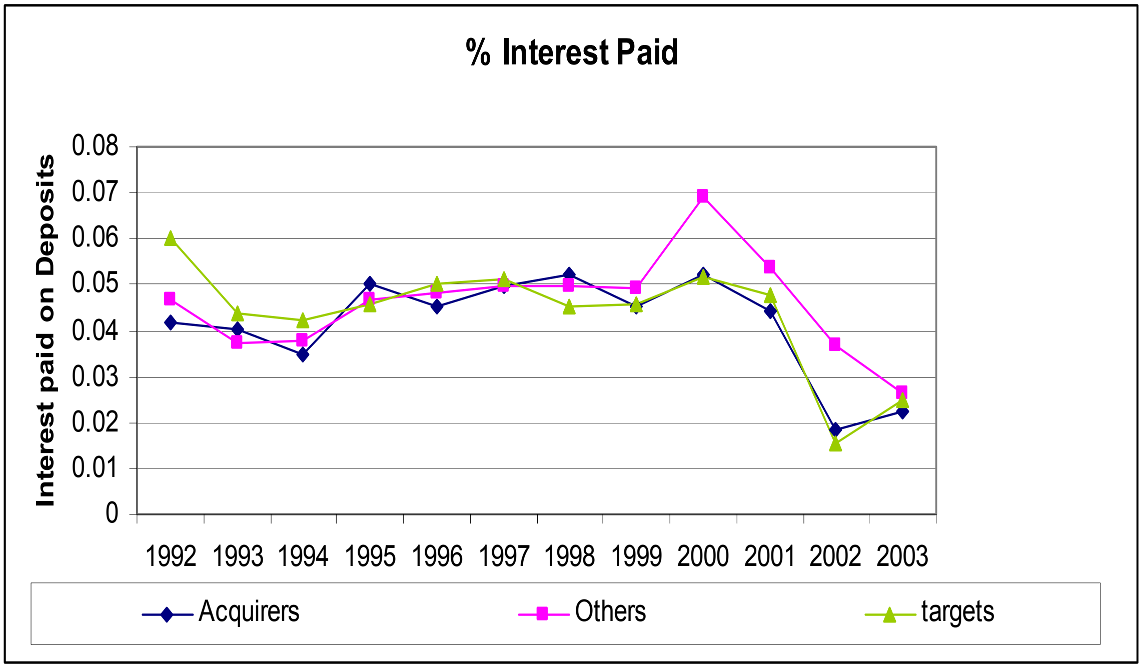
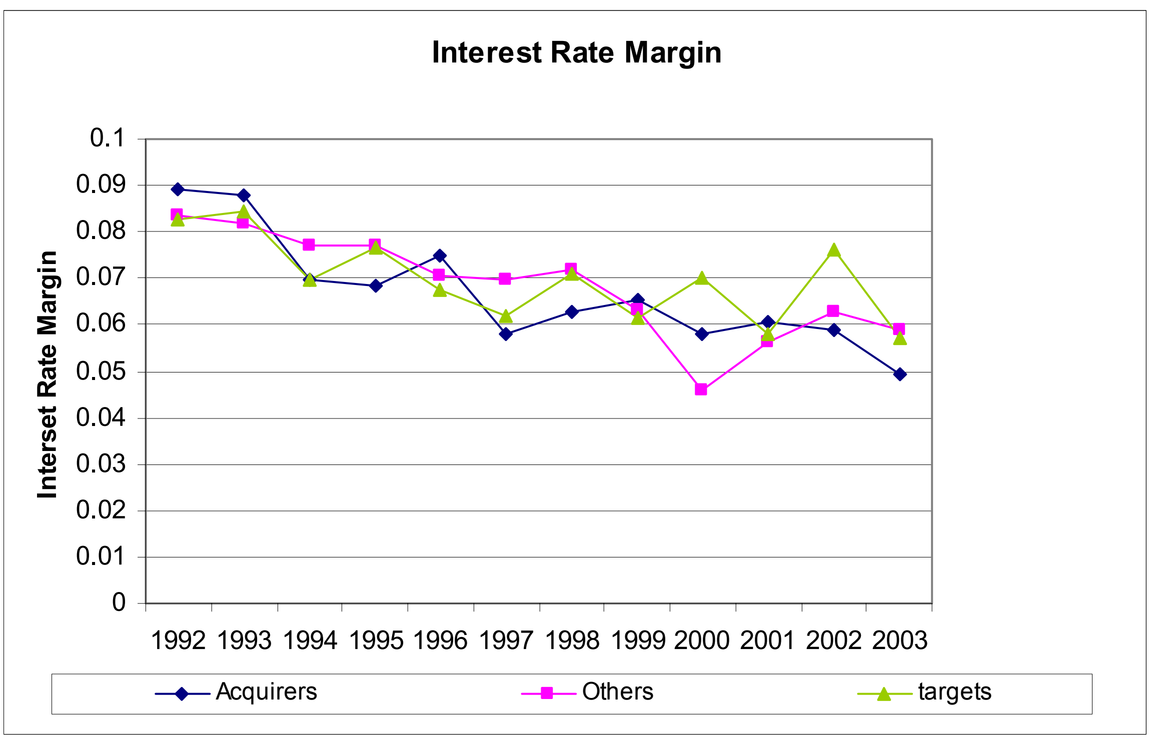


Figure 7: Interest Rate Margin for Targets, Acquirers, and Control Banks



sufficient resources to invest more in capital markets, while small banks remained focused on traditional banking activities. This result is supported by the return on other earning assets (investment). Exhibited in Figure 8, and consistent with our previous discussion, acquirers have the highest return on investment. Ranked second, control banks appear to be balanced in their investment and banking policies. Except for 1992, targets are ranked last in return on investment. It appears that acquirers have a comparative advantage in non-traditional banking activities over targets, but targets have a comparative advantage in traditional banking activities over acquirers.

Figure 8: Rate of Return on Other Earning Assets of the Targets, Acquirers, Control Banks

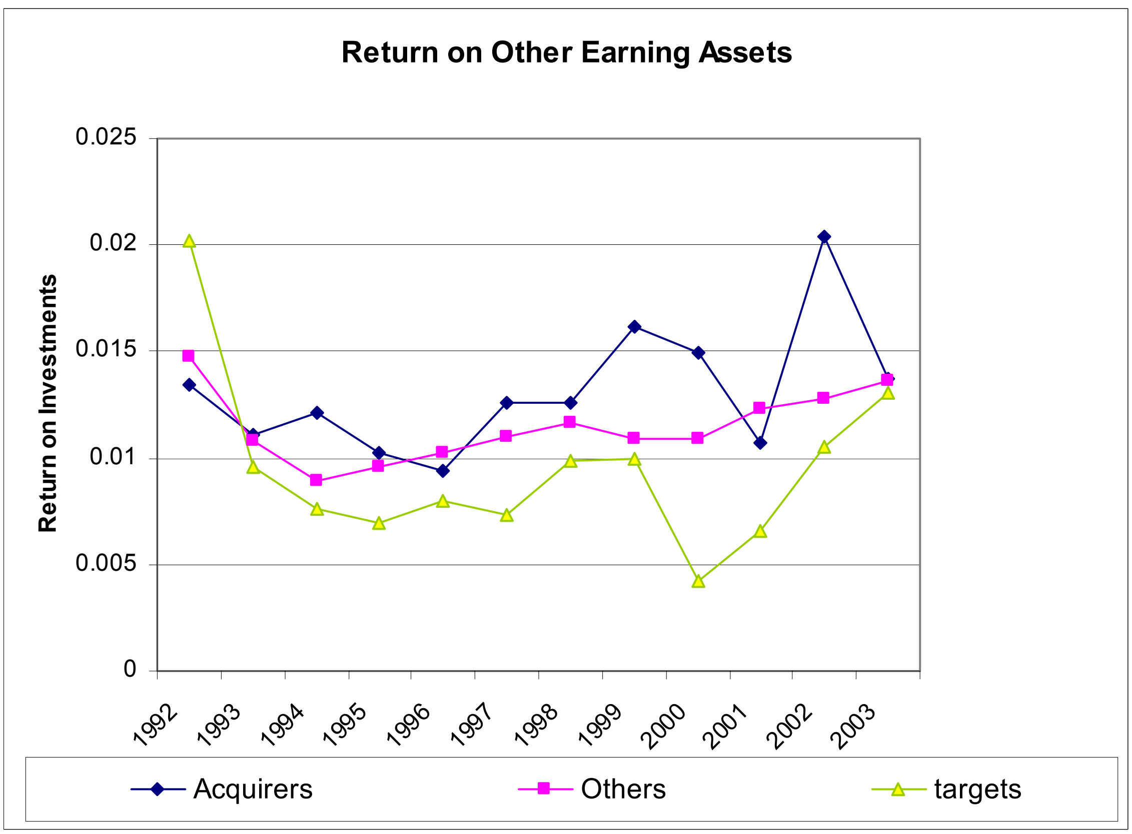
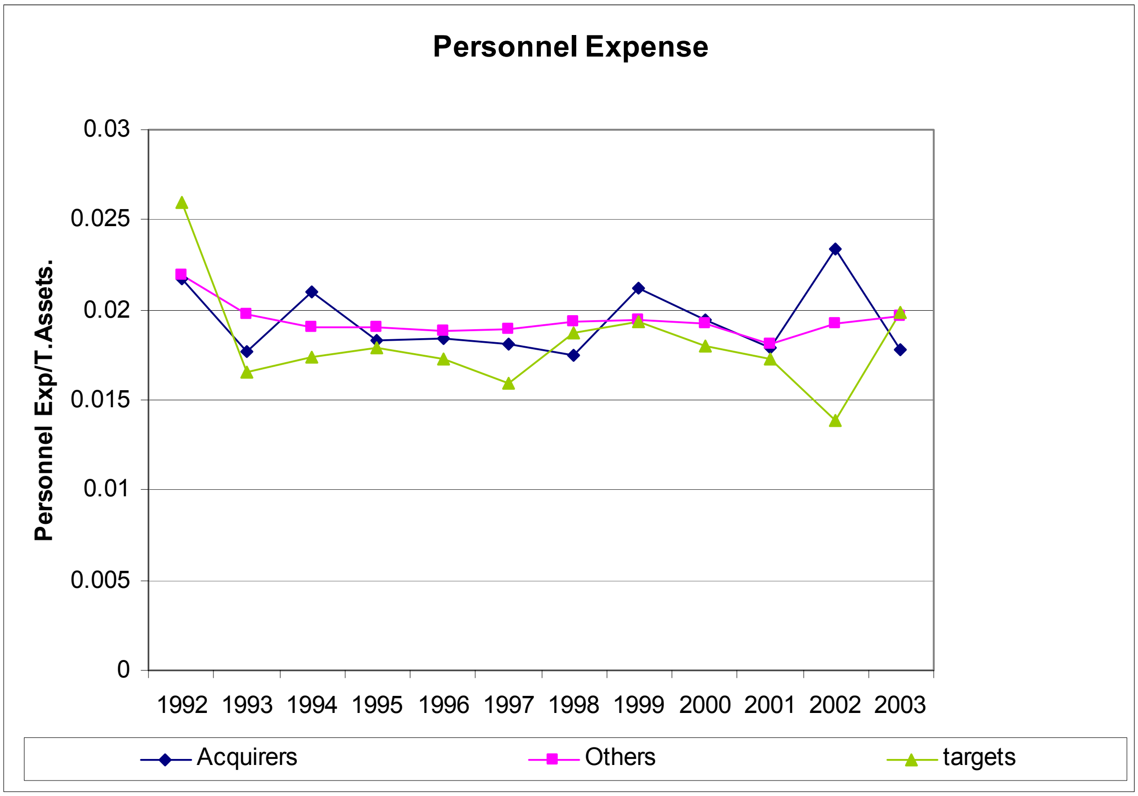


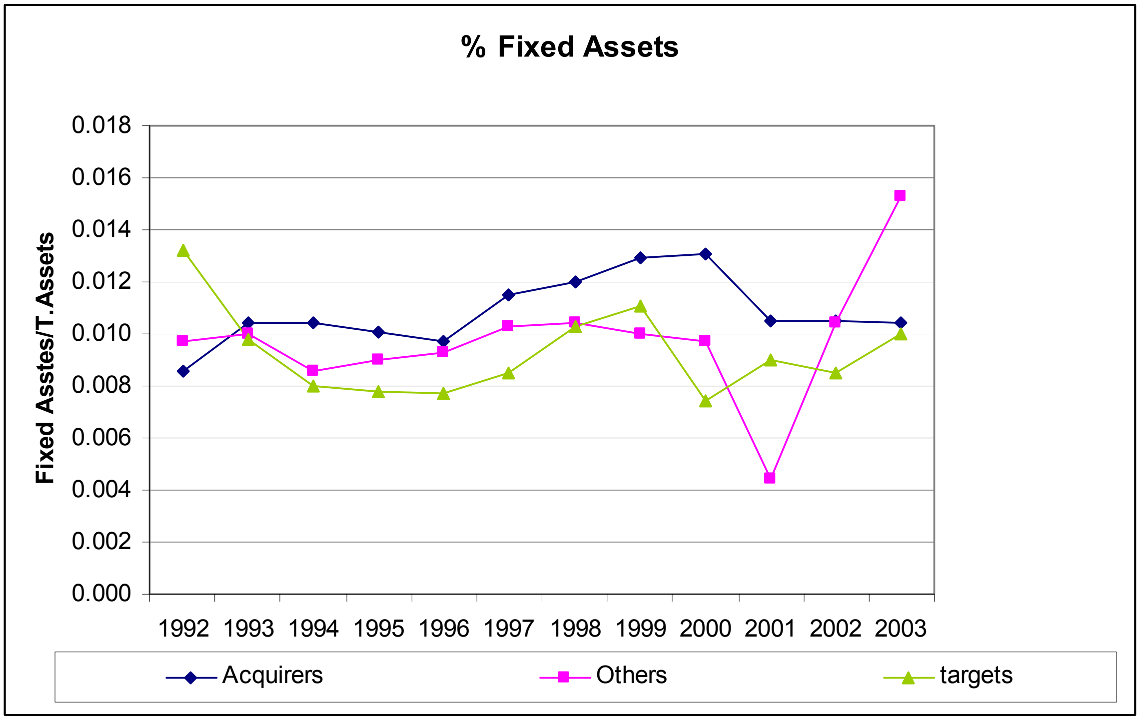
Figure 9 shows a comparison of personnel expenses to total assets (price of labor). Targets achieved the lowest labor price, except for in 1992 and 2003. In these years, acquirers achieved the lowest price. In contrast, control banks maintained a smooth, stable trend for the whole period. This result supports the cost minimization motive of mergers, where acquirers choose targets that have lower operating costs.

Figure 9: Personnel Expense of Targets, Acquirers, and Control Banks



Finally, Figure 10 shows the percentage of fixed assets to total assets. Acquirers have the highest ratio, while targets have the lowest ratio. One reason for this is the geographic dispersion of large banks.

Figure 10: Rate of Return on Other Earning Assets of Targets, Acquirers, and Control Banks



V. EMPIRICAL FINDINGS ON EFFICIENCY CONCEPTS

In this section, we discuss the summary statistics of cost, technical, pure technical, scale, allocative, revenue, and profit efficiency scores for acquirers, targets, and control banks for the period from 1992 to 2003. These results were obtained from the DEA linear programming problems solved for each bank. Our results are derived from efficient frontiers constructed separately for each year. Table 6 shows the number of banks included in constructing our annual frontiers. Unlike much of previous literature (see Berger and Humphrey, 1992; Rhoades, 1997; and Akhavein et al., 1997), we included the largest possible sample of non-merging banks. This is crucially important because we argue that the market distinguishes the efficiency characteristics relative to the whole industry even before the merger is announced. In other words, acquirers and targets cannot be matched with each other in one frontier because they were not yet recognized by the market as a pair. Accordingly, the more banks that we can include in determining the efficient frontier, the more reliable the efficiency scores will be.

Table 6: Number of Banks Used to Construct the Non-parametric Efficient Frontier, 1991-2002

Year	Stock	Cash	Combination	Number of Merger Deals	Non- Merging Banks	Efficient Frontier
1992	5	1	1	**7**	149	**156**
1993	9	39	2	**50**	102	**152**
1994	24	0	3	**27**	539	**566**
1995	23	3	4	**30**	561	**591**
1996	21	8	6	**35**	542	**577**
1997	46	0	4	**50**	518	**568**
1998	31	1	2	**34**	497	**531**
1999	31	0	2	**33**	501	**534**
2000	17	1	4	**22**	564	**586**
2001	14	11	7	**32**	548	**580**
2002	1	0	10	**11**	571	**582**
2003	10	0	18	**28**	548	**576**

Our efficiency analysis is fully discussed in the following three sections. In the first section, the efficiency characteristics of merging and non-merging banks for the whole study period are examined. The efficiency changes following the merger event are discussed in detail in the second section. We chose two methods to determine the efficiency changes. The first is using the time trend of the efficiency scores considering the year of merger as the base year. The second is by using large and small banks as control banks to compare it with these banks. We further applied the Malmquist total productivity index for mergers of large and small merging banks combined with the peer groups of each size. As mentioned earlier, the Malmquist total productivity index is used to check if the efficiency improvement is derived from efficiency change and/or from technology change. Finally, the last section of this chapter discusses the efficiency changes of the nine merger combinations we presented earlier, where the profit efficiency scores will be deducted for each efficiency pair for the four years following the merger event. This section is crucially important because it enables us to judge if the market reaction is derived from the expectations about the future cash flows of the merger, and if the market can distinguish between the profit efficiency characteristics of the merger parties.

Tables 7 through 13 show the efficiency results of all groups. To make comparison easier, we present the results in Figures 11 through 17.

