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Short-Term, Long-Term, and Efficiency Impacts of Recent Mergers and Acquisitions in the U.S. Banking Industry

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SHORT-TERM, LONG-TERM, AND EFFICIENCY IMPACTS OF RECENT MERGERS AND ACQUISITIONS IN THE U.S. BANKING INDUSTRY

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DEDICATION

To my family, for their overwhelming love and support.

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ABSTRACT

This dissertation examines the wealth effects of bank mergers on bidder, target, and combined firm shareholders for a sample of 785 mergers during the period 1980-2000. The dissertation employs two unique bank event study methodologies to calculate abnormal returns for bidder, target and combined firms. The first methodology is a modified market model that controls for shocks common to the banking industry. The second is an EGARCH (1,1) model that adjusts for the violated regression assumptions of the traditional market model event study. Namely, it controls for the linearity assumption, heteroskedasticity, and the correlation in the error term. The results of both methodologies reveal that target shareholders enjoy significantly positive abnormal returns, whereas the bidder shareholders experience significantly negative abnormal returns. Overall, announcements of bank mergers generate positive wealth effects for the combined shareholders. However, the evidence presented in this dissertation, to some extent, underscores the importance of the choice of models describing stock returns in examining the impact of bank mergers. In addition, when mergers are analyzed to determine the effects of relative size and relative book-to-market values, we find evidence that the relative size significantly affects the target, bidder and combined firm return; method of payment is also found to be significant in abnormal returns. Moreover, we find that the number of bidders affects only the bidder returns, while book-to-market values are irrelevant factors.

CHAPTER 1

SHAREHOLDER WEALTH EFFECTS IN BANK MERGERS: NEW EVIDENCE DURING THE PERIOD (1980-2000)

1.1 Abstract

This essay examines the wealth effects of bank mergers on bidder, target, and combined firm shareholders for a sample of 785 mergers during the period 1980-2000. The essay employs two unique bank event study methodologies to calculate abnormal returns for bidder, target and combined firms. The first methodology is a modified market model that controls for shocks common to the banking industry. The second is an EGARCH (1,1) model that adjusts for the violated regression assumptions of the traditional market model event study. Namely, it controls for the linearity assumption, heteroskedasticity, and the correlation in the error term. The results of both methodologies reveal that target shareholders enjoy significantly positive abnormal returns, whereas the bidder shareholders experience significantly negative abnormal returns. Overall, announcements of bank mergers generate positive wealth effects for the combined shareholders. However, the evidence presented in this essay, to some extent, underscores the importance of the choice of models describing stock returns in examining the impact of bank mergers. In addition, when mergers are analyzed to determine the effects of relative size and relative book-to-market values, we find evidence that the relative size significantly affects the target, bidder and combined firm return; method of payment is also found to be significant in abnormal returns. Moreover, we find that the

number of bidders affects only the bidder returns, while book-to-market values are irrelevant factors.

1.2 Introduction

Banks play a pivotal role in the proper functioning of the economy via their input in the payment's system as well as in the channeling of funds between savers and investors. Consequently, banks are the single most important conduits of monetary policy. Developments of the financial system in the past three decades have seen the emergence of other financial institutions, including mutual funds. Notwithstanding, these institutions have yet to eclipse the banks' role as the principal suppliers of deposit accounts and commercial credit, both of which facilitate the proper functioning of financial intermediation. However, changes in the average scale, and the in organizational and market structure of the banking industry would have critical implications for not only the future evolution of financial markets, but also the implementation of monetary policies.

From 1934 through the 1970s, the number of banks in the United States remained fairly stable. In the late 80s, however, the number of American banks started to decrease significantly. Specifically, between 1980 and 2000, the number of banks declined from 14,404 to 9,214, a decrease of 36 percent.[1] The two main causes of such a retreat were bank failures and bank mergers. Statistics show that between 1985 and 1992, failures contributed significantly to the decreases in the number of banks. Still, failures accounted for less than half of the decrease in the number of the banks. This trend has become more evident since 1992, where the number of bank failures accounted for less

[1] http://www.fdic.gov

than 15% of the total decline in the number of banks. The remaining part of the reduction can be explained by the growing trend towards larger banks and bank consolidation.

The merger mania has yielded considerable research interest in this topic. In spite of a large body of literature, many puzzling questions remain unanswered. For instance, a common finding is that bank mergers do not create value, yet they continue to occur. Empirical evidence indicates that, on average, there is no statistically significant gain in either market performance or operating performance of the combined firm. Moreover, shareholders of target firms gain at the expense of the bidder firms. This has been documented over the course of many studies covering different time periods and across countries, and it is true whether one examines accounting data or the market value of equity.

Additionally, markets are unable to accurately anticipate the ultimate success of individual mergers, as indicated by the absence of any correlation between changes in accounting-based performance measures and stock market returns around the merger announcement. Indeed, the merger wave that has swept across the U.S. shows no sign of waning, and there is increasing evidence of a similar move in Europe. A number of empirical questions surface with respect to the effectiveness of such events. First, do bank mergers, on average, create value? Second, are there merger characteristics that allow us to distinguish between bank mergers' announcement period returns?

The main objective of this essay is to analyze the effect of bank mergers on bidder, target and combined firms. For this purpose, the analysis is extended to a relatively larger data set (785 mergers) over a long time period (1980-2000). This large data set will provide a better opportunity to measure the full wealth effects from bank

mergers. Statistically, it has been shown that with small data sets, one or two unusual mergers can easily influence results.

This analysis differs from previous studies of bank mergers in three respects. First, this analysis of bank mergers spans a longer time period, with the advantage of considering more recent bank mergers. Second, this study reveals a detailed analysis of stock market returns pertinent to 785 mergers of U.S banks. Examining combined returns will help to determine the overall economic impact of the merger. In particular, the expected overall contribution of the merger is studied as opposed to only the expected value from either the bidder's or the target's standpoint.

Third, we introduce two new bank merger event-study models. Previous bank merger event studies utilize the standard market model methodology to find whether bank mergers generate abnormal returns for bidder, target and combined firms. There is a critical assumption in using the traditional event study methodology, including the linearity of the relationship and the independence and the homoskedasticity of the stock returns. In this essay, we construct an EGARCH model that is superior to the standard market model in the sense that it controls for the linearity, homoskedasticity and correlated error term assumptions of the standard market model. Violation of these assumptions could lead to inefficient estimators in the market model. Moreover, using a sample from the banking industry provides a control for industry-specific factors that could affect returns.

The common control in previous event studies is the market return. However, there may be other factors specific to each industry that should be included in order to obtain unbiased results. Unlike previous bank merger literature, this study goes beyond

the simple market model. We use a three-factor model that controls for exchange rate and interest rate shocks common to the banking industry.

This is the first attempt, to the best of our knowledge to focus on models used in the bank mergers event study. Hence, not only does this study evaluate bank mergers but it also investigates the results of two new different event study methodologies. The results show that the target bank shareholders experience significant positive abnormal returns while abnormal returns to bidding bank shareholders are significantly negative. For combined firms, cumulative abnormal returns are significantly positive. Comparing the results of both methodologies reveals that the modified market model may overstate the abnormal returns for bidder, target and combined firms. Therefore, we argue that basic conclusions regarding issues such as the wealth impact of bank mergers can depend on the chosen model. Actually, the empirical results suggest that the choice of methodology will affect inference about the magnitude effect of bank mergers. Accordingly, the failure to use accurate models to describe stock returns might be responsible for the mixed and contradictory results reached by earlier studies regarding the impact of bank mergers.

Finally, this study estimates cross-sectional regressions of the abnormal returns of target, bidder, and combined firms on a number of explanatory variables. In particular, we examine the effects of relative size, relative book-to-market value, method of payment, and the number of bidders on the abnormal returns of bidder, target, and combined firms. For bidder returns, the regression results demonstrate that the coefficient on relative size is significantly positive, suggesting that relatively large targets capture a significantly large merger premium. Interestingly, for bidders, abnormal return is

negatively related to relative size. The larger the target relative to the bidder, the smaller the CAR will be for the bidder. This result indicates that the bidders fare much worse when target is relatively large. This negative coefficient is consistent with the positive coefficient on relative size in the target returns if the higher returns to target shareholders in relatively large mergers lose bidder shareholders. Moreover, if the market believes the merger is value destroying for the bidder, the larger the relative size of the target, the more value will be transferred from the bidder to the target.

Empirical evidence suggests target, bidder, and combined firm returns are positively related to cash mergers. As for the number of bidders variable, it is negatively related to bidders' returns. The negative sign of this variable is consistent with the overpayment hypothesis. Also, there is evidence that diversifying mergers are bad for bidders. However, we fail to find evidence that this variable affects target and combined returns. It is worth noting that the results show that relative book-to-market values are not confirmed as relevant factors.

The remainder of this essay proceeds as follows. Section 1.2 presents some literature related to bank merger theory. Section 1.3 reviews the literature on bank mergers. Section 1.4 describes the data and summary statistics. Section 1.5 describes the methodologies followed in this essay. Section 1.6 represents the empirical findings. The last section concludes.

1.2.1 Traditional Views of the Value of Mergers

Merger activity results in overall benefits to shareholders when a consolidated, post-merger firm is more valuable than a simple sum of the two separate pre-merger firms; therefore synergy is said to exist. Such a merger should create value for both firms. The

primary cause of this gain in value is supposed to be the performance improvement following the merger. The research on post-merger performance gains has focused on improvements in one of several areas, namely, efficiency improvements, greater market power, or greater diversification. With regard to efficiency gains, greater cost savings are most commonly mentioned. Many mergers have been motivated by a belief that a significant quantity of redundant operating costs could be eliminated through the consolidation of activities.

A bank is said to have economies of scale when its average cost falls as output increases. Mergers enable costs to be lowered if scale, or scope, economies can be achieved. Larger institutions may be more efficient if redundant facilities and personnel are eliminated within the post-merger organization. Moreover, costs may be lowered if one bank can offer several products at a lower cost than separate banks each providing individual products. Cost efficiency may also be improved through merger activity, especially if the management of the acquiring institution is skilled at holding down expenses for any given level of activity.

1.2.1.1 Underlying theories

It has been documented that banks engage in mergers because mergers may improve banking efficiency by offering a more profitable product mix besides eliminating redundant costs and improving management. Banks may also merge to take advantage of increasing market power. In either case, it is expected to see, in an efficient capital market, a higher combined value (adjusted for the market movement) of the two merging banks upon the announcement of a merger (conditional on its being unanticipated).

Various theories have been introduced to explain the wave of bank mergers. For example, the efficiency hypothesis predicts that mergers enhance efficiency and help poor banks to survive as competition becomes increasingly intensive in the banking industry. Another well-cited hypothesis suggests that mergers increase the market power[2] due to reduced competition. In general, studies have introduced the following three incentives for the bank mergers:

(1) Operating economics, which result from economics of scale in management, marketing and production.

(2) Financial economics, including lower transaction costs and better coverage by security analysts.

(3) Differential efficiency, which implies that the management of one firm is more efficient and that the weaker bank's assets will be more productive after the merger.

1.3 Review of Literature

The great pace of merger activity in the banking industry has attracted a lot of interest in detecting the wealth effects produced by such deals. The merger activity should be primarily motivated by the desire to maximize shareholders' wealth. Therefore, one would expect the acquisition to generate synergies that can be achieved in several ways.[3] Specifically, a merger may exploit economies of scale, benefit from diversification in the product mix or in the geographic market extension, displace inefficient management, or enhance revenues by improving marketing. Geographic or product diversification can then be valuable in stabilizing returns. This can raise value by

[2] On the other hand, some argue that the barriers to entry instituted by previous banking regulations may have created more market power than current market concentration.

[3] See Pilloff and Santomero (1996) and Berger, Demsetz and Strahan (1999) for analytical review of the motivations behind a merger deal.

reducing the expected value of bankruptcy costs and, accordingly, reducing the cost of capital.

There is some evidence that efficiency gains are a rational motive for acquisition. Cornet and Tehranian (1992)[4] report improvement in profitability of 30 large target banks. Financial firms can also engage in merger activity to increase their market power, thus reducing competition. If so, prices can be raised allowing the merged firm to earn monopolistic profits. Despite the fact that antitrust authorities can refuse the approval of a merger that results in a significant reduction in competition, potential gains for greater market power can still be substantial. Indeed, there is some evidence that merger deals in the banking industry are designed to increase market power. For instance, intrastate mergers show higher returns than interstate mergers (Becher (2000), DeLong (1999), Houston and Ryngaert (1994)).

The pace of consolidation activity may also be determined by changes in the regulatory environment. To illustrate, the number of deals in the U.S. banking sector has increased significantly after the removal of restrictions on interstate expansion. Barriers to the geographic diversification may have allowed inefficient organizations to survive. In Europe, a major impulse to consolidation activity comes from the EU directives setting the freedom of operation of financial firms across national boundaries and the implementation of the monetary union. This fosters the benefits of diversification and achievable economies of scale in cross-border mergers. However, previous studies that

[4] In this paper we do not follow the approach of comparing pre-merger and post-merger performance using accounting data, but I analyze merger benefits based on the stock market reaction to merger announcements. A discussion of the two approaches as well as a survey of studies is provided by Rhoades (1994) and Pilloff and Santomero (1996).

examine the impact of mergers on bidders, targets, and combined firms in the financial industry show mixed results. The evidence is summarized in Table 1.1.

Table 1.1

Comparison of event studies on bank mergers

Authors	Period	Sample	Event window	Bidder return (%)	Target return (%)	Combined firm Return (%)
De Long (2001)	1988-1995	280	-10+1	-1.68***	16.61***	0.04
Becher (2000)	1980-1997	553	-30+5	-0.1	22.64***	3.03***
Pilloff (1996)	1982-1991	48	-20+0	n.a.	n.a.	1.32
Houston and Ryngaert (1997)	1985-1992	184	-2+2	-2.40	20.40***	n.a.
Houston and Ryngaert (1994)	1985-1991	153	-2+2	-2.32***	14.39***	0.38
Cornett and Tehranian (1992)	1982-1987	30	-1+0	-0.80**	8.00***	n.a.
Cornett and De (1991)	1982-1986	152	-1+0	0.55***	8.10***	n.a.
Toyne and Tripp (1998)	1991-1995	68		-2.25**	14.77***	0.46
James and Wier (1987)	1972-1983	60	-4+0	1.77***	n.a.	n.a.
Trifts and Scanlon (1987)	1982-1985	21		-3.25**	21.37*	n.a
Neely (1987)	1979-1985	26	-10+0 (week)	1.25	31.26***	n.a.

***, ** , and * denote significant at 1 %, 5% and 10% levels respectively.

Despite their sensitivity to event window selection and to the time period, previous studies agree that targets show significantly positive returns, while abnormal returns to bidder shareholders are significantly negative or at best insignificantly positive. However, the combined banking firm appears to enhance values and that is especially true in recent years.

If mergers, on average, fail to create value for their shareholders, it seems plausible that a merger results from managers who tend to serve their own interests mainly by raising their compensation as the size of the company they manage increases. Therefore, agency costs can help explain the wealth results in value enhancement. Put simply, managers may get involved in merger activity to emulate their competitors or to avoid becoming an acquisition target.

As reported in Table 1.1, we notice three important issues concerning the studies of bank mergers in the 1980s: the analysis is based on early time periods; the sample sizes are limited; and there is no analysis of combined firm returns (James and Weir,1987; Neely, 1987; Trifts and Scanlon, 1987). The empirical results of these studies are mixed for the bidder. Specifically, James and Weir (1987) and Neely (1987) show that bidder shareholders experience positive abnormal returns, while Trifts and Scanlon (1987) find that bidder shareholders experience negative abnormal returns. In addition, many of these studies have relatively small sample sizes. Trifts, and Scanlon (1987) examine 21 mergers over 4 years, Neely (1987) studies 26 acquisitions over 7 years, James Wier (1987) examines 60 out of 264 potential acquisitions over a 9-year period, while Toyne and Tripp (1998) examine 68 interstate acquisitions over a 5-year period.

It is noteworthy that only a few essays examine the overall wealth effects of bank mergers (Becher, 2000; Houston and Ryngaert (1994)). Houston and Ryngaert find that bank merger neither creates nor destroys value for a sample of 153 mergers between 1985 and 1991. The authors show that bidders lose and targets gain experience. Also, a recent study written by Becher (2000) indicates that target and combined shareholders receive a positive wealth gain while bidders at best break-even. His results, however, are sensitive to the event window and time period, with overall returns largest in the 1990s. A more recent study conducted by Houston et al. (2001) examines 64 large bank mergers from 1986-1996 and reports that overall these deals create value. Their results, however, pertain to a sample of large bank mergers only, and the authors do not test for cross-sectional variation in these returns.

Finally, the more recent studies of stock market reaction to bank mergers find that they do not create value for the combined firm, and target shareholders gain at the expense of bidder shareholders. Houston, James, and Ryngaert (2001) and Becher (2000) also find some evidence that target shareholders may gain at the expense of bidder shareholders. However, these authors find that bank mergers in the 1990s create value for the combined firms and are not solely the result of hubristic motives. There are several alternative explanations for these inconsistencies. On the one hand, these mergers may be wealth-creating events; however, a bidder firm might overpay for the acquisition of these synergies. On the other hand, there may be identifiable differences across mergers in that certain mergers are wealth creating while others are not.

1.3.1 Cross-Sectional Variations in Bank Mergers

Many theories have been proposed regarding the characteristics of a stock that affects its return. Fama and French (1992) challenge the Asset-Pricing Model of Sharpe (1964), Litner (1965), and Black (1972). Instead, they show that using beta alone does not properly estimate the expected return of a stock. They present evidence that both size and book-to-market value are characteristics that need to be represented in a relevant model for stock returns. Others, on the other hand, have analyzed the effects of size and many different characteristics upon the bidder's and target's stock returns. Furthermore, several studies have indicated that announcement returns may differ by merger characteristics. For example, DeLong (2001) reports that those mergers that focus both in geography and activity create value while all others do not. Also, Becher (2000) finds that target and bidder returns are related to the method of payment and number of bidders. For these variables, however, the author does not examine combined firm returns.

This section proposes to investigate the effects of relative book-to-market values and relative sizes. In addition, mergers are analyzed by method of payment, and number of bidders.