5.1. The Efficiency Characteristics of Merging and Non-merging Banks

In this section, we describe the efficiency characteristics of acquirers, targets, and non-merging banks as of the year of merger. We first describe the cost efficiency of each party, and then we attempt to explain the source of the increased or decreased cost efficiency of each party by breaking down the cost efficiency concept into its more basic efficiency determinants. Next, revenue efficiency will be also compared between groups to determine which party has the greater ability to generate revenues. Finally, profit efficiency is also investigated for merging and non-merging banks.

5.1.1. Cost, Technical, Pure technical, Scale, and Allocative Efficiencies

In this section, we discuss the cost efficiency results and the other related efficiency measures. Table 7 shows the average cost efficiency scores of acquirers, targets, and non-merging banks. Acquirers maintain the highest cost efficiency until 1998, when the whole sector experienced a substantial decrease in cost efficiency. The comparison between 1992 and 2003 indicates that acquirers achieved 58% and 31% efficiency scores, respectively. This means that acquirers were able to reduce the waste in inputs by 42% in 1992 and by 69% in 2003. Targets and non-merging banks, on the other hand, look very similar in terms of cost efficiency and time trends. However, the minimum efficiency scores were always reported within non-merging banks. Figure 11 shows the trend of cost efficiency and the industry-wide decrease in cost efficiency scores.

To understand the source of loss in cost efficiency, we use Equations 1a and 1b to break down the cost efficiency concept into its more basic components, technical efficiency and allocative efficiency:

$$CE = TE \times AE \qquad (1a)$$

$$CE = PTE \times SE \times AE \qquad (1b)$$

where the first equation shows that cost efficiency is a product of technical efficiency (TE), which represents the ability of the bank to achieve the maximum output for a given input level, and allocative efficiency (AE), which indicates the management's success in constructing an optimal product mix, given their respective prices. Equation 1b decomposes further the technical efficiency into pure technical efficiency (PTE), which represents the proportional reduction in input usage if inputs are not wasted, and the scale efficiency (SE), which indicates the proportional output reduction if the bank achieves constant returns to scale (CRS).

Table 8 shows the average annual technical efficiency scores for all groups. In general, the technical efficiency scores look very similar. In other words, all the banks have essentially the same ability to achieve the optimal output, given their input levels. Figure 12 depicts this and shows the loss in technical efficiency over the study period. However, this steady smooth decrease is not enough to explain the significant loss of cost efficiency.

Table 7: The Non-parametric Cost Efficiency Scores of Targets, Acquirers, and Control Banks

	Target			Acquirer			Control		
	Mean	Standard Error	Min	Mean	Standard Error	Min	Mean	Standard Error	Min
1992	0.6041	0.0884	0.4831	0.5869	0.0760	0.4671	0.6131	0.1525	0.2379
1993	0.5676	0.1136	0.4061	0.5957	0.1286	0.4081	0.5563	0.1361	0.2626
1994	0.5040	0.1039	0.3749	0.5528	0.1214	0.3933	0.4764	0.1260	0.2569
1995	0.5014	0.1321	0.3279	0.5934	0.1631	0.3315	0.4991	0.1481	0.0660
1996	0.4965	0.1654	0.3218	0.5026	0.1452	0.3236	0.4914	0.1531	0.1719
1997	0.4933	0.1573	0.3000	0.5735	0.1557	0.2897	0.5018	0.1471	0.2646
1998	0.5006	0.1190	0.2893	0.5328	0.1408	0.3400	0.4859	0.1440	0.0987
1999	0.4596	0.1084	0.3048	0.2513	0.1506	0.1144	0.2675	0.1559	0.0637
2000	0.2276	0.1044	0.1002	0.1790	0.1170	0.0744	0.1258	0.1286	0.0168
2001	0.1174	0.0812	0.0372	0.2576	0.1172	0.0445	0.2943	0.1347	0.0674
2002	0.2306	0.0550	0.0971	0.2799	0.0846	0.1960	0.3293	0.1391	0.0924
2003	0.3133	0.1161	0.2026	0.3088	0.1277	0.2007	0.3330	0.1474	0.1068

The non-parametric cost efficiency scores of targets, acquirers, and other non-merging banks. The cost minimization problem is solved according to Equation 5. The cost efficiency scores presented in this table are obtained by the following equation:

$$CE = \frac{\sum_{i=1}^{m} p_i x_i^*}{\sum_{i=1}^{m} p_i x_i} = \frac{\text{Minimum virtual cost}}{\text{Observed cost}} \leq 1$$

where p_i is the price of input *i*, x^* is the optimal input quantity and x_i is the actual inputs quantity. The cost efficiency score will be one for DMUs on the efficient frontier. The cost efficiency scores take values in the range (0,1).

Figure 11: The Non-parametric Cost Efficiency Scores of Targets, Acquirers, and Control Banks

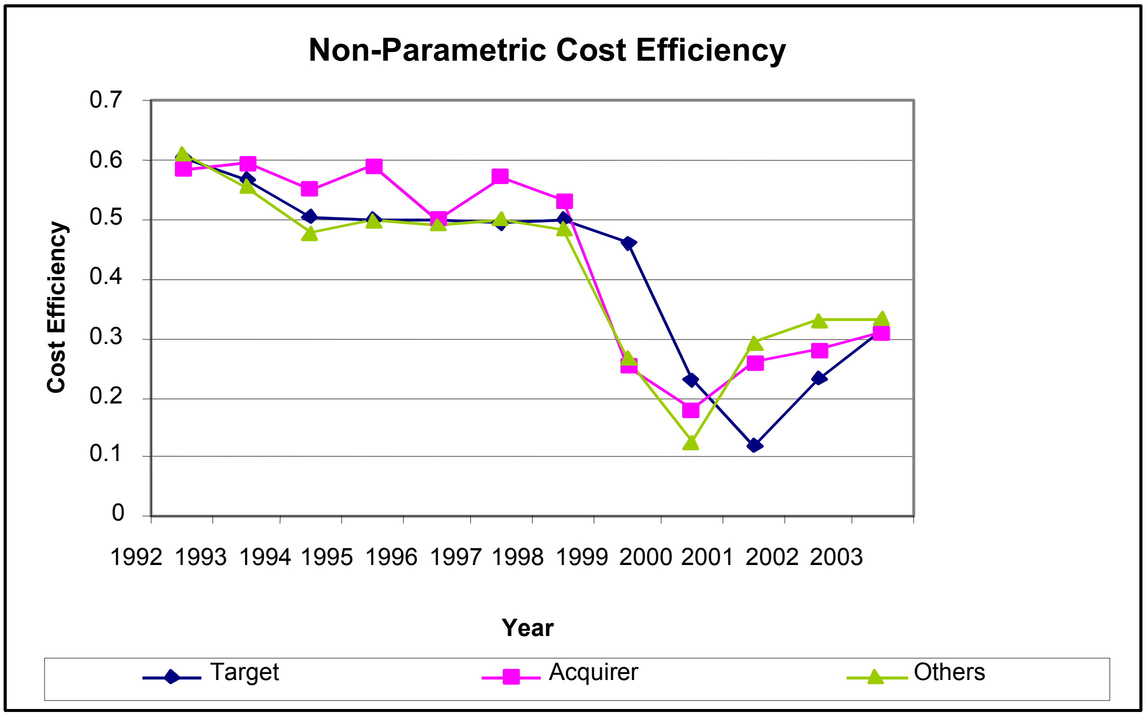


Figure 12: The Non-parametric Technical Efficiency Scores of Targets, Acquirers, and Control Banks

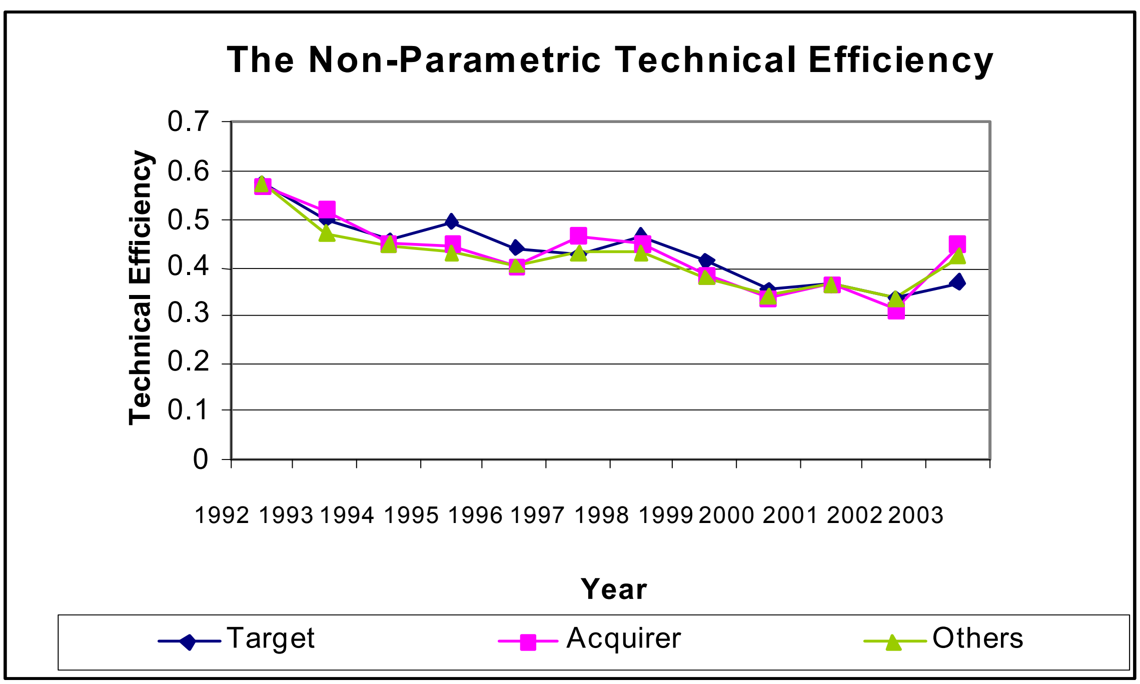


Table 8: The Non-parametric Technical Efficiency Scores of Targets, Acquirers, and Control Banks

	Target			Acquirer			Control		
	Mean	Standard Error	Min	Mean	Standard Error	Min	Mean	Standard Error	Min
1992	0.5741	0.0768	0.4789	0.5699	0.0528	0.4678	0.5746	0.1314	0.2448
1993	0.5003	0.1125	0.3785	0.5158	0.1323	0.3785	0.4687	0.0948	0.2268
1994	0.4543	0.0740	0.3598	0.4528	0.0612	0.3780	0.4465	0.1068	0.1932
1995	0.4938	0.1484	0.3130	0.4451	0.1058	0.3283	0.4304	0.1217	0.2140
1996	0.4423	0.1522	0.3057	0.4004	0.1156	0.2804	0.4050	0.1053	0.1538
1997	0.4246	0.1056	0.2867	0.4666	0.0909	0.2952	0.4305	0.1156	0.2106
1998	0.4628	0.1328	0.2942	0.4516	0.0922	0.3463	0.4298	0.1141	0.0759
1999	0.4138	0.0847	0.2659	0.3814	0.0674	0.2748	0.3811	0.1239	0.0783
2000	0.3552	0.0599	0.2590	0.3355	0.0540	0.2330	0.3384	0.1231	0.1139
2001	0.3623	0.1335	0.1821	0.3667	0.1113	0.2761	0.3641	0.1256	0.0730
2002	0.3340	0.0746	0.2391	0.3102	0.0535	0.2372	0.3373	0.1344	0.0596
2003	0.3678	0.1603	0.2270	0.4477	0.1225	0.2898	0.4243	0.1325	0.0473

The non-parametric technical efficiency (TE) scores of targets, acquirers, and other non-merging banks. The input-oriented TE problem is solved according to Equation 3, assuming constant returns to scale. The TE scores presented in this table are obtained as follows:

$$TE = \frac{\sum_{i=1}^{m} x_i^*}{\sum_{i=1}^{m} x_i} = \frac{\text{Minimum virtual inputs quantity}}{\text{Observed inputs quantity}} \leq 1.$$

The TE score is one for DMUs on the efficient frontier. TE scores take values in the range (0,1).

Table 9 shows the pure technical efficiency results. Acquirers dominated the other two groups for the entire study period, except for the last two years. Between 1992 and 2003, acquirers lost 13% (61.1%-48.8) of their efficiency and non-merging banks lost 15% (63.7-48.6). In opposition to this trend, targets achieved steady efficiency improvements over the study period. They began with an 18% efficiency score in 1992, and concluded the study period with a score of 44% in 2003. However, targets had the minimum technical efficiency for all years. Figure 13 shows the pure technical efficiency trend over the years. Scale efficiency, on the other hand, remains steady over time for all groups. Table 10 and Figure 14 show the results of the scale efficiency analysis. Summing up, the slight decrease in technical efficiency scores appears to be due to pure technical efficiency loss over time. For example, acquirers and non-merging banks are wasting more inputs without enhancing the output level. However, pure technical efficiency is still not enough to explain the cost efficiency loss reported in 1999 and thereafter.

Figure 13: The Non-parametric Pure Technical Efficiency Scores of Targets, Acquirers, and Control Banks

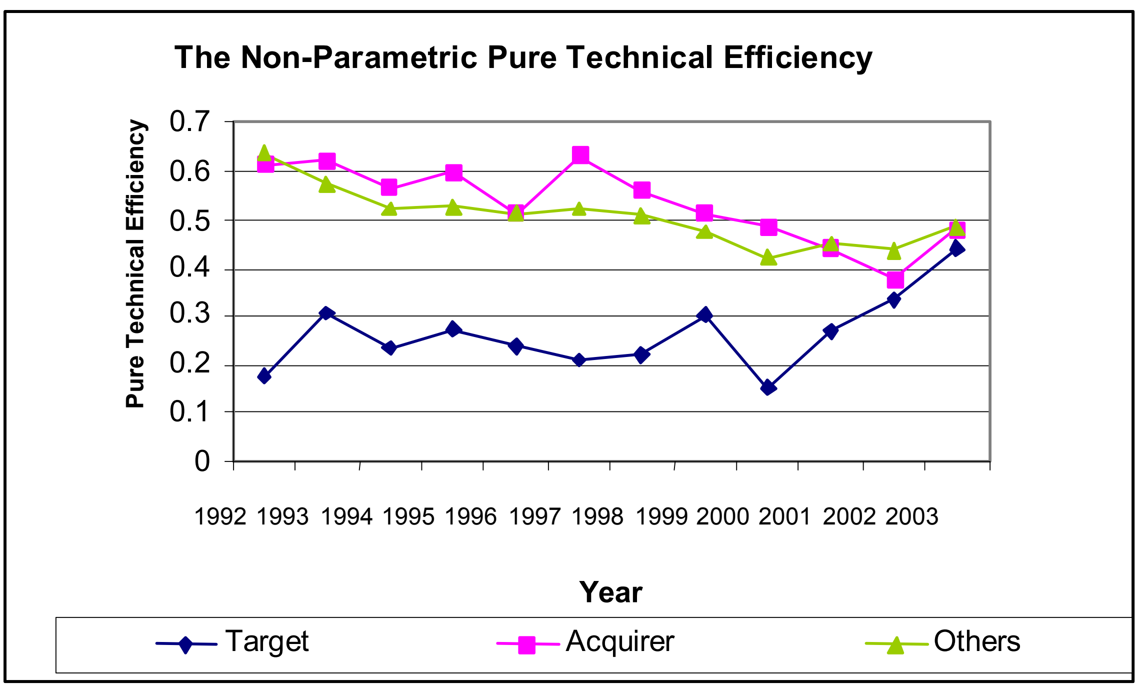


Table 9: The Non-parametric Pure Technical Efficiency Scores of Targets, Acquirers, and Control Banks

	Target			Acquirer			Control		
	Mean	Standard Error	Min	Mean	Standard Error	Min	Mean	Standard Error	Min
1992	0.1769	0.0456	0.1411	0.6114	0.0698	0.4694	0.6370	0.1664	0.2453
1993	0.3084	0.1735	0.1267	0.6247	0.1532	0.4083	0.5752	0.1476	0.2645
1994	0.2354	0.1198	0.1583	0.5678	0.1287	0.3991	0.5207	0.1601	0.2843
1995	0.2751	0.1037	0.1340	0.6003	0.1665	0.3437	0.5281	0.1665	0.3097
1996	0.2403	0.0843	0.1265	0.5126	0.1582	0.3263	0.5120	0.1652	0.1804
1997	0.2119	0.1388	0.0706	0.6306	0.1978	0.2953	0.5237	0.1625	0.2953
1998	0.2195	0.1501	0.0963	0.5587	0.1744	0.3476	0.5105	0.1637	0.1036
1999	0.3025	0.2136	0.0639	0.5133	0.1486	0.3048	0.4750	0.1808	0.1096
2000	0.1531	0.1140	0.0377	0.4844	0.1775	0.2411	0.4228	0.1870	0.1279
2001	0.2668	0.0858	0.0706	0.4409	0.1815	0.2972	0.4521	0.1711	0.0926
2002	0.3368	0.0548	0.2856	0.3802	0.1037	0.2457	0.4350	0.1812	0.0944
2003	0.4400	0.0348	0.1174	0.4808	0.1420	0.2997	0.4863	0.1633	0.1231

The non-parametric pure technical efficiency (PTE) scores of targets, acquirers, and other non-merging banks. The input-oriented PTE problem is solved according to Equation 3, assuming variable returns to scale. The PTE scores presented in this table are obtained as follows:

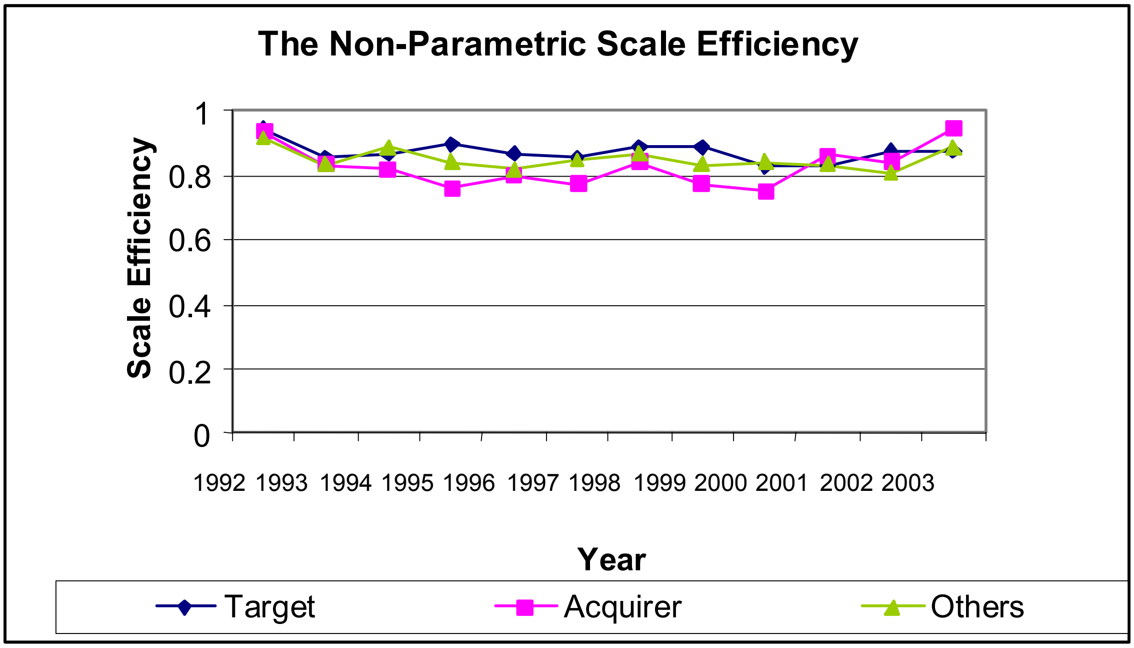
$$PTE = \frac{\sum_{i=1}^{m} x_i^*}{\sum_{i=1}^{m} x_i} = \frac{\text{Minimum virtual inputs quantity}}{\text{Observed inputs quantity}} \leq 1.$$ The PTE score is one for DMUs on the efficient frontier. PTE scores take values in the range $(0,1)$.