1.3.1.1 Effect of size and book-to-market value on returns of bank mergers

Fama and French (1992) find two variables that are consistently related to stock return: (1) the size of the firm, measured by the market value of its equity (MVE) (2) the book-to-market ratio (M/B). They report that small firms and firms with high B/M earn higher rates of return than the average stock. In addition, they find no relation between a

stock's beta and its returns. We expect this characteristic to follow in bank mergers as well. Accordingly, we investigate the following relationships.

Relative size (market value of target/ market value of bidder) could either have a positive correlation with the abnormal return of the target (small firm effect and small target are easier to be integrated to a large bidder) or a negative correlation (less synergy). Also, relative size could either have a positive correlation with the abnormal return of the bidder (smooth transaction and the merger is expected to be more easier to handle) or negative correlation (low synergy or diseconomies of scale). The empirical result will determine the sign of the above argument.

Fama and French (1992) also report that market-to-book value provides much information about stock's expected return. Thus, it is expected also to explain the abnormal return generated by a bidder, a target, and combined firm. A low market-to-book value ratio of the target, other things being equal, might signify to the bidder that the current management is not effectively using its assets, and that the current market value of the target is depressed because the management is inefficient. The hypothesis we test here is that the lower the market-to-book value ratio of the target firm, the higher the premium offered to the target firm's shareholders.

1.3.1.2 Medium of payment

It has been known for some time that the medium of payment used in mergers is an important factor to consider (see Carleton et al. 1983). It has also been noted that different methods of financing a project have different informational implications (Myers and Majluf 1984; Krasker 1986). Several hypotheses regarding a predictable relation between the medium of payment chosen and the bidder returns have been suggested in or

can be inferred from the existing literature. According to the bidder overvaluation hypothesis (see Myers and Majluf 1984), if the management of the bidding firm has superior inside information that the existing assets of the firm are overvalued (undervalued), they are more likely to undertake a stock-financed (cash-financed) merger. Rational market participation, on the other hand, will interpret a stock-financed (cash-financed) merger as a negative (positive) signal of the value of the existing assets of the bidding firm and react accordingly.

According to the wealth redistribution hypothesis, an unanticipated reduction in the leverage ratio (as is experienced with a stock-financed merger) makes outstanding debt less risky resulting in a transfer of wealth from stockholders to bondholders (Galai and Masulis 1976; Travlos 1987). Given that the cash flows of the two firms are not perfectly correlated, management has an incentive to finance the merger with stock because the default risk of the combined firm will decrease, thereby increasing the firm's debt capacity. Unless restructuring occurs, the bondholders of the merged firm will receive at least part of this benefit at the expense of the stockholders. As a result, share price reaction to the announcement of a stock-financed merger will reflect both the potential gains from the merger and the negative wealth redistribution effects. With a cash-financed merger no such wealth redistribution is experienced. Thus, according to both hypotheses, other things being equal, the returns to the shareholders of a bidding firm will be higher in a cash offer than in a common stock exchange offer.

The medium of payment used to finance a merger has also been widely examined. In examining the effects for bidders and targets, Toyne and Tripp (1999) infer that patterns in returns are driven by the method of payment. Amihud, Lev, and Travlos

(1990) and Houston and Ryngaert (1997) also report that mergers financed with stock appear to have lower abnormal returns than those financed with cash. Also, they find the more cash that is used to finance a merger, the greater the returns to the combined firms. On the other hand, recent studies by Delong (2001) and Becher (2000) report that the method of payment does not affect overall merger gains.

We will analyze mergers by method of payment: all cash or all stock. Cash is a binary variable equal to one if the merger is financed with 100% cash, while stock is a binary variable equal to one if the merger is financed with all stock. We hypothesize that returns to bidders when mergers are announced are related to the method of payment used to finance the mergers. Offers of stock are associated with negative returns to bidders, but cash offers generate positive returns. Hence mergers financed with stocks are a negative signal since the use of the stocks as a mean of payment is likely to occur when the stock is overvalued, while the use of cash is interpreted as the firm being undervalued. On the other hand, if target shareholders believe their bank is overvalued, they will prefer to receive cash. The sign of the regressing coefficient presumably reveals which effect dominates.

1.3.1.3 Number of bidders

An important factor that should be considered in our analysis is the number of bidders that a target firm received prior to merger. In this regard, the overpayment hypothesis has introduced in previous studies. The hypothesis suggests that if multiple firms bid on the same target, then returns to the winning bidder should be lower because this bidder is overpaying for the target in order to win the deal. If this hypothesis holds true, bidders who face competition have lower returns, target firms will experience higher

returns when there are multiple bidders. Lastly, this hypothesis does not predict the impact of such combination in combined firms. Accordingly, we hypothesize that returns to targets are larger when there are multiple bidders, which suggests that an increase in competition fir targets firms drives up premiums. Also, returns to bidders are lower when they are facing competition in the deal.

1.3.1.4 Interstate mergers

Previous research has found that bank merger returns differ for interstate (diversifying) versus intrastate (focusing) mergers. Interstate (intrastate) mergers are those mergers where the bidders and targets are not (are) located in the same state. Houston and Ryngert (1994) provide evidence that intrastate mergers gain significantly higher abnormal returns than interstate mergers. Also, DeLong (2001) reports that focusing mergers generate positive abnormal returns while diversifying mergers earn negative abnormal returns. We use the simple term of intrastate versus interstate merger to separate focusing from diversifying merger. Therefore, we include a dummy variable to control for geographic locations.

1.4 Methodology

1.4.1 Mergers Sample

This section looks at the data used to conduct this study. The merger data come from the M&A database of the Center for Research in Security Prices (CRSP) tapes .To create a sample of mergers during the 1980-2001 period, all firms from the Center for Research in Security Prices (CRSP) tapes that have a delist code in 200s (merger) or 300s (exchange) were selected. To focus on banks, all firms with three-digit SIC codes of 602 (banks) or 671 (holding companies) were chosen. Reviewing the Wall Street Journal

Index and the *Lexis-Nexis*[5] database identifies initial announcement dates. This resulted in preliminary sample of 1077 bank mergers.

To be included in this event study, it is required that both bidder and target had stock trading on one of the three main exchanges (the New York Exchange, the American Stock Exchange and the NASDAQ) over the entire event window and most of the estimation window. The daily stock prices, returns and other trading-related data are collected from the CRSP date tapes, and information of bank equities is from the COMPUSTAT data tape.

We notice that SIC code 671_ includes various types of holding companies (for example, both Transco Energy and Shawmut, the banking holding company for Shawmut National Bank, have SIC code of 6710). As a result, each firm with an SIC code of 671_ has to be examined to determine its primary business. Therefore, we have to search *Lexis-Nexis* for firms' primary business to determine if they qualify as banking firms. Also, we use the *Lexis-Nexis* database to identify target and bidder states.

From the preliminary sample, 172 firms are deleted because they are not bank holding companies (e.g. oil companies, shipping conglomerates. etc.), 34 additional firms are removed for technical reasons, and 86 are eliminated for missing key data.

This process results in a sample of 785 bank mergers from 1980-2000. For both the bidder and target firms we collect the following variables: target cusip, bidder cusip, initial merger-announcement date, completion date, target share price, bidder share price, bidder market value, target market value, method of payment, target state, bidder state.

Market data come from CRSP. Method of payment is determined by examining all announcements (in the Wall Street Journal and the *Lexis-Nexis*).

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[5] The *Lexis-Nexis* database contains full-text articles from several periodicals.

Finally, Table 1.2 provides descriptive statistics for selected variables to our bank mergers sample. Pane A presents descriptive statistics of the characteristics of target and bidder banks. The book value of total assets and the market value of equity are expressed in 1999 dollars using the consumer price index. Panel B shows merger characteristics for our sample. Of these 785 mergers, 73% are financed with cash and 12.5% are stock financed. 59% are classified as intrastate merger and 41% are interstate mergers. 91% are classified as single bidder mergers.

Table 1.2

Descriptive statistics for selected variables

Panel A: Bank characteristics

			Bidder firms		
Variable	Mean	Std Dev	Median	Minimum	Maximum
Market value of equity	9,209	18,119	4,786	15	197,547
Assets	29,810	49,362	13,216	12	265,231
			Target firms		
Market value of equity	3,622	6,723	489	4	59,591
Assets	8,150	23,383	971	5	315,108

Panel B: Merger characteristics

Variable	Full Sample	% of Full Sample
Cash Financed	785	73.20
Stock Financed	785	12.45
Intrastate	785	58.83
Interstate	785	41.17
Single Bidder Mergers	785	91.05

1.4.2 Methodology

In this section we apply two unique bank event study methodologies to calculate abnormal returns for bidder, target and combined firms. The first one is a modified market model that controls for shocks that are common to the banking industry. The second one is an EGARCH (1,1) that adjusts for the violated regression assumptions of the traditional market model event study. Specifically, it adjusts for the linearity assumption, the heteroskedasticity, and the correlation in the error term. Interestingly, to the best of our knowledge, none of the previous bank merger studies estimated abnormal returns using these two models.

1.5.2.1 Modified Market Model (Interest and exchange rate)

Using a sample from the banking industry provides a control for industry-specific factors that could affect returns. The common control in previous event studies is the market return. However, there may be other factors specific to each industry that should be included in order to obtain pure results. Sweeney and Warage (1986) provide evidence that investors demand a premium for interest rate risk. In their study, they include interest rate change variable in a simple market model to estimate abnormal returns. Hence in this study we go beyond the simple market model. We use modification of the standard market model that controls for exchange rate and interest rate to test if the merger announcement creates value. Unlike the previous bank mergers studies, the abnormal returns for bidders, targets, and combined forms will be calculated from the three factors model (market, interest and exchange rate). Previous research does not focus on this issue – instead it is much more concerned with the event window and controlling for the data in

which information was first revealed. By focusing on the banking industry, our model corrects for shocks that are common to the banking industry.

The globalization of the financial services industry has caused increasing exposure to foreign exchange risk. Foreign exchange risk arises from changes in foreign exchange rates that affects the values of assets, liabilities, and off-balance sheet activities denominated in currencies different from the bank's domestic currency. Such risk exists because most banks hold assets and issue liabilities denominated in different currencies. When the amount of assets differs from the amount of liabilities in a currency, exchange rate movement generates a gain or loss that affects the market value of the bank's stockholders' equity. This risk may exist in off-balance sheet loan commitments denominated in foreign currency.

Interest rate exposure on the other hand arises from the mismatch in the asset and liabilities of the financial intermediaries. Unexpected changes in the interest rate can significantly alter a bank's profitability. One definition of a bank's interest rates risk encompasses the volatility in net interest income associated with changing interest rates. All banks tend to mismatch their balance sheet maturities to some degree. Depending on the cash flow characteristics of a bank's assets and liabilities and the existence of embedded options, interest rate changes may raise or lower net interest income. The market model parameters are estimated (three times, on for the target, one for the bidder, and one for the combined firm) from the following three-factor model:

$$R_{it} = \alpha_i + \beta_{i,M} R_{M,t} + \beta_{i,F} R_{F,t} + \beta_{i,B} R_{B,t} + \varepsilon_{i,t} \qquad (1.1)$$

where,

R_{it} = the rate of return on security i (for the target, bidder and combined, as appropriate) on day t.

$R_{M,t}$ = the return on CRSP value weighted index on day t.

$R_{F,t}$ = the return on foreign exchange index on day t.

$R_{B,t}$ = the return on one-year T-bill index on day t.

α_i = the intercept term

$\beta_{i,M}$ = the market risk coefficient for security i.

$\beta_{i,F}$ = the foreign exchange risk coefficient for portfolio i.

$\beta_{i,B}$ = the interest rate risk coefficient for portfolio i.

$\varepsilon_{i,t}$ = the residuals.

The foreign exchange used in (1.1) is the Major Currencies Index.[6] The return is computed using the following formula[7]:

$$R_{F,t} = \frac{F_t - F_{t-1}}{F_{t-1}}$$

where Ft is the index value of foreign exchange on day t.

Interest rate returns are computed using the formula[8]:

$$R_{B,t} = \frac{B_t - B_{t-1}}{B_{t-1}}$$

[6] The major currencies index is a weighted average of the foreign exchange values of the U.S. dollar against a subset of currencies in the broad index that circulate widely outside the country of issue. The weights are derived from those in the broad index.
[7] Same as that used by Wetmore and Brick (1994.)
[8] Same as that used by Wetmore and Brick (1994)

where B_t is the interest of one-year T-bill on day t. Actual returns are used because there is no difference in the results regardless of whether or not interest rates are anticipated.[9] we also do not orthogonalize the indices, because Giliberto (1985) argues that orthogonalizing the indices results in biased estimators. Moreover, Kane and Unal (1998) argue that it is not apparent which index is the driving index and which is the driven one. Data for both the Indices are obtained from the Board of Governors of the Federal Reserve System.[10]

Modified market model parameters are estimated over day – 240 to day – 41 relative to the announcement date (t = 0). Returns are calculated using the modified model with the CRSP value-weighted index for market returns. Further, we define abnormal return for stock of firm i on day t as:

$$AR_{it} = R_{it} - \hat{R}_{it} \tag{1.2}$$

where,

$$\hat{R}_{it} = \hat{\alpha}_i + \hat{\beta}_{i,M} R_{M,t} + \hat{\beta}_{i,F} R_{F,t} + \hat{\beta}_{i,B} R_{B,t} \tag{1.3}$$

where α_i, $\beta_{i,M}$, $\beta_{i,F}$ and $\beta_{i,B}$ are modified market model parameters. As such, this model measures a bank's stock return in excess of the return to the whole bank group upon the merger announcement. If $R_{F,t}$ and $R_{B,t}$ are common factors to all the banks but are not already reflected in the market return, then abnormal returns estimates from the standard market model would be upward biased due the omitted variables problem. By including $R_{F,t}$ and $R_{B,t}$, the modified market model can gauge the impact of bank mergers more accurately. The cumulative abnormal returns (CARs) are calculated over several event

[9] Flannery and James (1984).
[10] All the information are available online from http://www.federalreserve.gov

windows to measure the impact of the merger announcement in the periods surrounding it. We hypothesize that abnormal returns (on the day of merger announcement) and the event period surrounding it are significantly different from zero, which implies that the market reacts to mergers.

Prior studies suggest that merger gains are typically not evenly divided between targets and bidders. Thus, we focus on wealth changes for bidder and target firms separately, as well as their combined. In doing this, a further step in my empirical evaluation is to evaluate abnormal returns of the combined firm (i.e. target plus bidder). Indeed, looking only at the two separate banks may give a partial and perhaps distorted interpretation of the market reaction merger's announcement. Therefore, we calculate abnormal returns of the combined firm using the method outlined in Houston and Ryngaert (1994).

$$\text{Combined Abnormal Return} = \frac{(MV_t * AR_t + MV_b * AR_b)}{(MV_t + MV_b)}$$

Where MV_t is the market value of the target firm's stock five days before the announcement date, MV_b is the market value of bidding firm's stock 10 days before the announcement date, AR_t and AR_b are the abnormal returns for the *i*th target and bidder firms over the event window. Houston and Ryngaert (1994) point out that this method gives the true percentage change in the value of the combined pre-merger firm.

1.4.2.2 EGARCH Event Study

Section 6.1 and previous bank merger event studies utilize the traditional event study methodology to test if the merger announcement creates abnormal returns. There is a critical assumption in using the traditional event study methodology including the linearity of the relationship, and the independence and the homoskedasticity of the stock returns.

However, the empirical studies about stock returns challenge the above assumptions. Carroll and Wei (1988) and Akgiray (1989) find some evidence against the linearity assumption. Roll (1984), Patel and Wolfson (1984), Jennings and Starks (1985) and French and Roll (1986) report autocorrelation in stock returns. Akgiray (1989) and Engle and Mustafa (1992) show that daily index stock returns and individual stock returns exhibit both autocorrelation and autoregressive conditional heteroskedasticity (ARCH) and generalized autoregressive conditional heteroskedasticity (GARCH). Hart and Apilado (1998) find that the banking stock returns exhibit ARCH and correlation. They use GARCH-M (1,1) event study methodology to examine for the bank returns reaction to bank merger regulations. They find that the GARCH-M (1,1) event study methodology outperforms the traditional market model event study methodology since involving the GARCH-M account for the risk-return trade off, the linearity assumption, the heteroskedasticity, and the correlation in the error term. The inclusion of the GARCH-M (1,1) is found to improve the efficiency of the estimated model parameters.

According to Hart and Apilado (1998), GARCH-M event study model accounts for the risk-return trade off, and the traditional OLS basic assumptions. However, it does not account for the asymmetric volatility or the leverage effect and the leptokurtosis

implied in the stock returns. The leptokurtosis implies that the stock returns have high dispersion, or the probability of getting outliers in gains (losses) is higher than the normal, [Mandelbort, (1963)].

Elyasiani and Mansur (1998) suggest that because the banking industry is highly leveraged then the inclusion of the GARCH models in the mean equation of the banking returns is extremely important. According to Elyasiani and Mansur (1998), we expect to see more negative skewness in the bank returns compared with other industries. Thus, in the banking industry, the increase in volatility following the negative returns would be higher compared with other sectors because of the high leverage ratio in the banking sector. Regarding the fat-tailed phenomenon, Hentschel (1995) reports that this leptokurtosis is reduced when returns are normalized by the time-varying variances of GARCH Models, but it is by no means eliminated.

In short, many studies have shown that daily stock returns may not follow the standard assumptions of traditional event study methodology. To our best knowledge, most previous bank merger studies incorporate those assumptions. Violation of these assumptions could lead to inefficient estimators in the market model.