Table 10: The Non-parametric Scale Efficiency Scores of Targets, Acquirers, and Other Non-merging Banks

	Target			Acquirer			Control		
	Mean	Standard Error	Min	Mean	Standard Error	Min	Mean	Standard Error	Min
1992	0.9429	0.0324	0.9073	0.9371	0.0757	0.8003	0.9166	0.1000	0.4799
1993	0.8570	0.1286	0.5237	0.8375	0.1224	0.5237	0.8369	0.1333	0.3646
1994	0.8684	0.1280	0.5061	0.8240	0.1473	0.5688	0.8870	0.1446	0.1932
1995	0.8970	0.1144	0.5017	0.7617	0.1311	0.5434	0.8407	0.1473	0.2728
1996	0.8723	0.1236	0.4155	0.8022	0.1361	0.5941	0.8238	0.1585	0.2849
1997	0.8576	0.1201	0.4256	0.7742	0.1367	0.5019	0.8489	0.1488	0.2802
1998	0.8931	0.1162	0.4454	0.8408	0.1364	0.5785	0.8680	0.1399	0.3292
1999	0.8906	0.1253	0.4021	0.7729	0.1256	0.4764	0.8334	0.1497	0.2050
2000	0.8316	0.1520	0.4764	0.7517	0.1877	0.4356	0.8409	0.1601	0.1290
2001	0.8375	0.1394	0.4054	0.8609	0.1029	0.6044	0.8333	0.1504	0.3143
2002	0.8753	0.0726	0.7456	0.8413	0.1341	0.5164	0.8062	0.1667	0.2052
2003	0.8739	0.1492	0.4217	0.9445	0.1111	0.4864	0.8895	0.1290	0.2535

The non-parametric scale efficiency (SE) scores of targets, acquirers, and other non-merging banks. The input-oriented SE problem is solved by Equation 4, where $SE = \frac{TE}{PTE}$, where TE is the technical efficiency score, and PTE is the pure technical efficiency score. The SE score is one for DMUs on the efficient frontier. SE scores take on values in the range (0,1).

Figure 14: The Non-parametric Scale Efficiency Scores of Targets, Acquirers, and Control Banks



The last possible explanation of the cost efficiency trend is the loss in the allocative efficiency. Table 11 reports the allocative efficiency for the three subsamples. The results show that since 1992, acquirers have lost 32% (.96-.64)of their allocative efficiency, targets have lost 23% (.99-.76), and non-merging banks have lost 28% (.97-.68). This loss of allocative efficiency is significant enough to explain the cost efficiency loss. Figure 16 shows the trend in allocative efficiency. Figures 11 and 16 show that the trends of cost and allocative efficiency are similar. This result indicates that banks became less efficient in allocating their resources over time, and moved further and further away from achieving the optimal mix of inputs and outputs. One explanation for this result is the implementation of the Graham-Leach-Bliley Act in 1997. Because of this new regulation, managers found themselves challenged with new investment choices that were not available before.

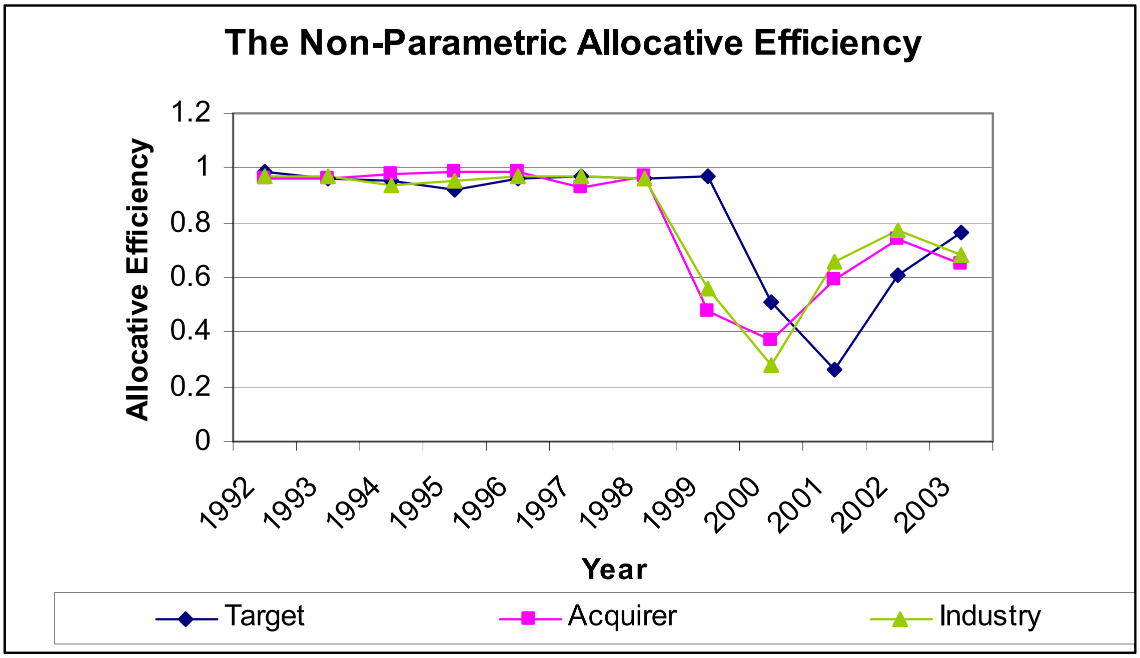
Table 11: The Non-parametric Allocative Efficiency Scores of Targets, Acquirers, and Control Banks

	Target			Acquirer			Control		
	Mean	Standard Error	Min	Mean	Standard Error	Min	Mean	Standard Error	Min
1992	0.9902	0.0035	0.9833	0.9607	0.0654	0.8274	0.9693	0.0751	0.5406
1993	0.9638	0.0652	0.6462	0.9626	0.0679	0.6462	0.9716	0.0595	0.4864
1994	0.9494	0.0855	0.6811	0.9757	0.0395	0.7987	0.9343	0.1141	0.3748
1995	0.9178	0.1156	0.5910	0.9890	0.0117	0.9455	0.9569	0.1002	0.1661
1996	0.9655	0.0475	0.8119	0.9838	0.0242	0.9049	0.9673	0.0781	0.3302
1997	0.9728	0.0693	0.6084	0.9249	0.0838	0.7237	0.9659	0.0672	0.3977
1998	0.9642	0.0718	0.6234	0.9664	0.0642	0.7337	0.9616	0.0752	0.4318
1999	0.9715	0.0386	0.8244	0.4788	0.2015	0.2105	0.5564	0.1637	0.1737
2000	0.5083	0.1418	0.2537	0.3704	0.1794	0.1594	0.2823	0.1464	0.0251
2001	0.2670	0.1210	0.1024	0.5936	0.1324	0.1273	0.6549	0.1248	0.1332
2002	0.6081	0.1260	0.3295	0.7410	0.1358	0.5115	0.7759	0.1409	0.2788
2003	0.7610	0.1423	0.3479	0.6453	0.1754	0.3592	0.6862	0.1499	0.2074

The non-parametric allocative efficiency (AE) scores of targets, acquirers, and other non-merging banks. The AE scores presented in this table are obtained by the following equation:

$CE = TE \times AE \Rightarrow AE = \dfrac{CE}{TE}$ where CE is the cost efficiency and TE is the technical efficiency. The AE score is one for DMUs on the efficient frontier. AE scores take values in the range (0,1).

Figure 15: The Non-parametric Allocative Efficiency Scores of Targets, Acquirers, and Control Banks



5.1.2. Revenue Efficiency Results

Revenue efficiency indicates how efficient the bank is in maximizing its output level, holding prices fixed. Revenue efficiency results are presented in Table 12. The results show that acquirers lost 11% (.56-.45) of their revenue efficiency between 1992 and 2003. Similar results are reported for non-merging banks, who lost 18% (.42-.60), and for targets, who lost 32% (.61-.29), during the same time period. However, Figure 16 shows that acquirers have persistently higher efficiency scores than others. As we mentioned in section 4.2, this revenue efficiency advantage may be due to the higher returns on other earning assets (investments) rather than higher interest charges on loans. Figures 8 and 16 show this. Furthermore, Figure 16 shows an interesting result about the management style of acquirers. While targets and non-merging banks kept a smooth decreasing efficiency trend over time, acquirers were more active in enhancing their product mix and waste rates. This result can be considered as evidence of active management of acquiring banks.

Table 12: The Non-parametric Revenue Efficiency Scores of Targets, Acquirers, and Other Non-merging Banks

	Target			**Acquirer**			**Control**		
	Mean	Standard Error	Min	Mean	Standard Error	Min	Mean	Standard Error	Min
1992	0.6116	0.0901	0.4858	0.5638	0.0928	0.4307	0.6034	0.1614	0.1631
1993	0.4544	0.1214	0.1334	0.4797	0.1359	0.1334	0.4664	0.1630	0.1385
1994	0.3965	0.1324	0.1133	0.5405	0.1194	0.3443	0.3977	0.1624	0.0839
1995	0.4146	0.1640	0.2133	0.4896	0.1832	0.1308	0.3834	0.1702	0.0627
1996	0.3324	0.1535	0.1308	0.3927	0.1580	0.1159	0.3787	0.1744	0.0827
1997	0.3600	0.1475	0.1937	0.5378	0.1905	0.2362	0.3761	0.1679	0.1152
1998	0.3357	0.0997	0.2123	0.4937	0.1734	0.2280	0.3742	0.1622	0.0417
1999	0.3328	0.1066	0.1998	0.4924	0.1609	0.2096	0.3662	0.1766	0.0508
2000	0.3700	0.1485	0.2041	0.4540	0.2050	0.1624	0.3280	0.1736	0.0381
2001	0.3084	0.1699	0.1269	0.3517	0.1276	0.2142	0.3545	0.1505	0.0653
2002	0.2856	0.0451	0.2101	0.3676	0.1005	0.2253	0.3328	0.1720	0.0291
2003	0.2920	0.0803	0.1557	0.4494	0.1122	0.3198	0.4153	0.1553	0.0150

The non-parametric revenue efficiency scores of targets, acquirers, and other non-merging banks. The revenue maximization problem is solved according to Equation 6. The revenue efficiency scores presented in this table are obtained by the following equation:

$RE = \frac{\sum_{r=1}^{s} q_r y_r}{\sum_{r=1}^{s} q_r y^*}$ where q_r is the price outputs and y_r is the quantity of output r. $\sum_{r=1}^{s} q_r y_r$ is the observed/actual revenue of the DMU and $\sum_{r=1}^{s} q_r y^*$ is the virtual efficiency profit that could be achieved if the DMU lies on the efficient frontier. The profit efficiency scores take values in the range (0, 1).

Figure 16: The Non-parametric Revenue Efficiency Scores of Targets, Acquirers, and Control Banks

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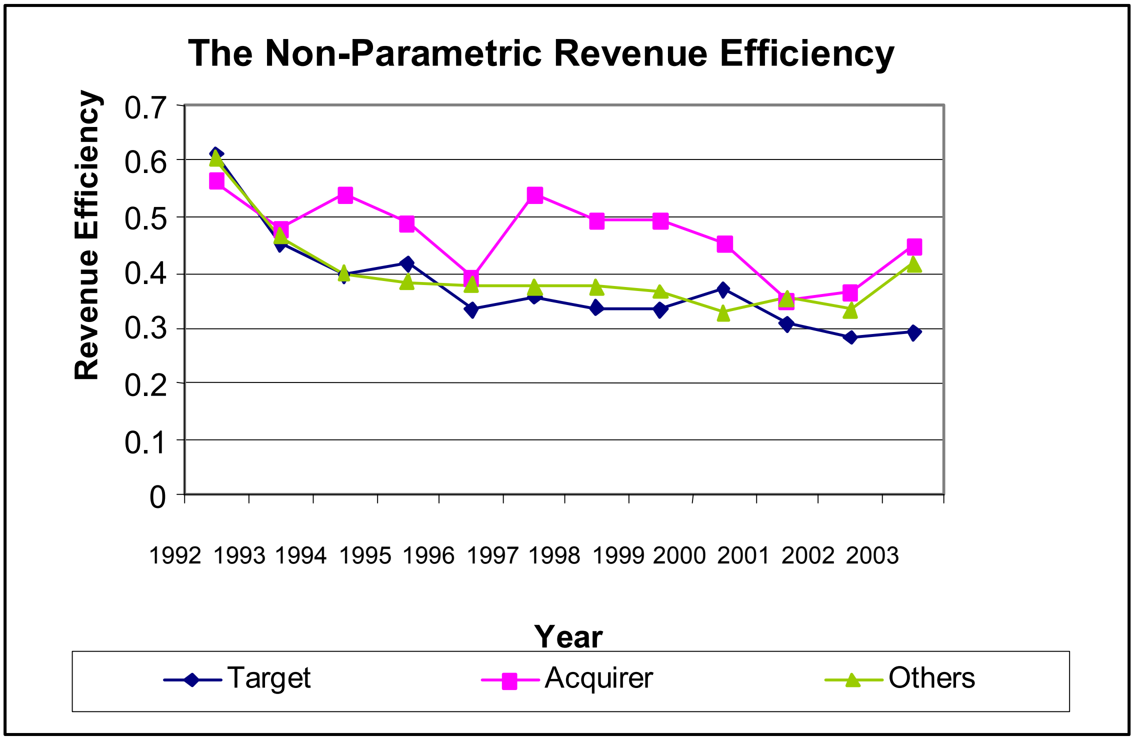


5.1.3. Profit Efficiency Results

As mentioned earlier, profit efficiency is the most demanding efficiency measure since it seeks to minimize costs and maximize revenues simultaneously by allowing inputs and outputs to vary throughout the optimization process. The results for this section are presented in Table 13 and shown in Figure 17. The results show that acquirers lost 4% (.41-.37) of their profit efficiency during the study period. Targets and non-merging banks suffered efficiency reductions of 18% (.41-.23) and 16% (.49-.33), respectively. Figure 17 shows the decreasing profit efficiency trend over time. A comparison of Figures 16 and 17 indicates that profit maximization is almost equivalent to revenue efficiency maximization. Acquirers maximize the output level of a given input level with little cost minimization enhancement.