Therefore in evaluating full wealth effects from banks mergers, we utilize the EGARCH event study methodology. The main purpose of EGARCH model is to provide a more statistically efficient event study methodology. It also accounts for the violated regression assumptions of the traditional market model event study. In doing so, we take the asymmetric volatility phenomenon of the returns into account. Among the GARCH family, the EGARCH model proposed by Nelson (1991) is one of the models that allow for the inclusion of the leverage/asymmetry term γi. Hentschel (1995) argues that the

EGARCH model does not impose sign restriction on ω, δ, ψ and γ. Nelson and Cao (1992) argue that the nonnegativity constraints in the linear GARCH model are too restrictive. The GARCH model imposes the nonnegative constraints on the parameters ω, δ, ψ and γ, while there is no restrictions imposed on these parameters in the EGARCH model, the conditional variance *σ2t* is an asymmetric function of lagged disturbances ε*t-i*.[11]

$$\ln \sigma_t^2 = \omega + \sum_{i=1}^{p} \delta_i \ln \sigma_{t-i}^2 + \sum_{i=1}^{q} \psi_i \frac{|\varepsilon_{t-i}| + \gamma_i \varepsilon_{t-i}}{\sigma_{t-i}} \qquad (4)$$

We employ the EGARCH (1,1) in our formulation since many studies including Bollerslev (1986), Akgiray (1989), and Elyasiani and Mansur (1998) report that the $p = 1$, and $q = 1$ for the conditional (σ2) and unconditional (ε) variance lags are the best in describing the economic and finance data. Then the market model with the EGARCH (1,1) specification will take the following form:

$$R_{it} = \alpha_{1i} + \beta_{1i} RM_t + \beta_{2i} \left(\omega + \delta_i \ln \sigma_{t-1}^2 + \psi_i \frac{|\varepsilon_{t-1}| + \gamma_i \varepsilon_{t-1}}{\sigma_{t-1}} \right) + \mu_{it} \qquad (5)$$

i in equation (5) represents the financial institution, where *i* in equation 4 represents the lag. β2*i* is the EGARCH coefficient, which specifies the risk-return relationship. Accordingly, we expect to find a negative sign for this coefficient; μ*it* is a white noise random error. Equation (5) is estimated for each bank in the sample. Then the abnormal return AR*it* is calculated as the difference between the actual return and the predicted return as estimated from equation (5) for each company *i* for each day *t* around the bailout date as follows,

[11] For the problems arising from testing GARCH models that imposes restrictions on ω, δ, and ψ see Hentschel (1995).

$$AR_{it} = R_{it} - [EGARCH(1,1)] \quad (6)$$

where

AR_{it} : the abnormal return of bank i on day t (where t = 0, the announcement day)

R_{it} : the actual return of bank i on day t=0

Abnormal returns (ARs) are calculated for each target, bidder, and combined firm. Further, the cumulative abnormal returns (CARs) are calculated over several event windows to better evaluate the market reaction before and after the merger announcement date.

1.4.3 Regression Analysis of Merger Returns

As noted, prior studies provide information about the expected correlation between abnormal returns and relative size, relative book-to-market value, method of payments, number of bidders -sectional differences in bank merger returns. This section attempts to gain insight into which of the independent variables has a significant influence on target, bidder and combined abnormal returns. Toward this end, we conduct multiple regression analysis because it is possible that multiple explanatory variables influence bank merger returns. In the cross-sectional test, the dependent variable is either the combined, bidder or target firm cumulative abnormal announcement period returns.

we will use the following model

$$\begin{aligned}\text{CAR(-1,0)}_{\text{i}} = {} & \alpha_i + \beta_1 \log \text{size}_{\text{i}} + \beta_2 \text{BVM}_{\text{i}} + \beta_3 \text{number of bidders}_{\text{i}} + \beta_4 \text{cash (dummy)}_{\text{i}} + \\ & \beta_5 \text{stock (dummy)}_{\text{i}} + \beta_6 \text{Interstate (dummy)}_{\text{i}} + \mu_i\end{aligned}$$

where:

$CAR(-1,0)$: the two-day (t=-1 to t=0) cumulative abnormal returns for bank i.

Size: relative size of the bank to be acquired, measured as the market value of the target divided by the market value of the bidder at the time of merger.

BMV: relative book-to-market value of the bank to be acquired, measured as the book-to-market value of the target divided by the book-to-market value of the bidder at the time of merger.

Number of bidders: the number of firms that bid for the target firm within a one-year window.

Cash (dummy): dummy variable equal to 1 if all cash financed and 0 otherwise.

Stock (dummy):.dummy variable equal to 1 if all stock financed and 0 otherwise.

Interstate (dummy): dummy variable equal to if interstate merger and 0 otherwise.

α_i : intercept term

1.5 Results

We report the empirical results for the modified market model and the new bank event study methodology (EGARCH). This will enable us to compare the outcomes of two different methodologies

1.5.1 Results form the Modified Market Model

1.5.1.1 results for targets and bidder

Extending the analysis to a relatively larger data set (785 mergers) over a longer time period (1980-2000) will provide a better opportunity to measure the full wealth impact from the bank mergers. Results from employing event study methodology are presented in Table 1.3. We observe that the CARs for target banks are positive for all intervals and statistically significant in most windows except for two event windows

[(+1,+5) and (+1,+10)]. The positive cumulative abnormal return is the highest for the 21 day window (-10,+10) with 8.63%, while it reaches the lowest for the window (-5,-1) with 4.97%. We can compare the results presented in Table 1.3 with those reported in previous studies (Table 1.1). For a two-day excess return our results (about 7.5%) are similar to those reported in the study of Cornett and Tehranian (1992). DeLong (2001) reports a mean CAR of 16.61% for the twelve-day window, while our closest event window shows a mean of 5.84%. Becher (2000) over an 11-day event window (-5,+5) finds that target significantly gains value (16.94%), while we also find that the target significantly gains value, the gains are less (7.59%). The results seem to indicate that mergers are anticipated a few days before the announcement day. There is a sharp increase in the CARs about one week before the announcement date, and there is a downward trend in the days following the announcement.

Table 1.3

Cumulative abnormal returns (Target Banks)

	Modified Market Model		EGARCH (1,1) Model	
Event Windows	Return (%)	t-statistic	Return (%)	t-statistic
CAR (-10,-1)	5.84	2.49**	1.05	1.65**
CAR (-5,-1)	4.97	9.53***	0.73	2.82***
CAR (-1,0)	7.45	15.28***	0.14	5.17***
CAR (0,+1)	7.96	4.24***	0.31	2.15**
CAR (+1,+5)	-3.14	-1.67	-0.21	-0.96
CAR (+1,+10)	-5.01	-1.33	-0.47	0.23
CAR (-1,+1)	7.65	10.46***	0.27	2.07**
CAR (-5,+5)	7.59	6.13***	0.76	3.45***
CAR (-10,+10)	8.63	5.14***	1.72	1.38*

***Indicates statistical significant at the 0.01 level.
**Indicates statistical significant at the 0.05 level.
*Indicates statistical significant at the 0.10 level.

For bidders (Table 1.4), we observe that the cumulative abnormal returns are slightly negative for most event windows except for the (+1,+5) and (+1,+10) windows. CARs are positive in those windows but they are statistically insignificant. It is noteworthy that bidder banks show a less significant loss in the shorter event windows. It seems that our results are consistent with some of the empirical literature reported in Table 1. For instance, Cornett and Tehranian (1992) over a 2-day event window (-1,0) find a CAR of –0.80%; our comparable CAR is –0.18%. The magnitude of the bank mergers in bidders deserves some comment with respect to previous results (Table 1.1). Our results show that bidder banks lose less than what is reported in previous work.

Table 1.4

Cumulative abnormal returns (Bidder Banks)

	Modified Market model		EGARCH (1,1) Model	
Windows	Return (%)	t-statistic	Return (%)	t-statistic
CAR (-10,-1)	-0.73	0.02	0.26	1.02
CAR (-5,-1)	-0.54	-0.41	0.08	.40
CAR (-1,0)	-0.26	-2.13*	-0.17	-1.72**
CAR (0,+1)	-0.18	-1.97*	-0.06	-2.19**
CAR (+1,+5)	0.55	1.52	-0.04	-2.3**
CAR (+1,+10)	0.82	-1.43	-0.16	-0.92
CAR (-1,+1)	-0.33	-2.22**	-.05	-1.86**
CAR (-5,+5)	-0.09	-1.98**	-.10	-1.64**
CAR (-10,+10)	-0.88	-1.84*	-0.14	-2.3**

***Indicates statistical significant at the 0.01 level.
**Indicates statistical significant at the 0.05 level.
*Indicates statistical significant at the 0.10 level.

For instance, the negative CAR reaches -0.73% for the window (-10,-1), while DeLong (2001) over a similar event window find a CAR of –1.68%. Also, the CAR reaches -0.33% over the window (-1,+1), while Houston and Ryngaert (1994) over a similar window find a CAR of –2.32%.

These results indicate that bidder shareholders realize significantly negative abnormal returns while target bank shareholders gain significantly. Our results suggest that mergers have increased only target shareholders' wealth, which does not support the theoretical hypothesis that mergers are driven by synergies. In general, our results are consistent with most empirical literature on the banking sector. For instance, Becher (2000) over an 11-day event window (-5,+5) finds that the bidder significantly loses value (-.88%), while Cybo-Ottone and Murgia find a positive but insignificant abnormal return of 0.31% for bidder banks. On the other hand, research by Cornett and De (1991) indicate positive abnormal return for bidders, while Cornett and Tehranian (1992), Houston and Ryngaert (1994), and Neely (1987) provide results supporting the theory that bidder bank shareholders realize non-positive or negative returns.

1.5.1.2 Combined firm returns

Table 1.5 reports cumulative abnormal returns for combined firms. The results indicate that bank mergers create value for combined firms, with a statistically significant positive mean. These results are robust to event window and measurement of value changes. This result is consistent with recent studies of bank mergers (Becher, 2000; Houston et al., 2001). However, it contrasts with a number of prior studies that find negligible evidence of value creation (see. e.g., Houston and Ryngaert, 1999; James and Wier, 1987; and DeLong, 2001). All of these studies find that the average combined

return to the bidder and target is insignificantly positive. In other words, combined partners neither create nor destroy value.

1.5.1.3 Summary of CARs

Our results indicate that bank mergers create value for shareholders of the combined firms. These findings are consistent with recent studies of mergers (Becher,2000; Houston et al. 2001). However, bidder and target shareholders do not share gains equally. Consistent with prior studies, bidder shareholders lose value while target shareholders gain significantly.

Table 1.5

Cumulative abnormal returns (Combined Firms)

	Modified Market model		EGARCH (1,1) Model	
Windows	Return (%)	t-statistic	Return (%)	t-statistic
CAR (-10,-1)	1.53	2.06*	0.58	3.31***
CAR (-5,-1)	0.44	2.93**	0.25	2.92***
CAR (-1,0)	3.01	3.34***	0.10	2.74***
CAR (0,+1)	3.24	2.20*	0.28	1.97**
CAR (+1,+5)	0.18	0.37	-0.04	-0.45
CAR (+1,+10)	1.03	0.29	-0.26	-0.63
CAR (-1,+1)	3.82	1.81*	0.22	3.51**
CAR (-5,+5)	2.26	2.51**	0.37	2.39***
CAR (-10,+10)	4.74	2.86**	0.54	1.69**

***Indicates statistical significant at the 0.01 level.
**Indicates statistical significant at the 0.05 level.
*Indicates statistical significant at the 0.10 level.

1.5.2 Results from the EGARCH Model

The main purpose of EGARCH (1,1) is to take care of linearity of the relationship, and the independency and the homoskedasticity of the stock returns.

Table 1.3 reports the cumulative abnormal returns (CARs) for bidders, targets and combined firms using EGARCH (1,1) methodology. It should be noted that the same computation from Table 1.2 are calculated using the EGARCH (1,1) methodology. The results are consistent with prior research: target shareholders enjoy gain while bidder shareholders suffer negative returns. Also, the results show that bank mergers create value for combined firms. These results are robust to the event window. We observe important notes when the EGARCH (Table 1.3) methodology abnormal returns are compared to the modified market methodology abnormal returns (Table 1.1). For targets, the EGARCH (1,1) methodology shows less statistically positive CARs than that of the modified market methodology. Table 1.3 shows that, generally, the targets experience positive wealth gains; the magnitude and the level of significance depend on the event window. We observe that the highest gains (1.72%) occur over the 21 day (-10,+10) window and the lowest gains (0.14%)occur over the (-1,0) window. Table 2 shows that the targets experience the highest gains (8.63%) occur over the (-10,+10) and the lowest gains (4.97%) occur from days-5 to +1.

As for the bidders, the EGARCH (1,1) methodology shows less statistically negative CARs than that of the modified market methodology. Table 1.4 shows that the highest loss (-0.17) occurs over the 2 day (-1,0) window and the lowest loss (-0.04%) occurs over (+1,+5). Table 3 shows that the highest loss (-0.88) occurs over (-10,+10) and the lowest loss (-0.09%) occurs over (-5,+5). The same result is observed for the combined firms. These results indicate that merger is regarded good news for targets and as bad news for bidders. These results are consistent with previous studies. But our results are more robust, because EGARCH provides more efficient estimator and also

accounts for the violated regression assumptions of the traditional market model event study. It is noteworthy that the EGARCH (1,1) methodology shows that bank merger create less value for the combined firms than that of the modified market methodology. These results may suggest that the using the modified market methodology may overstate the CARs. In other words, the gain from bank mergers is exaggerated using the modified market methodology. In short, the results show that empirical conclusions may differ when abnormal returns are estimated using a modified market model, rather than using an EGARCH (1,1) model.

Table 1.6

Target Cumulative abnormal returns by time period

	1980-1990		1991-2000		1980-1990 versus 1991-2000
Event Windows	Return (%)	t-statistic	Return (%)	t-statistic	p-values
CAR (-10,-1)	0.96	3.58**	2.22	2.11**	0.39
CAR (-5,-1)	0.63	3.32**	1.61	1.86**	0.03
CAR (-1,0)	0.22	1.83**	0.45	0.69	0.02
CAR (0,+1)	0.42	3.48***	2.96	1.96**	0.11
CAR (+1,+5)	-0.22	-1.17	-0.19	-1.67	0.45
CAR (+1,+10)	-0.59	-1.19	-0.68	-1.33	0.37
CAR (-1,+1)	0.49	3.36***	1.01	2.06**	0.06
CAR (-5,+5)	0.55	1.96**	0.78	1.88**	0.09
CAR (-10,+10)	0.52	1.33*	1.89	1.73**	0.01

Note: expected return is estimated from the EGARCH (1,1) model parameters. The null hypothesis is that average (cumulative) abnormal returns are not statistically different from zero. Column 6 provides p-values of t-tests. t-tests are constructed comparing CARs from 1980-1990 versus 1991-2000.
***Indicates statistical significant at the 0.01 level.
**Indicates statistical significant at the 0.05 level.
*Indicates statistical significant at the 0.10 level.

1.5.3 Analysis of Sub-samples

The above results show that the target bank shareholders enjoy significant positive abnormal returns while abnormal returns to bidding bank shareholders are significantly negative. For combined firms, cumulative abnormal returns are significantly positive.

It can be instructive to examine whether those findings pervade our entire sample or is confined to certain sub-samples. Accordingly, we next subdivide our results by time periods (1980-1990 versus 1991-2000) and by size (large mergers versus small mergers).

We first examine the effects of bank mergers over time. In doing so, CARs are estimated for time periods: 1980-1990 and 1991-2000. CARs for bidders across the two time periods are reported in Table 1.6. It appears that there is much difference in valuation effects between the two periods (1980-1990 vs.1991-2000). The positive evaluation effects appear to be more pronounced for bidder banks involved in a merger during the period 1991-2000 than those involved in the period 1980-1990. Returns to targets in the 1980-1990 period range from over the all event windows from 0.22% in the (-1,0) window to 0.96% in the (-10,-1) window, while returns in the 1991-2000 period rage from 0.45% in the (-1,0) window to 2.96% in the (0,1) window. It is interesting to note that the 1991-2000 period differs significantly from 1980-1990 (see column 6). This difference indicates that target returns in the 1990s are statistically more positive than in the 1980s.

For bidder banks (Table 1.7), returns in the 1980-1990 period range over all event windows from –0.36% in the [(-1.0), t = -2.35] to 0.02%in the [(+1,+5), t=0.30], while returns for bidders in the 1991-2000 period range from –0.15% (t=-1.81) to

0.48%(t=0.23). Clearly, returns appear to be higher in the 1990s, however, statistical shows that the 1980-1990 period does not differ from 1991-2000 period. For the combined firm (Table 1.8), CARs follow a similar pattern to target returns (Table 1.6). In particular, the combined firm returns are more positive in the 1991-2000 period than in the 1980-1990 period. Collectively, our findings indicate that more recent bank mergers (those occurring in the 1990's) have greater positive abnormal returns.

Table 1.7

Bidder Cumulative abnormal returns by time period

	1980-1990		1991-2000		1980-1990 versus 1991-2000
Event Windows	Return (%)	t-statistic	Return (%)	t-statistic	p-values
CAR (-10,-1)	-0.19	-0.83	0.48	0.23	0.17
CAR (-5,-1)	-0.25	-0.76	-0.03	1.96**	0.35
CAR (-1,0)	-0.36	-2.35***	-0.14	-1.86**	0.62
CAR (0,+1)	-0.07	-1.85**	0.01	0.78	0.33
CAR (+1,+5)	0.02	0.30	0.08	0.57	0.49
CAR (+1,+10)	-0.36	-1.69**	-0.12	-1.66*	0.30
CAR (-1,+1)	-0.27	-0.40	-0.15	-1.81*	0.01
CAR (-5,+5)	-0.11	-1.68**	-0.06	0.77	0.27
CAR (-10,+10)	-0.23	-2.24***	-0.08	-1.97	0.22

Note: expected return is estimated from the EGARCH (1,1) model parameters. The null hypothesis is that average (cumulative) abnormal returns are not statistically different from zero. Column 6 provides p-values of t-tests. t-tests are constructed comparing CARs from 1980-1990 versus 1991-2000.
***Indicates statistical significant at the 0.01 level.
**Indicates statistical significant at the 0.05 level.
*Indicates statistical significant at the 0.10 level.

Table 1.9 presents returns of bank mergers categorized into large merger and small mergers. As we observe from this table, the two sub-samples of mergers

experienced significant positive abnormal returns. The analysis shows that returns for large mergers are greater than those for small mergers. For example, CRA (-10,10) for large mergers is 6.02%, compared with 1.44% for small mergers. However, statistical tests show (column 6) that large mergers do not differ from small mergers.

Table 1.8

Combined Cumulative abnormal returns by time period

	1980-1990		1991-2000		1980-1990 versus 1991-2000
Event Windows	Return (%)	t-statistic	Return (%)	t-statistic	p-values
CAR (-10,-1)	0.53	0.92	0.75	1.34*	0.09
CAR (-5,-1)	0.18	0.94	0.35	1.03	0.06
CAR (-1,0)	0.08	1.72**	0.31	1.29*	0.03
CAR (0,+1)	0.16	2.18***	0.56	1.30*	0.01
CAR (+1,+5)	-0.02	0.10	0.04	1.05	0.08
CAR (+1,+10)	-0.09	0.54	0.02	1.22	0.10
CAR (-1,+1)	0.11	1.40*	41	1.36*	0.00
CAR (-5,+5)	0.22	1.65**	0.94	1.56**	0.04
CAR (-10,+10)	0.35	1.73**	1.09	1.31*	0.02

Note: expected return is estimated from the EGARCH (1,1) model parameters. The null hypothesis is that average (cumulative) abnormal returns are not statistically different from zero. Column 6 provides p-values of t-tests. t-tests are constructed comparing CARs from 1980-1990 versus 1991-2000.
***Indicates statistical significant at the 0.01 level.
**Indicates statistical significant at the 0.05 level.
*Indicates statistical significant at the 0.10 level.