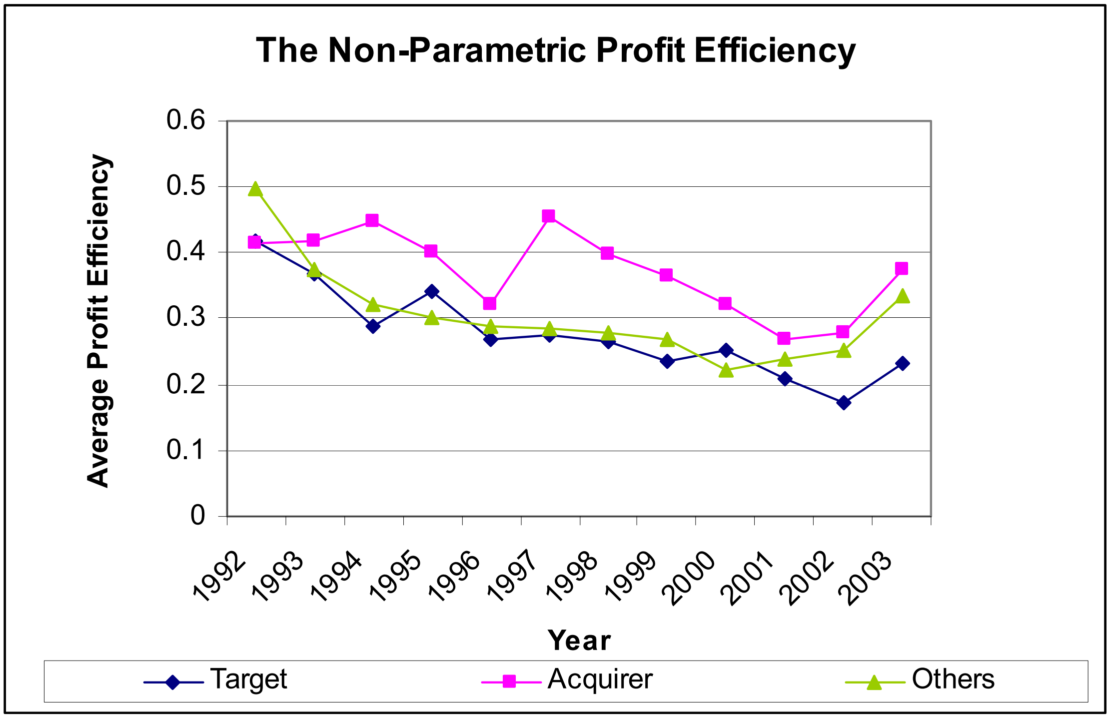
Table 13: The Non-parametric Profit Efficiency Scores of Targets, Acquirers, and Control Banks

	Target			**Acquirer**			**Control**		
	Mean	Standard Error	Min	Mean	Standard Error	Min	Mean	Standard Error	Min
1992	0.4164	0.0979	0.3032	0.4145	0.0655	0.3125	0.4972	0.2082	0.0915
1993	0.3667	0.1447	0.2011	0.4189	0.1815	0.2022	0.3754	0.1774	0.1162
1994	0.2880	0.1133	0.1021	0.4469	0.1285	0.2551	0.3203	0.1842	0.0649
1995	0.3422	0.2056	0.1538	0.4023	0.2051	0.1765	0.3004	0.1951	0.0705
1996	0.2681	0.1958	0.1411	0.3203	0.1720	0.0639	0.2871	0.1886	0.0608
1997	0.2736	0.1660	0.1267	0.4557	0.2557	0.1759	0.2847	0.1871	0.0795
1998	0.2651	0.1611	0.1340	0.3980	0.2090	0.1943	0.2799	0.1822	0.0277
1999	0.2343	0.0763	0.1630	0.3657	0.1463	0.1561	0.2677	0.1990	0.0300
2000	0.2512	0.1328	0.1265	0.3223	0.1719	0.1105	0.2205	0.1910	0.0273
2001	0.2074	0.1829	0.0706	0.2688	0.1842	0.1431	0.2402	0.1746	0.0041
2002	0.1739	0.0377	0.0963	0.2792	0.0881	0.1676	0.2530	0.1882	-0.0239
2003	0.2320	0.1700	0.0987	0.3753	0.1592	0.2293	0.3347	0.1710	-0.0083

The non-parametric profit efficiency scores of targets, acquirers, and other non-merging banks. The profit maximization problem is solved according to Equation 7. The profit efficiency scores presented in this table are obtained by the following equation:

$\dfrac{\sum_{r=1}^{s} q_r y_r - \sum_{i=1}^{m} p_i x_i}{\sum_{r=1}^{s} q_r y_r^* - \sum_{i=1}^{m} p_i x_i^*}$ where $\sum_{r=1}^{s} q_r y_r - \sum_{i=1}^{m} p_i x_i$ is the observed profitability of the bank$_i$ and $\sum_{r=1}^{s} q_r y_r^* - \sum_{i=1}^{m} p_i x_i^*$ is the virtual profitability that could be achieved if the DMU is located on the efficient frontier. The profit efficiency score takes values in the range $(-\alpha, 1)$.

Figure 17: The Non-parametric Profit Efficiency Scores of Targets, Acquirers, and Control Banks



In general, the results show that efficiency measures decrease over time. However, acquirers maintained the highest average cost, revenue, and profit efficiencies. This trend may account for the latest merger wave, which according to Floegel et al. (2005),[8] started in late 1997. Using efficiency scores to explain merger waves could be a subject for future research.

5.2. The Post- Merger Efficiency Dynamics

In this section, we discuss the efficiency development of merging and non- merging banks of different sizes following the merger event. To evaluate the efficiency development, we compare the efficiency scores of each bank in the year preceding the merger with each of the four following years' efficiency scores. To control for the size effect, we define large banks as those banks with total assets greater than the median of the whole sample, including control banks, one year after the merger. Furthermore, we compare the performance of large and small non-merging banks with the performance of merging banks of different sizes. All efficiency results are represented in Tables 14 through 20. The efficiency changes relative to the year of merger are reported in Columns 4 and 9 for small and large banks combined with their peer banks. Each year's performance of the acquirers following the merger event is compared with the performance of their peer group to check if acquirers are still performing better than non-merging banks after the merger event. The results of the later comparison are reported in the bottom part of each efficiency table.

5.2.1. Profit Efficiency Changes

Table 14 presents the profit efficiency changes for acquirers for the four years following the merger. The results show that small banks experienced gradual statistically significant losses following the merger, losing around 11.7% in four years. However, control banks of the same size experienced a statistically significant average gain of 11.6% over the same period. On the other hand, large banks experienced a 2.1% statistically insignificant efficiency loss in the four years following the merger compared with a 7.5% statistically significant efficiency improvement for control banks. Furthermore, we compared merging and non-merging banks' performance for each year starting from the merger year. The results are reported in Columns 1 and 6. Starting with small banks, we can see that small merging banks kept outperforming other banks of the same size with decreasing margin over the first two years, but then underperformed their peer banks by a statistically significant 13.5% in the fourth year. This result indicates that

[8] Floegel et al. (2005) studied mergers that took place between 1993 and 2002. Their results show that the early mergers (1992-1998) kept bidders with 1.556% average abnormal returns but, the late stage of merger wave kept

small merging banks had lost their profit efficiency comparative advantage following the mergers. The results are different for large banks, which had insignificant efficiency losses and maintained greater profit efficiency than their peers. However, the profit efficiency difference between large merging and non-merging banks decreased from 14.9% in the merger year to 5.3% in the fourth year following the merger event.

5.2.2. Cost Efficiency Changes

Table 15 presents the cost efficiency dynamics of acquiring banks and their peers. The results show that small merging banks lost about 7.7% of their cost efficiency in the four years following the merger event compared with an average efficiency gain of 10.0% for their peers. Small merging banks maintained higher cost efficiencies over their peers for the whole period, but in decreasing margins. Large merging banks, on the other hand, experienced insignificant losses in the four years following the merger event compared with a significant efficiency gain of 6.4% for their peers. Again, large acquirers maintained higher efficiencies than their peers.

Because the cost efficiency concept is a product of technical, pure technical, scale, and allocative efficiencies, the results of these efficiency scores are presented in this section. The technical efficiency results are presented in Table 16. The results look very similar to the results of the preceding sections. Large acquirers experienced insignificant efficiency losses during the four years after the merger, but maintained superior technical efficiency over their peers. Small acquirers also experienced a significant loss of 5.6% during the four years following the merger compared with a significant efficiency gain of 7.9% for their peers. Indeed, small acquirers were outperformed by their peers by the fourth year following the merger event. In general, this result means that large acquirers' ability to maximize their outputs given fixed inputs is best relative to

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them with -1.1079% average abnormal returns.

merging and non-merging banks of different sizes. As expected, the pure technical efficiency results look just the same as the results of the technical efficiency results. This is expected because changing the CRS assumption to a VRS assumption will not change the ranking of banks included in the efficient frontier. The pure technical efficiency results are shown in Table 17.

Scale efficiency results are reported in Table 18. The results show that small banks experienced insignificant gains of 1.3% in the fourth year compared with 4.6% significant gains for their peers. However, there is no clear trend indicated when comparing acquirers with their peers on an annual basis. Generally, acquirers outperformed their peers for the first three years, but not the fourth year. Large banks, on the other hand, experienced insignificant gains in scale efficiency in the fourth year after significant losses of 3.5% and 3.9% in the first and second year, respectively. The large bank peer group gained 8.6% by the fourth year, which enabled then to outperform large acquirers in terms of scale efficiency. These results indicate that the higher cost and profit efficiency scores of large acquirers is coming from the pricing policy of their inputs and outputs rather than from efficiency in their use of inputs. The results are inconsistent with Akhavein et al. (1997), who conclude that anti-trust law prevents large banks from exercising market power.

Finally, allocative efficiency results are shown in Table 19. The results show that small banks experienced insignificant losses of 1.9% four years after the merger compared with a significant efficiency improvement of 30.3% for their peers. However, small acquirers ranked lower than their peers starting from the second year. Large merging banks also experienced a significant loss of 11.7% by the fourth year versus an insignificant loss by their peers. Anyway, this efficiency loss didn't affect the superiority of large banks over all other groups. Comparing the scale efficiency results with these results provides a further interesting conclusion. Large acquirers are more efficient in constructing an optimal product mix, given their respective prices, and consequently they are more cost efficient than others. As mentioned earlier, the source of the higher allocative efficiency is mostly derived from their being more engaged in non-traditional banking. This conclusion is further supported by the small banks' efficiency loss after merger. We argue that small acquirers were challenged by creating new investment opportunities.

Table 14: Profit Efficiency Improvement During the Four Years After Merger of Small and Large Banks Compared With Control Banks

		Profit Efficiency									
		Small					Large				
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
		Mean	variance	Z-value	difference	t-stat	Mean	variance	Z-value	difference	t-stat
	t	0.355	0.035	9.648			0.381	0.033	10.763		
	t+1	0.291	0.026	9.163	-0.065	-1.819	0.367	0.032	10.424	-0.014	-0.890
Acquirers	t+2	0.307	0.031	8.866	-0.049	-1.590	0.372	0.038	9.677	-0.010	-0.560
	t+3	0.256	0.012	11.999	-0.099	-2.808	0.366	0.046	8.734	-0.015	-0.417
	t+4	0.238	0.004	18.300	-0.117	-4.700	0.360	0.057	7.690	-0.021	-0.898
	t	0.257	0.046	6.891			0.233	0.060	5.451		
	t+1	0.224	0.010	13.120	-0.033	-2.668	0.209	0.011	11.547	-0.024	-1.716
Control Banks	t+2	0.246	0.045	6.671	-0.011	-0.896	0.224	0.058	5.348	-0.008	-0.607
	t+3	0.272	0.071	5.857	0.016	0.869	0.246	0.101	4.442	0.013	0.618
	t+4	0.373	0.075	7.812	0.116	5.770	0.308	0.119	5.113	0.075	3.022
		difference	**t-stat**				**difference**	**t-stat**			
	t	0.099	6.576				0.149	9.255			
Acquirers Compared	t+1	0.067	6.739				0.158	14.477			
With Control Banks	t+2	0.061	4.204				0.147	8.997			
	t+3	-0.016	-1.052				0.121	5.970			
	t+4	-0.135	-9.086				0.053	2.380			

Table 15: Cost Efficiency Improvement During the Four Years After Merger of Small and Large Banks Compared With Control Banks

		Cost Efficiency									
		Small					Large				
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
		Mean	variance	Z-value	difference	t-stat	Mean	variance	Z-value	difference	t-stat
Acquirers	t	0.553	0.019	20.443			0.504	0.022	17.511		
	t+1	0.446	0.014	19.265	-0.107	-4.110	0.478	0.022	16.362	-0.026	-0.890
	t+2	0.467	0.038	12.298	-0.087	-3.873	0.486	0.036	13.150	-0.017	-0.560
	t+3	0.433	0.027	13.458	-0.120	-3.103	0.484	0.040	12.406	-0.020	-0.417
	t+4	0.476	0.013	21.229	-0.077	-2.047	0.456	0.050	10.434	-0.048	-0.898
Control Banks	t	0.255	0.028	8.750			0.231	0.035	7.120		
	t+1	0.128	0.026	4.593	-0.127	-10.418	0.125	0.029	4.251	-0.106	-9.789
	t+2	0.297	0.026	10.544	0.043	3.560	0.259	0.034	8.140	0.028	0.358
	t+3	0.343	0.033	10.943	0.089	6.933	0.288	0.044	7.873	0.056	2.235
	t+4	0.355	0.044	9.739	0.100	6.860	0.296	0.062	6.812	0.065	2.409
		difference	**t-stat**				**difference**	**t-stat**			
Acquirers Compared With Control Banks	t	0.299	26.114				0.273	21.790			
	t+1	0.319	30.445				0.353	29.720			
	t+2	0.170	12.732				0.227	16.377			
	t+3	0.090	6.999				0.197	12.895			
	t+4	0.122	9.697				0.160	9.077			

Table 16: Technical Efficiency Improvement During the Four Years After Merger of Small and Large Banks Compared With Control Banks

		Technical Efficiency									
		Small					Large				
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
		Mean	variance	Z-value	difference	t-stat	Mean	variance	Z-value	difference	t-stat
Acquirers	t	0.484	0.019	17.751			0.472	0.016	18.807		
	t+1	0.478	0.017	18.522	-0.006	-0.238	0.442	0.015	18.678	-0.030	-1.158
	t+2	0.488	0.019	18.160	0.004	0.176	0.451	0.024	14.744	-0.021	-0.827
	t+3	0.431	0.003	39.666	-0.053	-1.925	0.459	0.033	12.838	-0.013	-0.317
	t+4	0.428	0.003	39.105	-0.056	-4.431	0.471	0.042	11.779	-0.001	0.045
Control Banks	t	0.425	0.020	17.258			0.326	0.027	11.401		
	t+1	0.378	0.022	14.653	-0.048	-4.440	0.305	0.029	10.305	-0.021	-1.669
	t+2	0.411	0.024	15.368	-0.015	-1.316	0.321	0.032	10.290	-0.005	-0.399
	t+3	0.373	0.029	12.478	-0.053	-4.352	0.304	0.040	8.699	-0.022	-1.567
	t+4	0.504	0.043	13.941	0.079	5.532	0.358	0.069	7.830	0.032	1.843
		difference	**t-stat**				**difference**	**t-stat**			
Acquirers Compared With Control Banks	t	0.059	5.609				0.146	13.270			
	t+1	0.100	9.602				0.137	12.436			
	t+2	0.078	7.160				0.130	10.410			
	t+3	0.059	6.167				0.155	10.862			
	t+4	-0.076	-6.735				0.113	6.441			

Table 17: Pure Technical Efficiency Improvement During the Four Years Following Merger of Small and Large Banks Compared With Control Banks

		Pure Technical Efficiency									
		Small					Large				
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
		Mean	variance	Z-value	difference	t-stat	Mean	variance	Z-value	difference	t-stat
	t	0.587	0.032	16.837			0.564	0.026	17.909		
	t+1	0.536	0.021	19.103	-0.050	-1.495	0.555	0.026	17.615	-0.009	-0.248
Acquirers	t+2	0.545	0.023	18.534	-0.042	-1.541	0.569	0.036	15.345	0.005	0.209
	t+3	0.489	0.010	24.670	-0.097	-3.242	0.563	0.034	15.636	-0.001	0.019
	t+4	0.505	0.010	25.242	-0.081	-3.508	0.552	0.046	13.174	-0.013	-0.205
	t	0.533	0.054	13.151			0.369	0.093	6.955		
	t+1	0.472	0.070	10.261	-0.061	-3.285	0.351	0.120	5.826	-0.018	-0.728
Control Banks	t+2	0.512	0.062	11.776	-0.021	-1.117	0.364	0.108	6.361	-0.005	-0.199
	t+3	0.486	0.080	9.840	-0.047	-2.381	0.358	0.144	5.421	-0.011	-0.412
	t+4	0.586	0.071	12.644	0.052	2.557	0.381	0.134	5.976	0.012	0.428
		difference	**t-stat**				**difference**	**t-stat**			
	t	0.053	3.461				0.195	10.750			
Acquirers Compared	t+1	0.064	4.051				0.204	10.142			
With Control Banks	t+2	0.033	2.157				0.205	10.264			
	t+3	0.004	0.227				0.205	9.236			
	t+4	-0.080	-5.353				0.171	7.645			

Table 18: Scale Efficiency Improvement During the Four Years Following Merger of Small and Large Banks Compared With Control Banks

		Scale Efficiency									
		Small					Large				
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
		Mean	variance	Z-value	difference	t-stat	Mean	variance	Z-value	difference	t-stat
Acquirers	t	0.848	0.020	30.838			0.847	0.012	40.105		
	t+1	0.902	0.013	39.714	0.054	2.037	0.812	0.018	31.162	-0.035	-1.625
	t+2	0.905	0.009	49.158	0.057	2.594	0.808	0.017	31.930	-0.039	-1.467
	t+3	0.899	0.011	44.099	0.051	2.712	0.823	0.022	28.254	-0.025	-0.767
	t+4	0.861	0.010	44.749	0.013	0.566	0.861	0.013	38.765	0.014	0.431
Control Banks	t	0.876	0.056	21.319			0.816	0.022	19.987		
	t+1	0.886	0.067	19.708	0.010	0.526	0.836	0.054	20.458	0.020	1.351
	t+2	0.882	0.058	20.997	0.005	0.290	0.854	0.029	20.884	0.038	2.479
	t+3	0.856	0.074	18.113	-0.021	-1.076	0.807	0.072	12.040	-0.010	-0.567
	t+4	0.922	0.042	25.820	0.046	2.554	0.902	0.088	20.238	0.086	4.072
		difference	**t-stat**				**difference**	**t-stat**			
Acquirers Compared With Control Banks	t	-0.029	-1.976				0.031	3.173			
	t+1	0.016	1.046				-0.024	-1.703			
	t+2	0.023	1.664				-0.046	-4.109			
	t+3	0.043	2.794				0.016	0.972			
	t+4	-0.061	-5.090				-0.042	-2.487			

Table 19: Allocative Efficiency Improvement During the Four Years After Merger of Small and Large Banks Compared With Control Banks

Allocative Efficiency											
		Small					Large				
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
		Mean	variance	Z-value	difference	t-stat	Mean	variance	Z-value	difference	t-stat
Acquirers	t	0.960	0.006	60.984			0.908	0.032	25.886		
	t+1	0.858	0.043	21.194	-0.101	-6.679	0.874	0.050	19.931	-0.035	-0.963
	t+2	0.857	0.074	16.107	-0.103	-2.623	0.856	0.060	17.888	-0.053	-1.157
	t+3	0.869	0.066	17.269	-0.090	-1.660	0.839	0.067	16.471	-0.070	-1.185
	t+4	0.941	0.015	38.729	-0.019	-0.313	0.792	0.056	17.075	-0.117	-1.733
Control Banks	t	0.675	0.052	16.976			0.388	0.099	7.092		
	t+1	0.304	0.044	8.305	-0.371	-22.660	0.264	0.061	6.155	-0.124	-5.884
	t+2	0.899	0.024	33.167	0.224	16.220	0.379	0.044	10.409	-0.008	-0.493
	t+3	.9450	0.059	29.686	0.576	37.954	0.294	0.161	4.208	-0.094	-3.930
	t+4	0.978	0.059	23.229	0.303	16.793	0.370	0.138	5.715	-0.018	-0.618
		difference	t-stat				difference	t-stat			
Acquirers Compared With Control Banks	t	0.2840	22.283				0.521	27.354			
	t+1	0.5540	35.658				0.610	34.796			
	t+2	-0.042	-2.553				0.477	28.141			
	t+3	-0.076	-20.544				0.545	21.643			
	t+4	-0.037	-2.596				0.422	18.179			

5.2.3. Revenue Efficiency Changes

Table 20 presents the revenue efficiency results of the merging and peer banks. The results show that small acquiring banks experienced a statistically significant loss of 7.6 % by the fourth year versus an 8.8% significant gain for their peers. The results further show that acquirers lost their superiority after the second year to their peers, who experience a 12.9% higher efficiency by the fourth year. Large acquirers also experienced a 2.5% insignificant loss versus a 3.7% significant gain for their peers, but they continued to exceed the efficiency of their peers by over 5.4%. This result supports our argument that acquirers exercise market power in setting prices.