Table 1.9

Combined cumulative abnormal returns by size

	Large Mergers		Small Mergers		Large versus Small
Event Windows	Return (%)	t-statistic	Return (%)	t-statistic	p-values
CAR (-10,-1)	0.61	1.45*	0.37	0.92	0.07
CAR (-5,-1)	0.33	1.19	0.13	0.94	0.21
CAR (-1,0)	0.27	2.09***	0.05	1.76**	0.61
CAR (0,+1)	0.45	3.06***	0.18	2.88***	0.20
CAR (+1,+5)	0.12	2.96**	-0.06	-0.60	0.16
CAR (+1,+10)	0.08	1.09	-0.29	-0.82	0.30
CAR (-1,+1)	0.31	3.80**	0.11	1.45*	0.15
CAR (-5,+5)	0.49	5.09**	0.14	1.67*	0.55
CAR (-10,+10)	0.56	6.02***	0.51	1.44*	0.29

Note: expected return is estimated from the EGARCH (1,1) model parameters. The null hypothesis is that average (cumulative) abnormal returns are not statistically different from zero. Column 6 provides p-values of t-tests. t-tests are constructed comparing CARs from large mergers versus small mergers.
***Indicates statistical significant at the 0.01 level.
**Indicates statistical significant at the 0.05 level.
*Indicates statistical significant at the 0.10 level.

Table 1.10

Expected signs of independent variables

Independent Variables	Target	Bidder	Combined
Log (ME of target/ME of bidder)	?	?	?
Log (BM of target/BM of bidder)	?	?	?
Payment in Cash (dummy)	+	+	+
Payment in Stock (dummy)	-	-	-
Interstate Merger (dummy)	-	-	-
Single Bidder	-	+	?

1.5.4 Cross-Sectional Analyses

We learn from section 7.2 that any single set of results based on a specific model should be interpreted within the context. This is especially true if further regressions are estimated to find out the factors that determine the CARs in response to bank merger announcement. In a regression, the estimated CARs are used as the dependent variable. Hence such regressions may become meaningless if the initial abnormal return estimates are not robust. Our model (1.1) is regressed using weighted ordinary least squares to find the coefficients based upon the sample collected. The only correction to be made is the use of White Heteroskedasticity-Consistent Standard Errors (1980) and Covariance in an effort to control for heteroskedasticity. All variables are linear in parameters except for size, which has been transformed using natural log in an effort to stay consistent with the work of Fama and French (1992).

We report the results of cross-sectional regression analyses in Table 1.11 (targets), Table 1.12 (bidders) and Table1.13 (combined). Following Houston and Ryngaert (1994), we run regressions with and without separate year dummies that are included to control for any changes over time that are not captured in the independent variables. We observe that the relative size seems to be statistically significant in these 3 tables. The coefficient for relative size is negative in Table 1.12. This means that the relative size does affect bidders' returns negatively (i.e. relative size is associated with lower bidder returns). Also, it suggests the market reacts more unfavorably when the relative size increases. Accordingly, the bidding bank experiences lower abnormal returns, indicating low synergy or diseconomies of scale. Also, this could support the

overpayment hypothesis in sense that the bidder is willing to pay a higher premium in expecting of potential synergy resulting from merger.

Table 1.11

Cross-sectional regression results for target firms

Independent Variable	Regression 1	Regression 2
Intercept	0.246	0.361
	(0.74)	(2.78)***
Log (ME of target/ME of bidder)	0.011	0.0198
	(2.02)**	(2.34)**
Log (BM of target/BM of bidder)	-0.042	-0.023
	(-1.34)	(-1.62)
Payment in Cash (dummy)	0.056	0.196
	(3.12)***	(2.70)***
Payment in Stock (dummy)	-0.0303	-0.210
	(-1.61)	(-1.04)
Interstate Merger (dummy)	-0.135	-0.187
	(-0.524)	(-.68)
Number of Bidders	0.018	0.192
	(1.36)	(1.66)
Year Dummies	No	Yes
Adjusted R2	0.158	0.212

***, ** , and * denote significant at 1 %, 5% and 10% levels respectively.

As for the target and combined firms (Table 1.11 and 1.12), the positive coefficient on the relative size indicates that the cumulative returns for the target increase significantly as the target size increases relative to the bidder size. This result is consistent with the economics of scale hypothesis, suggesting the larger the target relative

to the bidder, the greater the abnormal returns to target and combined firms. Indeed, the economics of scale argument suggests that the coefficient should be positive. Put differently, this observation supports the hypothesis that one motivation of bank mergers is the economics of scale or economics of scope.

Table 1.12

Cross-sectional regression results for bidder firms

Independent Variable	Regression 1	Regression 2
Intercept	-0.136	-0.155
	(-0.53)	(-0.74)
Log (ME of target/ME of bidder)	-0.142	-0.119
	(-2.44)**	(-3.02)***
Log (BM of target/BM of bidder)	-0.034	-0.007
	(-0.225)	(-0.55)
Payment in Cash (dummy)	0.024	0.028
	(2.05)**	(2.39)**
Payment in Stock (dummy)	-0.161	-0.178
	(-.284)**	(-3.45)***
Interstate Merger (dummy)	-0071	-0.066
	(-5.09)***	(-5.38)**
Number of Bidders	-0.126	-0.411
	(-2.47)**	(-2.54)**
Year Dummies	No	Yes
Adjusted R2	0.29	0.31

***, ** , and * denote significant at 1 %, 5% and 10% levels respectively.

Another interesting interpretation to this result suggests that relatively large targets gain significantly larger merger premiums. For bidder returns, the negative coefficient is consistent with positive coefficient on relative size in the target regression if the higher returns to target in relatively large deals hurt bidder firms.

Table 1.13

Cross-sectional regression results for combined firms

Independent Variable	Regression 1	Regression 2
Intercept	0.059	0.086
	(2.12)**	(2.23)**
Log (ME of target/ME of bidder)	0.008	.039
	(5.07)***	(5.42)***
Log (BM of target/BM of bidder)	0.025	0.033
	(0.79)	(1.42)
Payment in Cash (dummy)	0.008	0.029.
	(2.02)**	(2.35)**
Payment in Stock (dummy)	-0.013	0.059
	(-0.21)	(1.16)
Interstate Merger (dummy)	-0.024	0.013
	(-0.83)	(0.35)
Number of Bidders	-0.032	0.015
	(-0.59)	(0.19)
Years Dummies	No	Yes
Adjusted R2	0.221	0.257

***, ** , and * denote significant at 1 %, 5% and 10% levels respectively.

We observe that payment in cash is positive and significant in all regressions. The coefficient on the cash dummy variable is significantly positive for targets, bidders and

combined firms. This result indicates that the market reacts positively to the announcement of mergers that are financed with cash. As for the payment in stock, the coefficient is only negatively significant for bidders. It seems that the rational market participants interpret a cash financed merger as a positive signal of the existing assets of the bidding bank and react accordingly. This implies that the bidder, target and combined receive a positive wealth gain when mergers financed with all cash. These results are consistent with Toyne and Tripp (1999) and Houston and Ryngaert (1994). They report that mergers financed with stock have lower abnormal returns than those financed with cash. However, these results contradict recent studies by Delong (2001) and Becher (2000) who report that the method of payment does not influence returns to combined firms.

It is worth noting that the number of bidders is only statistically significant in Table 1.12. This variable is negatively related to bidders returns. The negative sign of this variable is consistent with the overpayment hypothesis that predicts if more than one bidder bid on the same target, the winning bidder will overpay for the target to get the deal. As a result, the bidder return will be lower in this case. Surprisingly, this variable does not affect target and combined returns. This is inconsistent with our hypothesis that predicts target firm will experience higher returns where there are multiple bidders.

The coefficient for interstate variable is statistically different from zero only in bidder returns (Table 1.12). The results indicate that interstate (diversifying) mergers create negative abnormal returns to bidders. Relative book-to-market ratio variable is never statistically significant. These results indicate that the relative book-to-market ratios are not confirmed as relevant factor in our sample. Finally, the yearly dummies

appear to provide additional explanatory power when included in the regression specifications.