5.3. Malmquist Total Productivity Index

Considering the merger year as the base year, Table 21 presents the Malmquist total productivity index results of merging banks and their peers. The table also shows the two main components of the Malmquist index, the efficiency change and the frontier shift for each group.

Starting with the index itself, the results show that large merging banks tend to have the highest scores compared with all other groups. However, control banks achieved higher total productivity than merging banks in the third year following the merger. The source of the higher productivity seems to be the efficiency change rather than the frontier shift. Column 3 in Table 24 presents the efficiency change for all groups. However, large merging banks experienced higher efficiency improvements for the first two years after the merger than other groups, but experienced lower efficiency improvements than their peers by the third year. The frontier shift is presented in Column 5 of Table 21. All values in the frontier shift, or technology change, are less than one. This means that the frontier is moving to the right, or that the whole sector, on

Table 20: Revenue Efficiency Improvement During the Four Years After Merger of Small and Large Banks Compared With Control Banks

Revenue Efficiency											
		Small					Large				
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
		Mean	variance	Z-value	difference	t-stat	Mean	variance	Z-value	difference	t-stat
Acquirers	t	0.426	0.020	15.549			0.428	0.019	15.640		
	t+1	0.365	0.013	16.540	-0.061	-2.303	0.441	0.022	15.090	0.014	0.507
	t+2	0.385	0.020	13.925	-0.041	-1.917	0.430	0.023	14.340	0.002	0.100
	t+3	0.385	0.016	15.429	-0.042	-1.475	0.424	0.024	14.099	-0.004	-0.090
	t+4	0.350	0.010	17.708	-0.076	-2.601	0.403	0.023	13.485	-0.025	-0.609
Control Banks	t	0.388	0.039	11.211			0.313	0.057	7.528		
	t+1	0.351	0.048	9.216	-0.037	-2.350	0.295	0.069	6.443	-0.018	-0.963
	t+2	0.387	0.038	11.472	-0.001	-0.032	0.311	0.054	7.703	-0.002	-0.092
	t+3	0.365	0.056	8.831	-0.023	-1.431	0.302	0.084	5.977	-0.011	-0.552
	t+4	0.476	0.055	11.698	0.088	5.039	0.349	0.090	6.705	0.037	1.671
		difference	**t-stat**				**difference**	**t-stat**			
Acquirers Compared With Control Banks	t	0.039	3.018				0.115	7.913			
	t+1	0.014	1.110				0.147	9.217			
	t+2	-0.002	-0.135				0.119	8.152			
	t+3	0.020	1.417				0.122	7.063			
	t+4	-0.126	-9.369				0.054	3.049			

Table 21: Malmquist Productivity Index of Merging Large and Small Banks Compared With Control Banks

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		Malmquist	variance	Efficiency Change	variance	Frontier Shift	variance	Improved	Lost	% Improved
Large Merging Banks	t+1	1.004	0.007	1.052	0.019	0.964	0.009	42	58	0.420
	t+2	1.003	0.022	1.078	0.061	0.953	0.018	42	64	0.396
	t+3	1.006	0.024	1.075	0.061	0.963	0.026	50	59	0.459
Large Control Banks	t+1	0.993	0.021	1.043	0.036	0.963	0.011	186	213	0.466
	t+2	0.998	0.044	1.083	0.075	0.942	0.021	198	269	0.424
	t+3	1.015	0.071	1.099	0.114	0.955	0.035	228	316	0.419
Small Merging Banks	t+1	0.983	0.015	1.040	0.031	0.958	0.014	45	50	0.369
	t+2	0.971	0.027	1.034	0.059	0.964	0.026	41	78	0.336
	t+3	1.011	0.102	1.129	0.170	0.924	0.031	46	76	0.377
Small Control Banks	t+1	0.994	0.017	1.055	0.031	0.954	0.011	185	333	0.357
	t+2	0.997	0.036	1.089	0.068	0.938	0.022	193	339	0.363
	t+3	1.019	0.047	1.124	0.092	0.938	0.034	138	189	0.422

average, used more inputs to generate a given level of output. However, the portion of large merging banks that experienced higher productivity three years after their mergers is about 46% compared with 42% of their peers.

Small merging banks, on the other hand, experienced lower productivity than their peers. However, the trend of both groups' Malmquist index was similar. Both experienced productivity losses in the first two years after merger, but then experienced 1.1% and 1.9% productivity improvements for merging and control banks, respectively. The source of the productivity improvement is the efficiency change rather than the technology shock (frontier shift). Column 3 shows that small merging banks experienced a 12.9% efficiency improvement versus 12.4% for their peers. However, the portion of small acquirers who experienced efficiency gains is 37.7% compared with 42.2% for their peers.

To check the distributional characteristics of the Malmquist productivity index, we applied the bootstrapping technique. We allowed every sample to contain 60% of the whole sample of each group (small banks and their peers, and large banks and their peers). We further generated 65,000 subsamples to get the distributional statistics of each group. The results are shown in Table 22 and in Figures 18 through 25. Figures 18 and 19 show the time trend of the Malmquist productivity index of large merging banks and their peers. Figure 18 shows that peer banks experienced gains for three continuous years, while Figure 19 shows that large acquirers experienced very slight productivity improvements in the two years after merger.

Figures 20 and 21 show the productivity index distributions of small acquirers and their peers. Acquirers experienced a negative distributional shift in the first year following the merger, but a positive shift one year later, while their peers achieved continuous productivity improvement. Furthermore, we compared merging banks with their peers one and three years

Table 22: The Distributions of Malmquist Productivity Index of Merging Large and Small Banks Compared With Control Banks

Panel A

	Large Merging Banks			Large Control Banks		
	t+1	**t+2**	**t+3**	**t+1**	**t+2**	**t+3**
Mean	0.993	0.986	0.992	0.986	0.989	1.009
Percentile 2.5%	0.977	0.958	0.963	0.978	0.978	0.995
Percentile 97.5%	1.010	1.018	1.023	0.994	1.002	1.024
Median	0.993	0.985	0.992	0.986	0.989	1.009
Sdev	0.008	0.015	0.016	0.004	0.006	0.007
1st Quartile	0.988	0.975	0.982	0.983	0.985	1.004
3rd Quartile	0.999	0.996	1.002	0.989	0.993	1.013

Panel B

	Small Merging Banks			Small Control Banks		
	t+1	**t+2**	**t+3**	**t+1**	**t+2**	**t+3**
Mean	0.971	0.953	0.979	0.995	1.003	1.003
Percentile 2.5%	0.949	0.926	0.948	0.986	0.989	0.988
Percentile 97.5%	0.993	0.98	1.011	1.005	1.019	1.019
Median	0.971	0.953	0.979	0.995	1.003	1.003
Sdev	0.011	0.014	0.016	0.005	0.008	0.008
1st Quartile	0.964	0.944	0.968	0.992	0.998	0.998
3rd Quartile	0.979	0.962	0.99	0.999	1.008	1.008

Figure 18: The distribution of Malmquist productivity index of large non-merging banks.

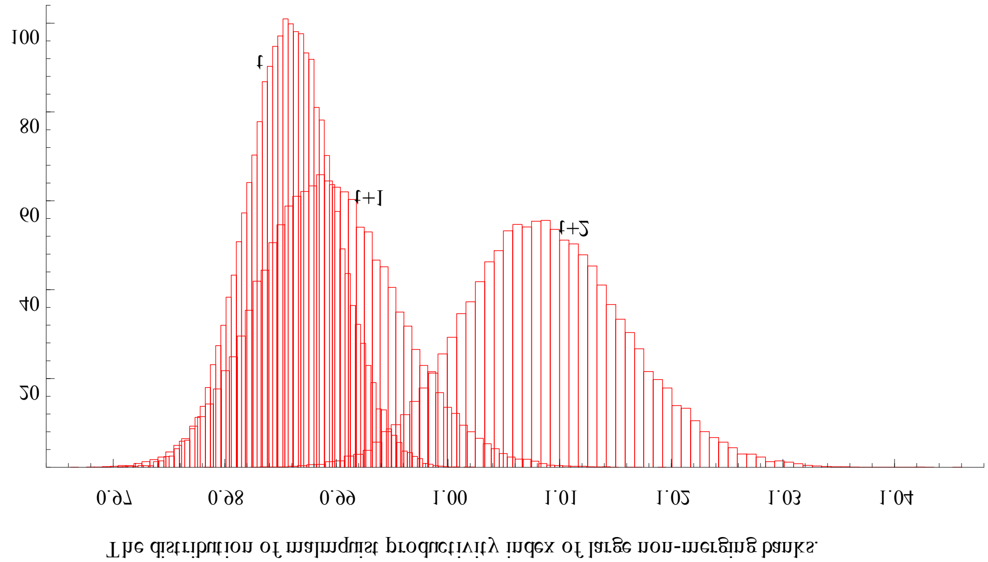


Figure 19: The distribution of Malmquist productivity index of large merging banks for the three years following the merger event

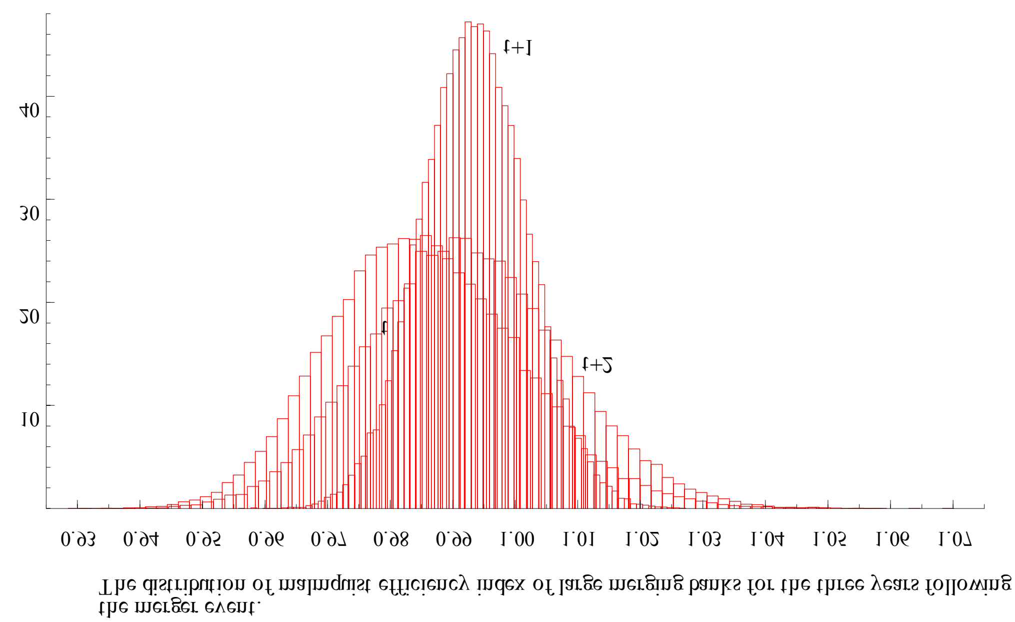


Figure 20: The distribution of Malmquist productivity index of small merging banks for the three years following the merger event

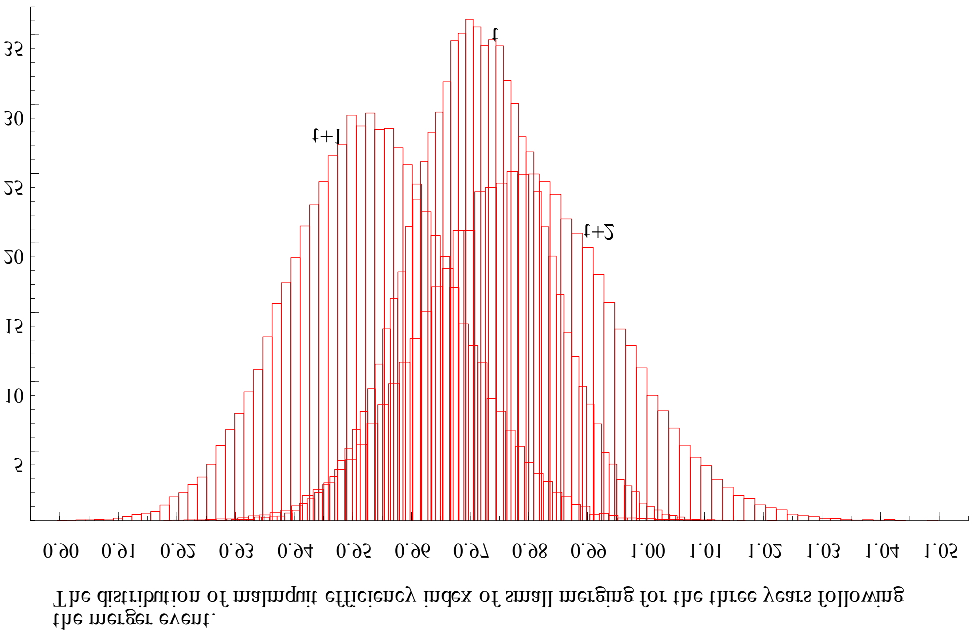
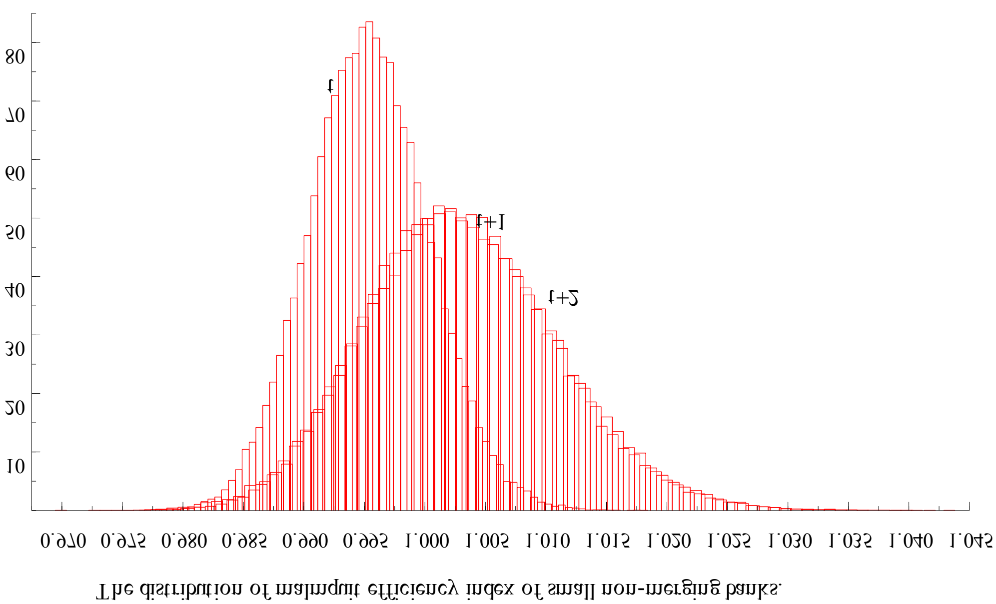


Figure 21: The distribution of Malmquist efficiency index of small Control banks



following the merger. Figures 22 and 23 show that small peer banks' distribution is located in the upper tail of small merging banks. Large merging banks' distributions and those of their peers are presented in Figures 24 and 25, respectively. Merging banks' productivity index distribution one year after the merger was more dispersed relative to that of their peers. This result shows that merging banks of large size were more productive than others. This result changed by the third year, when the non-merging banks' distribution became located in the upper tail of merging banks' distribution.

5.4. Classifying Merger Deals

Table 23 shows the subsample classification along with the number of mergers for each classification and the method of payment used in merger deals. The table shows that when mergers involve acquirers and targets from the same level of efficiency, mergers are most often paid with cash. Of 64 mergers paid fully by cash in our sample, 56 involved acquirers and targets with the same efficiency classification. In percentages, HEHE, MEME, and LELE mergers were 32%, 31%, and 36% financed with cash, respectively. These are the highest percentage cash deals in the table. This result supports the information asymmetry hypothesis, which argues that bidders will use stock-for-stock deals rather than cash deals when they recognize that their equity stocks are overvalued. However, this result shows that parties with the same performance level can fairly evaluate each other, but other merger parties working in different efficiency levels are less able to observe the real value of the bidder's equity value.

Figure 22: A comparison between the mamlmquist productivity index of small merging banks and their peers three years following the merger event

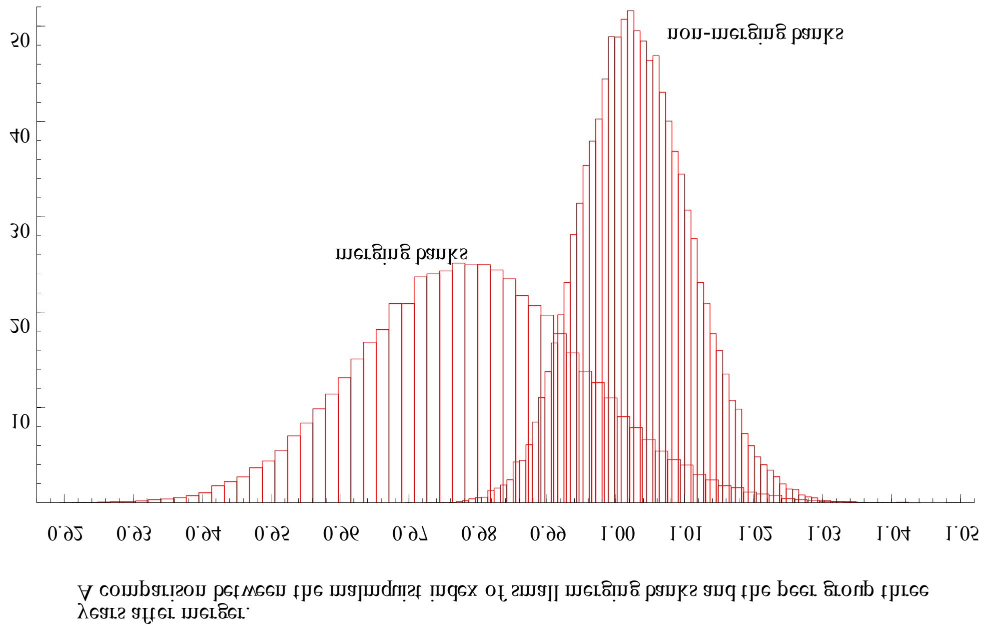


Figure 23: A comparison between the mamlmquist productivity index of small merging banks and their peers one year following the merger event

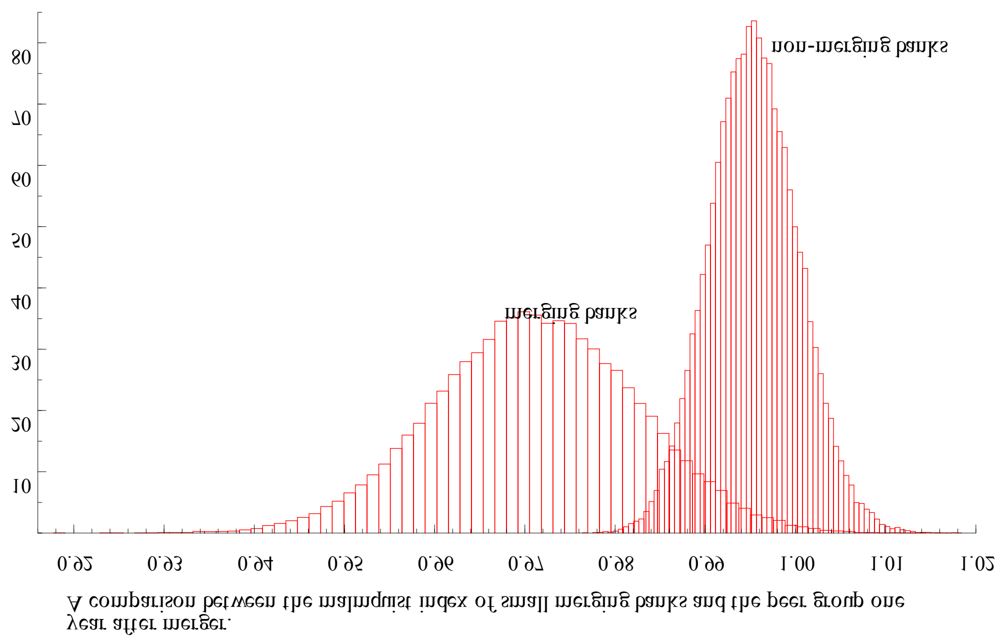
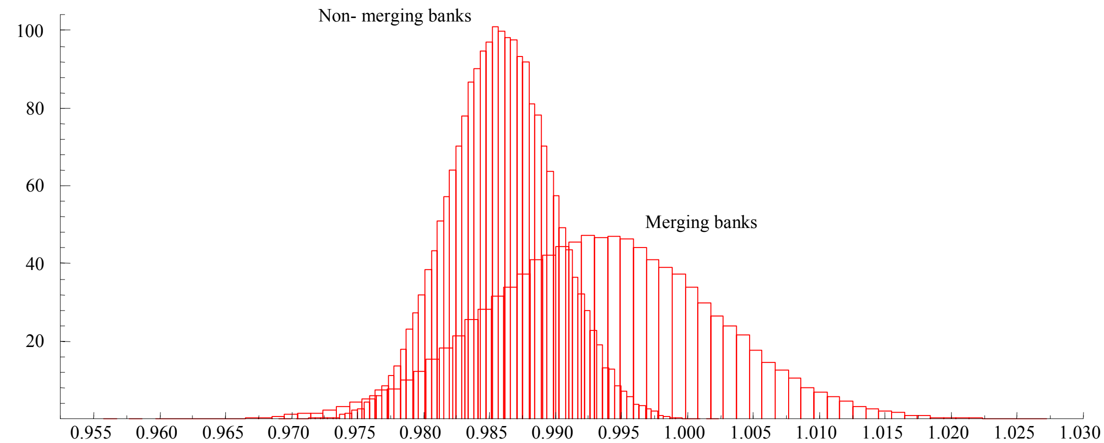
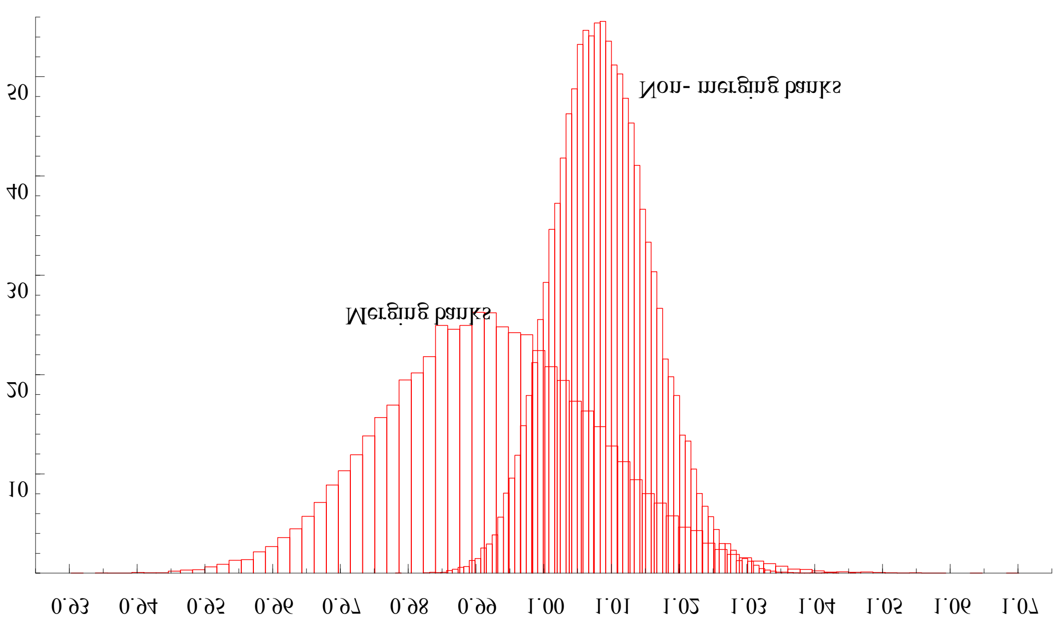


Figure24: A comparison between the mamlmquist productivity index of large merging banks and their peers one year following the merger event



A comparison between the malmquist index of large merging banks and their peer group one year after merger.

Figure25: A comparison between the mamlmquist productivity index of large merging banks and their peers three years following the merger event



A comparison between the malmquist index of large merging banks and the peer group three years after merger.

Table 23: The Pair-Wise Profit Efficiency Merger Classifications, 1991-2002

	Number				(%)		
	Cash Only	Stock only	Combination	Total	Cash Only	Stock Only	Combination
HEHE	8	15	2	**25**	0.32	0.60	0.08
HEME	0	46	2	**48**	0.00	0.96	0.04
HELE	0	21	7	**28**	0.00	0.75	0.25
MEHE	1	5	2	**8**	0.13	0.63	0.25
MEME	35	66	12	**114**	0.31	0.58	0.11
MELE	4	58	23	**85**	0.05	0.68	0.27
LEHE	1	0	2	**3**	0.33	0.00	0.67
LEME	2	5	5	**12**	0.17	0.42	0.42
LELE	13	17	6	**36**	0.36	0.47	0.17
Total	64	233	61	**359**	0.18	0.65	0.17

High efficiency/high efficiency (HEHE); high efficiency/medium efficiency (HEME); high efficiency/low efficiency (HELE); medium efficiency/high efficiency (MEHE); medium efficiency/medium efficiency (MEME); medium efficiency/low efficiency (MELE); low efficiency/high efficiency (LEHE); low efficiency/medium efficiency (LEME); and low efficiency/low efficiency (LELE).

5.5. Profit Efficiency Changes of Merger Combinations

The main objective of this section is to investigate the profit efficiency dynamics of each of the nine merger combinations. Furthermore, this section's results are to be compared with the market reaction of each merger combination. It is expected, according to the efficient markets hypothesis, that the economic gains arising from mergers will be accurately impounded into stock prices at the time of the merger announcement. According to the value additivity principle (VAP) (see Haley and Schell, 1979), the "economic gains" are observed as the expected future cash flows of the merger. The argument we are expressing here is that higher profit efficiency will be related to higher future cash flows. Hence, any merger deal followed by profit efficiency gains is expected to generate more cash flows, which in turn, will be impounded into the stock price. Accordingly, we present the *profit efficiency* dynamics of our nine efficiency merger combinations. Table 24 presents the profit efficiency scores of the nine merger combinations up

Table 24: The Profit Efficiency Changes of the Pair-wise Efficiency Merger Combinations During the Four Years Following Merger

		Profit Efficiency						Efficiency Change			
		t	t+1	t+2	t+3	t+4		t+1-t	t+2-t	t+3-t	t+4-t
HEHE	mean	0.696	0.629	0.590	0.455	0.426	Mean	-0.067	-0.106	-0.220	-0.327
	variance	0.036	0.075	0.079	0.054	0.055	Variance	0.019	0.018	0.059	0.061
	z-score	14.200	8.892	8.140	6.508	5.433	t-stat	-1.911	-3.042	-2.988	-4.397
HELE	mean	0.652	0.569	0.556	0.521	0.403	Mean	-0.083	-0.140	-0.209	-0.472
	variance	0.042	0.068	0.051	0.074	0.011	Variance	0.009	0.059	0.075	0.030
	z-score	9.582	6.538	6.050	4.278	6.679	t-stat	-2.640	-1.421	-1.710	-4.734
HEME	mean	0.682	0.644	0.604	0.573	0.696	Mean	-0.037	-0.070	-0.108	-0.014
	variance	0.033	0.027	0.035	0.034	0.054	Variance	0.009	0.015	0.024	0.016
	z-score	15.116	15.689	12.470	10.320	8.433	t-stat	-1.597	-2.237	-2.282	-0.325
LEHE	mean	0.194	0.165	0.209	0.177	0.186	Mean	-0.029	0.015	-0.019	-0.010
	variance	0.000	0.002	0.003	0.002	0.000	Variance	0.002	0.003	0.001	0.000
	z-score	65.651	7.697	7.817	6.935	20.966	t-stat	-1.449	0.560	-0.860	-0.821
LELE	mean	0.184	0.189	0.239	0.218	0.174	Mean	0.005	0.055	0.040	0.003
	variance	0.003	0.003	0.004	0.004	0.009	Variance	0.001	0.005	0.005	0.006
	z-score	17.048	18.861	18.117	13.174	4.007	t-stat	0.793	4.052	2.123	0.079
LEME	mean	0.185	0.205	0.236	0.243	0.253	Mean	0.020	0.051	0.041	0.036
	variance	0.005	0.009	0.011	0.006	0.004	Variance	0.007	0.009	0.010	0.007
	z-score	9.840	7.986	8.215	9.045	9.957	t-stat	0.921	1.971	1.180	1.030
MEHE	mean	0.297	0.279	0.284	0.356	0.367	Mean	-0.018	-0.013	0.023	0.033
	variance	0.006	0.018	0.027	0.038	0.069	Variance	0.003	0.008	0.014	0.035
	z-score	8.471	4.709	3.841	3.186	2.410	t-stat	-0.685	-0.322	0.334	0.304
MELE	mean	0.294	0.297	0.311	0.289	0.306	Mean	0.003	0.011	-0.012	-0.002
	variance	0.006	0.007	0.020	0.023	0.029	Variance	0.002	0.011	0.013	0.020
	z-score	24.212	21.854	12.789	10.010	8.050	t-stat	0.416	0.630	-0.565	-0.067
MEME	mean	0.315	0.294	0.306	0.294	0.295	Mean	-0.021	-0.011	-0.020	-0.027
	variance	0.008	0.008	0.011	0.014	0.016	Variance	0.003	0.010	0.012	0.009
	z-score	27.68067	25.57195	21.58414	16.72359	14.49168	t-stat	-3.00033	-0.84726	-1.24326	-1.732

to four years following the merger event. The results show that most acquirers experienced efficiency losses after merger, except for three merger combinations: 1) LELE mergers experienced statistically significant efficiency improvements of 5.5% and 4%, respectively, in the second and third year following the merger. However, the efficiency gains weren't significant for the first and fourth year after the merger; 2) LEME mergers experienced persistent positive efficiency improvements over time, but they only experienced statistically significant improvement after the second year; 3) MEHE mergers experienced insignificant efficiency improvement for the whole period. These mergers account for 15.6% of our whole sample. According to these results, we expect the above mentioned merger combinations to experience positive or at least higher merger returns upon the merger announcement.

On the other hand, all other merger combinations experienced efficiency losses over time. The two merger combinations with the most extreme efficiency loss were: 1) HEHE mergers, which suffered a 32.6% loss in profit efficiency by the fourth year following the merger; and 2) HELE mergers, which suffered a 47% loss in profit efficiency by the fourth year following the merger. These two extremes account for 14.7% of the total sample.

Other merger combinations experienced about a 2% efficiency loss by the fourth year. MELE and MEME mergers combined account for 55.5% of merger deals. These subsamples experienced 2% and 3% efficiency losses, respectively, by the fourth year. Based on these results, we expect that the market reaction will be negative upon merger announcement.

5.6. Conclusions

Applying the non-parametric data envelopment approach, we estimated the cost, revenue, and profit efficiency scores of merging and non-merging U.S. banks over the time period from 1992 to 2003. On average, acquirers have 1.65% and 2% cost efficiency advantages over targets and non-merging banks, respectively. To understand the source of this advantage, we decomposed the cost efficiency into its technical, pure technical, scale, and allocative efficiency components. We found that allocative efficiency is the main source of the higher cost efficiency of acquirers over their peers, especially during the 1990s.

We further investigated the post-merger efficiency dynamics for the four years following the merger event. Acquirers experienced statistically insignificant efficiency losses following the merger. However, large size acquirers maintained superior efficiency relative to their peers. Small merging banks, on the other hand, experienced statistically significant efficiency losses after the merger relative to their peers. Small merging acquirers ranked lower than their peers in efficiency by the fourth year following the merger.

Furthermore, we decomposed cost efficiency for each year following the merger to investigate the source of higher cost, revenue, and profit efficiencies of acquirers. The findings show that the pricing of acquirers' inputs and outputs is the main source of cost efficiency rather than scale efficiency (being closer to the efficient frontier). The results further show that acquirers gain their pricing advantage from their higher allocative efficiency (which indicates better management).

To compare the market reaction results with our efficiency changes, we investigated the profit efficiency dynamics of our nine merger combinations for four years following the merger. The results show that LELE mergers experienced significant 3% efficiency gains four years following the merger event. On the other extreme, HELE mergers experienced a significant 47% loss four years follow the merger event.

Summarizing, the results suggest that value-maximizing mergers are mostly large in size and match banks with clear chances to increase their future efficiency rankings.

VI. MARKET REACTION OF ACQUIRERS AND TARGETS UPON MERGER ANNOUNCEMENT

6.1. Introduction

Considering the puzzling results of prior event studies around mergers, this dissertation attempts to introduce a more consistent explanation of the merger effect on the wealth of the acquiring and target banks' shareholders. Motivated by the works of Shafer (1993), Berger and Humphrey (1992), and more recently, by Rhodes et al. (2004), this dissertation utilizes the non-parametric efficiency frontier for acquirers and targets in order to predict the market reaction more precisely depending on the profit efficiency pre-merger classification of targets and acquires.

Table 25 lists our expectations concerning the market reaction to each merger combination. It is apparent from the table that a merger between the most efficient banks is expected to produce positive returns to shareholders of both sides. Taking into consideration our argument about the limited information asymmetry of "within" group mergers, we argue that all mergers located in any diagonal cell (1, 5, and 9) will yield positive abnormal returns for both parties. Cells 2 and 3 show negative expected returns for acquirers combined with positive returns for targets. Our expectations are predicated upon the findings of Berger and Humphrey (1992), Shafer (1993), and Akhavein (1997), who argue that efficiency gains are expected for the target when a more efficient bank acquires a less efficient bank. Cells 4 and 7 show less certain expectations about the acquirer's abnormal returns. We believe that the relative size of the target to the bidder will determine the sign of the acquirer's abnormal returns. Rhodes et al. (2004) argues that when a less efficient acquirer merges with a more efficient target, the combined bank will experience efficiency gains. On the other hand, we expect that target abnormal returns will be affected by the method of payment used. Since we know that stock is mostly used in this kind

Table 25: The Expected Market Reaction to Merger Announcements

Target	High Efficiency Acquirer	Medium Efficiency Acquirer	Low Efficiency Acquirer
High Efficiency	(1) (HEHE) (+, +)	(4) (MEHE) (+/–, +) (+/–, –)	(7) (LEHE) (+/–, +) (+/–, –)
Medium Efficiency	(2) (HEME) (–, +)	(5) (MEME) (+, +)	(8) (LEME) (+/–, +/–)
Low Efficiency	(3) (HELE) (–, +)	(6) (MELE) (+/–, +)	(9) (LELE) (+, +)

High efficiency/high efficiency (HEHE); high efficiency/medium efficiency (HEME); high efficiency/low efficiency (HELE); medium efficiency/high efficiency (MEHE); medium efficiency/medium efficiency (MEME); medium efficiency/low efficiency (MELE); low efficiency/high efficiency (LEHE); low efficiency/medium efficiency (LEME); and low efficiency/low efficiency (LELE).

of merger, we argue that if the target (correctly) perceives an inefficiency signal from the acquirer, the target's abnormal returns will be negative when equity is used. We also expect the bidder's abnormal returns to be negative.

6.2. Methodology Used to Evaluate Market Reaction

To test the market reaction to merger announcements, the event study methodology (Dodd and Warner, 1983) is used to determine whether the market is able to identify the efficiency characteristics of the acquirer and the target. Following Delong (2001), the market model is estimated over a 300-day period ending 51 days before the announcement of the merger. The CRSP equally weighted index will be used as a proxy for the market portfolio:

$$AR_{it} = R_{it} - (a_i + b_i R_{mt}) \qquad (8)$$

where AR_{it} represents the abnormal returns to bank stock i at time t, R_{it} represents the actual returns to bank stock i at time t, a_i is the ordinary least squares (OLS) estimate of the intercept in the estimated market model, b_i is the OLS estimate of the slope coefficient market in the model which reflects the change in the market return relative to the return for bank i, and R_{mt} represents the actual returns to a market portfolio of bank stocks at time t. As mentioned earlier, the market reaction will be applied to each of the nine groups. To examine the factors that affect the abnormal return, the cumulative abnormal returns (CARs) will be calculated according to the following formula:

$$CAR_{t,t+n} = \sum_{t=-30}^{30} \left(\sum_{i=1}^{N} AR_{it} \right) \qquad (9)$$

In keeping with the previous event study literature, we will use five event windows to calculate CAR: (-1,1), one day before the merger announcement to one day after the merger announcement; (-5,5); (-10,10); (-15,15); and (-30,30).

Finally, we will check the explanatory power of the efficiency scores of acquirers and targets by regressing them against CAR. We include two other essential non-efficiency variables in our regression model. The first is the method of payment used to pay for the merger transaction. Antoniou et al. (2005) find that cash acquirers continue to achieve positive significant abnormal returns in the three years following the merger. The findings of Abhyankar et al. (2005) support cash over stock financing. In this dissertation, however, we consider the possibility of a combination of cash and stocks in addition to cash-only and stock-only methods of payment. Consequently, the method of payment here is not represented by a dummy variable, but by the percentage of cash used in the transaction. The second non-efficiency variable included in our regression model is the relative size of the target. James and Wier (1987) find that a merger between equals is positively related to the acquirer's returns. Delong (1999) finds that abnormal returns due to a merger announcement increase in relative size of target to bidder. We argue in this dissertation that the relative size of the target to bidder plays an important role in manipulating the market reaction to the merger announcement. Again, this result can be explained by the expected efficiency that the target can pass to the acquirer (e.g., if an inefficient bank acquires an efficient bank of the same size, then we can argue that the target will pass efficiency to the combined firm, especially if it has a meaningful share in operating the combined bank's operations (see Rhodes et al., 2004).

The final regression model for the acquirer is as follows:

$$\begin{aligned} CAR_A = \alpha &+ (\beta_1 * TE_A) + (\beta_2 * TE_T) + (\beta_3 * AE_A) + (\beta_4 * AE_T) + (\beta_5 * CE_A) + \\ &(\beta_6 * CE_T) + (\beta_7 * RE_A) + (\beta_8 * RE_T) + (\beta_9 * \pi E_A) + (\beta_{10} * \pi E_T) + \\ &(\beta_{11} * Pcash) + (\beta_{12} * Rsize) + (\beta_{13} * \text{Geo\_d}) + e \end{aligned} \tag{10}$$

where CAR_A is the acquirer's cumulative abnormal return. TE_A is the technical efficiency score of the acquirer and TE_T is the technical efficiency score of the target. AE_A and AE_T are the allocative efficiency scores of the acquirer and the target, respectively. CE_A and CE_T represent the cost efficiency of the acquirer and the target, respectively. RE_A is the revenue efficiency of the acquitter and RE_T is the revenue efficiency of the target. πE_A *and* πE_T are the profit efficiencies of the acquirer and the target, respectively. $Pcash$ is the portion paid by the acquirer in merger transaction. $Rsize$ is the size of the target relative to the bidder. Finally, Geo_d is a dummy variable where intrastate mergers are assigned a value of zero and interstate mergers are assigned a value of one.

The final regression model for the target is as follows:

$$\begin{aligned} CAR_T = \alpha &+ (\beta_1 * TE_A) + (\beta_2 * TE_T) + (\beta_3 * AE_A) + (\beta_4 * AE_T) + (\beta_5 * CE_A) + \\ &(\beta_6 * CE_T) + (\beta_7 * RE_A) + (\beta_8 * RE_T) + (\beta_9 * \pi E_A) + (\beta_{10} * \pi E_T) + \\ &(\beta_{11} * Pcash) + (\beta_{12} * Rsize) + (\beta_{13} * Geo\_d) + e \end{aligned} \quad (11).$$

where CAR_T is target's cumulative abnormal returns. TE_A is the technical efficiency score of the acquirer and TE_T is the technical efficiency score of the target. AE_A and AE_T are the allocative efficiency scores of the acquirer and the target, respectively. CE_A and CE_T represent the cost efficiency of the acquirer and the target, respectively. RE_A is the revenue efficiency of the acquirer and RE_T is the revenue efficiency of the target. πE_A *and* πE_T are the profit efficiencies of the acquirer and the target, respectively. $Pcash$ is the percentage of the target purchase price paid in cash by the acquirer. $Rsize$ is the size of the target relative to the acquirer. Finally, Geo_d is a dummy variable where intrastate mergers are assigned a value of zero and interstate mergers are assigned a value of one.

To test for significance, we use the Z-statistics described by Dodd and Warner (1983). This test statistic has a normal distribution, with values ranging from zero to one. Our null hypothesis is that there are no abnormal returns resulting from a merger announcement for either the acquirer or the target.

To examine whether the differences between various types of mergers are statistically significant, we use the t-statistic, which measures the statistical difference between the means of the two groups. The t-statistic divides the difference in means by a control for the variance of the CARs and the size of the groups being examined as follows:

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{v_1}{n_1} + \frac{v_2}{n_2}}} \qquad (i = 1,2,......,9) \tag{12}$$

where $\bar{x}_i$ is the mean of each sub-sample i, v_i is the variance of sample i, and n_i is the size of sample i. Under the null hypothesis of no difference in the abnormal returns of both groups, the t-statistic is distributed as a Student-t. Furthermore, the Wilcoxon signed rank non-parametric test is used as an alternative to the standard t-test in order to indicate whether the median is statistically different from zero. Nonparametric tests do not require any assumptions regarding the distribution of the data.[9] To apply the Wilcoxon test, we perform the bootstrapping technique by choosing 65,000 samples of each efficiency subgroup, where each sample consists of 50% of each efficiency subgroup. Because some efficiency subgroups have so little observations (MELE and LEHE), we excluded them from this test where we compared each subgroup's CARs with the joint CARs of the whole sample of targets and acquirers separately. This comparison is made possible because the distributional characteristics of targets and acquirers look asymptotically normal around the means (see Appendix A).

6.3. The Empirical Results

6.3.1. Acquirers' Market Reaction

Tables 26 and 27 show the cumulative abnormal returns (CARs) upon announcement of 309 bank mergers for acquirers and targets. We report CARs for nine windows: (0, -1), (-1, 1), (-5, 5), (-10, 10), (-15, 15), (-20, 20), (-25, 25), and (-30, 30). Table 26 shows that, in general,

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[9] Holding the sample size constant, the probability of rejecting the null hypothesis is higher than the comparable nonparametric test.

acquirers experienced significant losses over all windows. On average, acquirers lost 1.5%. LELE mergers experienced positive CARs. This merger combination is the only one that experienced persistent positive CARs ten days after the merger ((-10, 10) window). The results for this merger combination are consistent with the operating performance results discussed in Section 5.5, where we found that this merger combination is the only combination to experience profit efficiency gains. Consistent with the literature (Cornett, Hovakimian, Palia, and Tehranian (2003); Elyasiani and Deng (2004). Elyasiani and Deng (2004).), our results show that most acquirers experienced significant loss following the merger event. However, LELE mergers are the only who achieved significantly positive CARs which is a results not reported before where the classification used in this dissertation has never been used before. At the other extreme, we found that HEHE and HELE mergers experienced highly significant negative CARs. The CARs of the (-30, 30) window show HEHE mergers experienced statistically significant 4.45% losses, which is higher than the CARs of the whole sample. HELE mergers experienced the highest significant loss of 4.7%. These results are also consistent with the profit efficiency results, where we found that HEHE mergers lost about 47.2% four years following the merger. These results show that the market could distinguish between merger deals according to their efficiency characteristics. Investors reacted positively to LELE deals because this kind of merger can only result in efficiency gains at the merged bank in the post merger era. So, the announcement of this type of merger is perceived as an attempt from the acquirer's side to improve it's poor efficiency.

HEHE merger deals reveal negative information for the stockholders because they recognize that there is little or no way for efficiency improvement even when the target is an efficient bank. This argument is further supported by our results in Section 5.1.1, where we found that targets mostly depend on traditional banking activities and acquirers tend to depend more on other investment schemes. HELE deals further support our argument that the market *can* distinguish between merger deals according to their profit efficiency characteristics. Stockholders react negatively to HELE deals because acquirers can only lose efficiency when targets are inefficient. This result is supported by the fact that this type of merger experienced the worst declines in efficiency and stock prices. We argue that the market perceives LELE mergers as value maximizing and the other two types of mergers as value destroying.

Consistent with Delong (1999,2000), the results show that the sub-sampling methodology could indicate that some mergers in banking are motivated by value maximizing objective while the majority of these mergers could be explained by the surplus cash theory which suggests that managers seek mergers to use the access cash they have. In addition gaining more market share/ power could be the reason behind the majority of merger deals.

These puzzling results are discussed by Rholdes-Kropf et.al. (2004) who argue that value-maximizing, but low-skilled managers of low valued firms acquire managerial talent from outside. They further argue that mangers acquire higher value targets as a way of further entrenching themselves.

Finally, we used the bootstrapping technique to clarify the distributional differences between merger combinations. We iterated CARs of each merger combination 65,000 times to choose samples of 50% of each merger combination. The results are presented in Panel A of Table 27. Generally, the results show that each merger pair has its own characteristics.

Table 26: Acquirer's Market Reaction by Profit Efficiency Pair-wise Merger Combination

Acquirers		0-1	-1-1	-5-5	-10-10	-15-15	-20-20	-25-25	-30-30
HEHE	Mean	-0.0245[b]	-0.0003	-0.0362[b]	-0.0367[b]	-0.0386[b]	-0.0497[b]	-0.0545[a]	-0.0445[b]
HEHE	Variance	0.0025	0.0002	0.0078	0.0102	0.0101	0.0108	0.01	0.01
HELE	Mean	-0.0029	0.0021	-0.0114	-0.0099	-0.0206	-0.0255	-0.0232	-0.0470[c]
HELE	Variance	0.0012	0.0002	0.0023	0.0117	0.0119	0.0141	0.0169	0.0225
HEME	Mean	-0.0152[a]	-0.0018	-0.0182[b]	-0.0277[b]	-0.0335[b]	-0.0311[c]	-0.0174	-0.028
HEME	Variance	0.0009	0.0003	0.0033	0.0086	0.011	0.0194	0.0224	0.0268
LEHE	Mean	0.0252	0.029	0.0512	-0.0024	0.0061	0.0249	0.0768[b]	0.0347
LEHE	Variance	0.0017	0.0012	0.0083	0.0059	0.0027	0.0013	0.0038	0.0094
LELE	Mean	-0.005	-0.0003	0.0003	0.0158[c]	0.0346[b]	0.0308[b]	0.0364[b]	0.0350[b]
LELE	Variance	0.0015	0.0003	0.0022	0.0044	0.0075	0.0078	0.0116	0.0167
LEME	Mean	-0.0149	-0.0093	-0.0127	-0.0452	-0.0244	-0.0419	-0.044	-0.0547[c]
LEME	Variance	0.0026	0.0023	0.0102	0.0173	0.0118	0.0143	0.0211	0.0162
MEHE	Mean	-0.0015	0.013	0.009	0.0109	0.0107	-0.0097	-0.0148	0.004
MEHE	Variance	0.0003	0.0008	0.0005	0.0025	0.0061	0.0103	0.0154	0.0116
MELE	Mean	-0.0207[a]	-0.0047[b]	-0.0270[a]	-0.0280[a]	-0.0320[a]	-0.0286[a]	-0.0234[b]	-0.0251[b]
MELE	Variance	0.0017	0.0004	0.0027	0.0049	0.0087	0.0116	0.0139	0.0156
MEME	Mean	-0.0072[b]	-0.0061[a]	-0.0106[b]	-0.0111[c]	-0.0109[c]	-0.0177[b]	-0.0157[c]	-0.0208[b]
MEME	Variance	0.0013	0.0004	0.0022	0.0046	0.0065	0.0088	0.0105	0.0137
mean		-0.0121	-0.003	-0.0155	-0.0165	-0.0164	-0.0197	-0.0157	-0.0204
variance		0.0015	0.0004	0.0031	0.0064	0.0087	0.0114	0.0139	0.0166
z-score		-5.6424	-2.6289	-4.9828	-3.6885	-3.1468	-3.2864	-2.3756	-2.8304

a: Statistically significant at 1%
b: Statistically significant at 5%
c: Statistically significant at 10%

Table 27: The Distributional Characteristics of Targets and Acquirers (Bootstrapping Technique)

Panel A. Acquirers distributional characteristics.

Acquirers	all	HEHE	HELE	HEME	LELE	MELE	MEME
Mean	-0.0149	-0.0355	-0.0109	-0.0187	0.0026	-0.0305	-0.01
Percentile 2.5%	-0.0214	-0.0689	-0.0292	-0.0365	-0.0163	-0.0436	-0.0194
Percentile 97.5%	-0.0085	-0.0006	0.0075	-0.0009	0.0214	-0.0172	-0.0004
Median	-0.0149	-0.0357	-0.011	-0.0188	0.0026	-0.0305	-0.01
Sdev	0.0033	0.0173	0.0094	0.0091	0.0096	0.0068	0.0048
1st Quartile	-0.0171	-0.0473	-0.0173	-0.0249	-0.0039	-0.035	-0.0132
3 Quartile	-0.0127	-0.024	-0.0046	-0.0126	0.0091	-0.0259	-0.0067

Panel B. targets distributional characteristics.

Targets	all	HEHE	HELE	HEME	LELE	MELE	MEME
Mean	0.1621	0.1134	0.2357	0.1313	0.2211	0.1944	0.0949
Percentile 2.5%	0.1415	0.0572	0.1314	0.0894	0.1447	0.1513	0.0655
Percentile 97.5%	0.1834	0.1717	0.3501	0.1758	0.3068	0.2397	0.1255
Median	0.162	0.1128	0.2341	0.131	0.2195	0.194	0.0946
Sdev	0.0107	0.0292	0.0558	0.0221	0.0413	0.0226	0.0153
1st Quartile	0.1548	0.0934	0.197	0.1161	0.1925	0.1789	0.0844
3 Quartile	0.1692	0.133	0.272	0.1461	0.248	0.2094	0.1051

6.3.2. Targets' Market Reaction

Table 28 shows the CARs of targets in our sample. As documented in the literature, all targets experienced statistically significant CARs following the merger announcement for all windows. On average, targets experienced 15.6% CARs. HEHE merger announcements signaled negative wealth changes for acquiring bank shareholders as well as the smallest positive wealth changes for target bank shareholders among the efficiency combinations. The explanation presented in the previous section still holds, target bank shareholders recognize the negative effects of re-allocating resources within the new merged bank, especially since most merger deals are stock-for-stock mergers in which the target bank's shareholders still have future cash flows to worry about. The results also show that the best merger deal for targets are the ones that match low efficiency acquirers with medium efficiency targets (LEME). Finally, the bootstrapping technique is used to show the distributional differences between merger combinations. The results are presented in Panel B of Table 27. The results show that each merger pair has its own characteristics. Our results are consistent with the evidence of the existence of significantly positive CARs for target's shareholders reported by Cornett, Hovakimian, Palia, and Tehranian (2003), Elyasiani and Deng (2004), DeLong (1999), DeLong (2001) and Amihud et al. (2002).

6.3.3. The Total Wealth Effect of Each Merger Combination

In this section, we use the results of the last two sections to investigate the total wealth effect of each merger combination. We estimate the wealth effect by multiplying the market capitalization of acquiring and target banks by average CARs of both sides divided by the total market capitalization. We use the CARs of the (-30, 30) window. The results are presented in Table 29. The results show that LELE mergers experienced the highest wealth increases, HEHE mergers ranked second, and LEHE mergers ranked fourth. On average, the mergers created 2.25% positive returns for both parties.

6.3.4. The Cross-Sectional Analysis of Market Reaction

In this section, we present the cross-sectional analysis of market reaction for the combined sample. The dependent variable in all regression sets is the CARs of the whole sample for the (-5, 5) window. The results are presented in Tables 30 and 31. Table 30 shows five

Table 28: Target's Market Reaction by Profit Efficiency Pair-wise Merger Combination

Targets		0-1	-1-1	-5-5	-10-10	-15-15	-20-20	-25-25	-30-30
HEHE	mean	0.0922	0.0059	0.12	0.1261	0.1409	0.1389	0.1293	0.1313
HEHE	Variance	0.0058	0.0006	0.016	0.0178	0.0162	0.0206	0.0251	0.026
HELE	mean	0.1969	0.0819	0.2262	0.2375	0.2429	0.228	0.2491	0.2468
HELE	Variance	0.0472	0.0389	0.0577	0.0625	0.0523	0.0538	0.0637	0.0694
HEME	mean	0.121	0.0432	0.142	0.1551	0.1673	0.1768	0.1694	0.1702
HEME	Variance	0.0172	0.0118	0.0171	0.0167	0.0196	0.0251	0.0291	0.0349
LEHE	mean	0.1763	0.141	0.1627	0.2001	0.2296	0.2339	0.2473	0.2393
LEHE	Variance	0.0082	0.0104	0.008	0.014	0.0124	0.0225	0.0133	0.0078
LELE	mean	0.1974	0.0192	0.22	0.2275	0.2245	0.2346	0.2332	0.2307
LELE	Variance	0.0476	0.0042	0.0496	0.0499	0.0621	0.0589	0.0592	0.0616
LEME	mean	0.2119	0.0912	0.2124	0.2201	0.2787	0.2757	0.288	0.3099
LEME	Variance	0.121	0.0772	0.13	0.108	0.1064	0.1528	0.1974	0.2212
MEHE	mean	0.1501	0.0907	0.1536	0.1597	0.1438	0.1403	0.1441	0.1813
MEHE	Variance	0.021	0.0008	0.0136	0.0103	0.0122	0.0104	0.0192	0.0517
MELE	mean	0.1858	0.0342	0.2097	0.2149	0.2277	0.2266	0.2301	0.24
MELE	Variance	0.0239	0.0095	0.0274	0.0295	0.0303	0.0359	0.0401	0.043
MEME	mean	0.1034	0.028	0.0982	0.1078	0.1029	0.1165	0.1188	0.1269
MEME	Variance	0.02	0.0084	0.0213	0.0285	0.0339	0.0397	0.0419	0.0488
mean		0.1476	0.038	0.1612	0.17	0.1764	0.1811	0.1832	0.1896
variance		0.0289	0.0135	0.0329	0.0352	0.0384	0.0431	0.0484	0.0539
z-score		15.7309	5.7474	16.127	16.4333	16.2967	15.7886	15.0508	14.7638

* All mean values are statistically significant at 1% level.

Table 29: The Combined Wealth Effect of Profit Efficiency Pair-wise Merger Combinations

	Mean	Variance	Z- value
HEHE	0.0549	0.0198	1.8708
HELE	0.0023	0.0014	0.3001
HEME	-0.0043	0.0013	-0.7442
LEHE	0.0256	0.0007	1.7345
LELE	0.1730	0.2479	1.9660
LEME	-0.1205	0.2420	-0.7346
MEHE	0.0244	0.0005	3.1072
MELE	0.0252	0.0065	2.7463
MEME	0.0220	0.0051	3.0113

regression frameworks, where the dependent variable is the CARs of targets. Regression 1 is the most comprehensive since all explanatory variables are included. The results indicate that the relative size and revenue efficiency of the targets are negatively correlated with the CARs of the targets and significantly different from zero at 5% level. However, both variables remained significant through Regression 3. Regressions 4 and 5 show that the acquirers' profit efficiency is significantly and positively related to the CARs of targets. In other words, the higher the profit efficiency of the acquirer, the higher the CAR of the target. However, the highest R^2 is associated with the first regression, and at 23%, is higher than similar regressions reported in the previous literature (see Delong, 2001).

Table 31 shows the results of the same regression framework using the CARs of acquirers rather than targets. The results show that the technical efficiency of the acquirers is positively related to their CARs. The higher the ability of the acquirer to maximize its output quantity for a given level of inputs, the higher is the market return. So, any additional resources the acquirer acquires will be used to maximize output levels. Inconsistent with Delong (1999 and 2001), geographic diversification is positively related to market returns. Finally, and consistent with the most recent literature, the stock portion used in merger deals is negatively related to the CARS of acquirers.

Table 30: Regression Frameworks Used to Explain the Cumulative Abnormal Returns of Targets Upon Merger Announcement

	Efficiency	Regression 1	Regression 2	Regression 3	Regression 4	Regression 5
Acquirer's	**C**	0.4889 (.124)	0.4004^{c} (.080)	0.1582^{a} (.000)	0.5144^{b} (.038)	0.3615^{a} (.000)
	Profit	0.1768 (.167)			0.3117^{a} (.009)	0.2935^{b} (.013)
	Revenue	0.1127 (.310)			-0.0957 (.321)	-0.0555 (.516)
	Cost	0.1779 (.460)			0.2201 (.359)	-0.0431 (.601)
	Technical	0.2526 (.516)			-0.1142 (.770)	
	Pure Technical	-0.7032^{b} (.067)			-0.5978 (.131)	-0.3946^{b} (.003)
	Allocative	-0.0946 (.476)			-0.1996 (.133)	
	Scale	-0.0402 (.870)			-0.0030 (.991)	
	GEO	0.0293 (.109)	0.0270 (.135)	0.0301 (.115)		
	REL	-0.0724^{b} (.036)	-0.0733^{b} (.029)	-0.1053^{a} (.003)		
	STOCK	0.0182 (.516)	0.0274 (.323)	0.0021 (.942)		
Target's	**Profit**	-0.0447 (.708)	-0.0293 (.790)			-0.0410 (.566)
	Revenue	-0.2711^{b} (.019)	-0.2364^{b} (.020)			
	Cost	-0.3219 (.140)	-0.4299^{b} (.046)			-0.1262 (.101)
	Technical	-0.2597 (.477)	-0.1021 (.780)			
	Pure Technical	0.5623 (.117)	0.4004 (.265)			
	Allocative	0.0229 (.837)	0.0602 (.583)			
	Scale	-0.1271 (.598)	-0.2288 (.345)			
	R^2	0.2296	0.1854	0.0481	0.1156	0.1249

Table 31: Regression Frameworks Used to Explain the Cumulative Abnormal Returns of Acquirers Upon Merger Announcement

Ac	Efficiency	Regression 1	Regression 2	Regression 3	Regression 4	Regression 5
Acquirer's	**C**	0.1057 (.157)	0.0283 (.594)	0.0038 (.586)	0.0717 (.210)	-0.0182[c] (.052)
	Profit	-0.0187 (.535)			-0.0333 (.225)	-0.0450 (.100)
	Revenue	0.0410 (.117)			-0.0056 (.801)	-0.0014 (.942)
	Cost	-0.0179 (.751)			0.0359 (.518)	0.0341 (.077)
	Technical	0.2014[b] (.028)			0.1559[c] (.085)	
	Pure Technical	-0.1654[c] (.066)			-0.1271 (.165)	0.0052 (.865)
	Allocative	0.0287 (.359)			0.0008 (.979)	
	Scale	-0.1172[b] (.043)			-0.1013[c] (.082)	
	GEO	0.0078[c] (.069)	0.0071[c] (.094)	0.0075[c] (.072)		
	REL	0.0038 (.639)	-0.0005 (.945)	0.0008 (.914)		
	STOCK	-0.0224[a] (.001)	-0.0251[a] (.000)	-0.0265[a] (.000)		
Target's	**Profit**	0.0110 (.694)	-0.0022 (.933)			0.0195 (.243)
	Revenue	-0.0363 (.181)	-0.0111 (.638)			
	Cost	0.0562 (.273)	0.0606 (.227)			0.0016 (.929)
	Technical	-0.0267 (.756)	0.0029 (.973)			
	Pure Technical	0.0042 (.960)	-0.0253 (.762)			
	Allocative	-0.0350 (.182)	-0.0262 (.304)			
	Scale	-0.0109 (.847)	-0.0148 (.793)			
	R^2	0.1389	0.1045	0.0897	0.0408	0.0381

6.4. Conclusions

We investigate the market reaction upon merger announcement of nine profit efficiency pair-wise merger combinations. Our findings show that mergers combining low efficiency acquirers and targets create significant market returns following the merger event, while mergers combining high efficiency parties destroy the acquirer's wealth more than any other type of merger. Medium efficiency merger parties experienced the lowest market returns for all windows, while low efficiency mergers experienced the fourth best among the efficiency combinations.

Our findings further show that acquirers generally lost about 2% of their wealth upon merger announcement. Consistent with the literature, targets experienced, on average, 15.5% significant market returns following the merger announcement.

From the total wealth effect perspective, our overall results show that low efficiency merger combinations left both parties with the highest returns (around 17.3%), followed by mergers between high efficiency parties (5%). On the other extreme, LEME and HEME combinations destroyed the overall mergers values by 12.05% and 0.04%, respectively. Generally, mergers left both parties with a 2.2% average market return.

We further performed the cross-sectional analysis of our combined sample. The findings show that CARs of acquirers are positively related to their technical efficiency and geographic diversification. This result indicates that acquirers are able to access new markets and better manage and invest the new resources acquired from targets. We further find that targets' CARs are negatively related to relative target size and revenue efficiency.

Finally, by combining our results in Section 5 with the market reaction results, we argue that the market can distinguish the profit efficiency characteristics of acquirers and targets and the consequent changes on the future cash flows of each merger deal. This result strongly supports the efficient markets hypothesis.

VII. OVERALL CONCLUSIONS

Applying the non-parametric data envelopment approach, we estimated the cost, revenue, and profit efficiency scores of merging and non-merging U.S. banks over the time period from 1992 to 2003. On average, acquirers have 1.65% and 2% cost efficiency advantages over targets and non-merging banks, respectively. To understand the source of this advantage, we decomposed the cost efficiency into its technical, pure technical, scale, and allocative efficiency components. We found that allocative efficiency is the main source of the higher cost efficiency of acquirers over their peers, especially during the 1990s.

We further investigated the post-merger efficiency dynamics for the four years following the merger event. Acquirers experienced statistically insignificant efficiency losses following the merger. However, large size acquirers maintained superior efficiency relative to their peers. Small merging banks, on the other hand, experienced statistically significant efficiency losses after the merger relative to their peers. Small merging acquirers ranked lower than their peers in efficiency by the fourth year following the merger.

Furthermore, we decomposed cost efficiency for each year following the merger to investigate the source of higher cost, revenue, and profit efficiencies of acquirers. The findings show that the pricing of acquirers' inputs and outputs is the main source of cost efficiency rather than scale efficiency (being closer to the efficient frontier). The results further show that acquirers gain their pricing advantage from their higher allocative efficiency (which indicates better management).

To compare the market reaction results with our efficiency changes, we investigated the profit efficiency dynamics of our nine merger combinations for four years following the merger. The results show that LELE mergers experienced significant 3% efficiency gains four years following the merger event. On the other extreme, HELE mergers experienced a significant 47% loss four years follow the merger event.

We investigate the market reaction upon merger announcement of nine profit efficiency pair-wise merger combinations. Our findings show that mergers combining low efficiency acquirers and targets create significant market returns following the merger event, while mergers combining high efficiency parties destroy the acquirer's wealth more than any other type of merger. Medium efficiency merger parties experienced the lowest market returns for all windows, while low efficiency mergers experienced the fourth best among the efficiency combinations.

Our findings further show that acquirers generally lost about 2% of their wealth upon merger announcement. Consistent with the literature, targets experienced, on average, 15.5% significant market returns following the merger announcement.

From the total wealth effect perspective, our overall results show that low efficiency merger combinations left both parties with the highest returns (around 17.3%), followed by mergers between high efficiency parties (5%). On the other extreme, LEME and HEME combinations destroyed the overall mergers values by 12.05% and 0.04%, respectively. Generally, mergers left both parties with a 2.2% average market return.

We further performed the cross-sectional analysis of our combined sample. The findings show that CARs of acquirers are positively related to their technical efficiency and geographic diversification. This result indicates that acquirers are able to access new markets and better manage and invest the new resources acquired from targets. We further find that targets' CARs are negatively related to relative target size and revenue efficiency.

Summing-up, the results suggest that value-maximizing mergers are mostly large in size and match banks with clear chances to increase their future efficiency rankings

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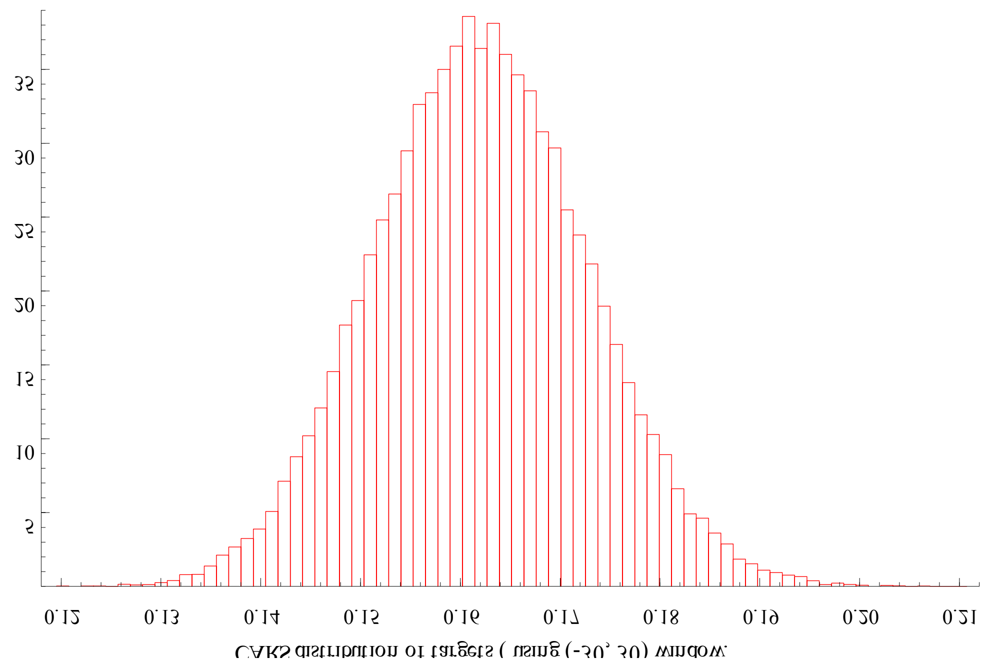
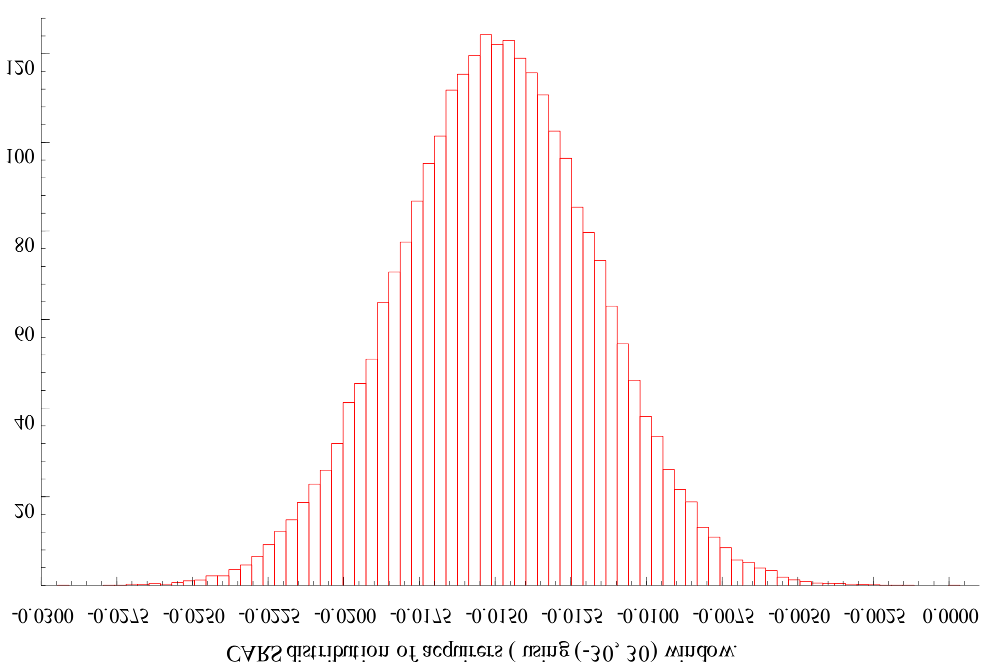
Appendix A: The CARs distributional characteristics of acquirers and targets**.**





VITA

Jamal Al-khasawneh was born in Aidoun, Jordan. He received his Bachelor of Science degree in Finance and Banking from Yarmouk University in 1995. Upon graduation, he joined Cairo-Amman Bank as accountant. In 1998, he earned his Master of Science degree in Finance from the University of Jordan, Amman, Jordan. He joined the Hashemite University, Zarqa, Jordan in 1999, where it sponsored him to get his Ph.D. in Finance. He joined the University of New Orleans in 2001, where he received his Master of Arts degree in Financial Economics in 2005 and his Ph.D. in Financial Economics in 2005.