1.6 Conclusion

In this essay, we attempt to measure the wealth effect of bank mergers announcements on participating banks. For this purpose, we utilize two new bank event study methodologies. This is the first essay to apply these two event study methodologies in bank mergers. The first one is a modified market model that adjusts for exchange and interest rates. If exchange and interest rates are common factors to all the banks but are not already reflected in the market return, then abnormal returns estimates from the standard market model would be biased due the omitted variables problem. We argue that, by including exchange and interest rates, the modified market model can estimate the impact of bank mergers more efficiently. The second one is an EGARCH (1,1) that takes into account the basic shortcoming of the standard market model event study. Specifically, it adjusts for the linearity assumption, the heteroskedasticity, and the correlation in the error term. The presence of heteroskedasticity results in unbiased but inefficient coefficient estimators and biased estimators of the coefficient variances. It is worth of mentioning that none of the previous bank merger studies estimated abnormal returns using these two models. The results of two methodologies show that the merger is regarded as good news for the target and combined shareholders and as bad news for the bidder shareholders. However, EGARCH (1,1) methodology shows that bank merger generate lower value for the combined firms than that of the modified market methodology, suggesting the using the modified market methodology may overstate the CARs. In other words, the gain from bank mergers is exaggerated using the modified

market methodology. Hence, we argue that basic conclusions about the effects of bank mergers may vary as the choice models describing stocks returns varies (i.e. modified market model or EGARHC).

The second objective of this essay is to investigate the effects of relative size, relative book-to-market value, method of payment, number of bidders on the abnormal returns of bidder, target and combined firms. Toward this end, we run a weighted ordinary least squares regression using White's method (1980) to control for heteroskedasticity. We find evidence that the relative size does affect positively the target returns and negatively bidder returns. These findings imply that relatively large targets capture significantly large merger premium. Also, larger targets make worse deals for the bidder (i.e. are larger negative NPV for bidder). As for the method of payment, we find that target; bidder and combined firms returns are positively related to cash mergers. As for the number of bidders variable, it is negatively related to bidders returns. The negative sign of this variable is consistent with the overpayment hypothesis. Also, interstate mergers are negatively related to bidder abnormal returns, suggesting diversifying mergers are associated with lower returns. Finally, we fail to find evidence that number of bidder and interstate merger variables affect target and combined returns. Also, it appears that relative book-to-market values are not relevant factors to abnormal returns.

CHAPTER 2

LONG-RUN PERFORMANCE FOLLOWING U.S. BANK MERGERS & ACQUISITIONS

2.1 Abstract

This essay examines the long-run stock and operating performance of bank mergers during period (1985-1999). To this end, the essay compares the post-merger performance with the pre-merger performance of the merging banks utilizing pre-and post-merger accounting data. The performance effects measured by profitability ratios are mixed. Merged banks show no significant improvement in return on assets relative to their peer group, while they have significant improvements in return on equity. The sub-period analysis suggests that more recent bank mergers have more positive effects than earlier mergers, and that large targets are associated with more successful mergers.

A buy-and-hold abnormal return technique and the Fama and French (1993) three-factor model are used to evaluate the long-run returns following bank mergers. The empirical evidence indicates that merged banks have significantly under-performed their peer group of non-merged banks. Such poor performance can be attributed to the larger banks in the sample, suggesting that size is an important explanatory variable of long-run post-merger performance. Finally, we examine each calendar year to determine if the underperformance is concentrated in certain years of the study, and find evidence that

more recent bank mergers are associated with better performance than earlier mergers. However, the average performance of recent mergers is still worse than that of comparably sized banks. Overall, the analysis shows poor stock and operating performance in the years following bank mergers.

2.2 Introduction

The last decade has witnessed an unprecedented pace of bank merger and acquisitions. In particular, between 1990 and 2002, the number of mergers and acquisitions activities surged by about 520 per year compared with 345 per year over the (1980-89) period. Consequently, the number of banks operating in the U.S. has declined by about 33 as compared to 1990. Such a rapid pace of bank mergers and acquisitions is likely to continue into the future. Moreover, the pace of bank acquisitions of securities firms and insurance companies is also likely to rise in the future as a result of the recent enactment of the Gramm-Leach-Bliley (GLB) Act of 1999.[12] The said trend in bank mergers represents one of the most discussed issues in the current banking literature.

A number of banking studies have focused on mergers and acquisitions over the past few years. Essays have been published about the advantages and disadvantages of mergers and acquisitions, and about the most effective form of their implementations. However, a number of issues still remain unresolved, in particular the long-run stock returns behavior of bank mergers. We investigate a basic issue in this essay, notably, bank mergers' post-merger, long-run performance. This issue is fundamental since the assumption of bank mergers' favorable contribution to the combined wealth of bidder and target shareholders is solely based on the findings of event studies over the short term.

[12] GLB allows banks, brokerage firms and insurance companies to merge.

The said studies conclude that abnormal returns to bidders are small or at least insignificantly different from zero in the short-run.

A considerable amount of research has been conducted on bank mergers with a focus on merger motives, and the immediate market reaction to their public announcement. However, much less attention has been devoted to determining whether mergers enhance combined firm value over the long run. Our objective is to evaluate the long-term effect of merger on the combined firm.

Several reasons make the study of the long- run performance relevant. First, from an investor's viewpoint, the existence of price patterns may present opportunities for active trading strategies to produce superior returns. Second, the premium paid to merger target can be justified only if there is a long-run improvement in both operating and market performance of the combined firm. Third, despite continuously ongoing research on bank mergers, we still know surprisingly little about the long-run performance following bank mergers. While the immediate market reaction to bank mergers has been studied extensively, the long-run performance resulting from mergers has been largely ignored. The contribution of this essay to the bank mergers literature is to help bridge this significant gap.

Early studies of long-run performance simply extended event study techniques to a longer horizon. Such analysis compares the subsequent equity performance of each individual firm associated with the event study to that of a reference portfolio. Some researchers make specific adjustments for the security's beta or other factor loading. However, Kothari and Warner's (1997) simulation evidence suggests that the size and power of these parametric tests are both overstated. In particular, the abnormal returns

computed by subtracting benchmark portfolio returns from an individual security's returns tend to be substantially skewed. Barber and Lyon (1997) reiterate the importance of simple abnormal returns' skewness, and describe additional potential biases that may arise from new listings and market portfolio rebalancing. All of these problems can be alleviated by using peer-adjusted, buy-and-hold abnormal returns (BHARs) to measure long-run performance effects, as in Ritter (1991). For each sample firm, Barber and Lyon (1997) suggest choosing a peer firm based on market capitalization and their equity's book-to-market ratio. The difference between the sample firm's and its peer firm's holding period returns then indicates the impact of the studied event on subsequent performance. Barber and Lyon conclude that this BHAR technique produces well-randomized samples when appropriate peer firms are chosen.

Since there is still no consensus in the literature regarding the valuation consequences of bank merger, we believe that it is important to maintain the careful evaluation of the performance of banks engaged in mergers using a variety of samples and empirical methodologies. More importantly, the principle drawback of the extensive event study in bank mergers literature is its short-run focus. While ex ante expectation are important sources of information, the possibility exists that the market does not always accurately predict the future performance of bank mergers in the short time period surrounding announcement. Therefore, an evaluation of the long-run performance of bank mergers may be necessary. Accordingly, the essay makes a valuable contribute to existing literature by currently investigating the long-run post-merger operating as well as market performance of the bank merger sample by examining the monthly returns from a sample of banks over thirty-six to sixty-month intervals following their announcements to

merger. We also aim to shed light on the long-run wealth effects of bank mergers. To this end, we use buy-and-hold abnormal returns and the Fama and French (1993) three-factor model to measure long-run effects of bank mergers. This is the first essay to examine the long-run performance following bank mergers using those two techniques. Interestingly, to the best of our knowledge, there is only one study (Madura and Wiant, 1994) that measures the long-run performance resulting from bank acquisitions. However, the analysis was based on an event study utilizing standard market model.

As for operating performance, we utilize traditional ratios such as return on assets (ROA) and return on equity (ROE). ROA and ROE are the most commonly used measure of bank profitability. For the post-merger period, the analysis will focus on the combined firm relative to a control group. Post-merger data are compared with pre-merger data to determine the performance changes that took place upon the transition from pre-merger to post-merger. The control group is particularly valuable because it permits an assessment of whether any observed changes in the combined firm simply reflect changes in economic environment or, instead, are unique to the combined firm.

The results of long-run operating performance indicate that there are statistically significant improvements in profitability in terms of ROE following mergers. However, profitability in terms of ROA shows no virtually improvement (it increases but not statistically significant).[13] We also find evidence that banks engaged in mergers, on average, under-perform the peer group before the merger and outperform it after the merger. This indicates that mergers are able to improve ROE, and it may imply that profitable motivations are driving bank mergers. Additionally, when we examine pre-merger and post-merger profitability in terms of ROA, we find that ROA is unrelated to

[13] ROE is the product of ROA times equity multiplier.

merger activity. Upon further analysis, our findings also show that more recent bank mergers have more positive effects than earlier mergers. Notably, only more recent bank mergers were able to achieve significant cost cuts. Another interesting finding is that mergers in which small banks are involved show large cost savings compared with the large bank mergers. This sounds intuitively correct, as it is easier to implement cost savings when the overall size of the new banks remains manageable. Lastly, our empirical results suggest that large targets are associated with more successful mergers.

The results of long-run stock returns show that merged banks exhibit significant underperformance after a merger. Buy-and-hold abnormal return results indicate that merged banks underperforms a matched bank of similar size by almost 18.4% in five years following the merger. The Fama-French three-factor regression model yields underperformance of –10% over the five-year post-merger period. Notably, Recent studies of bank mergers such as Becher (2000) and Houston et.al. (1994) find that bank mergers create value for the combined firms, with a statistically significant positive. In contrast, we find evidence of long-run underperformance following bank mergers that is statistically significant. This finding indicates that it may be difficult for investors to earn profits by trading on this underperformance. Further analysis shows that this poor performance can be attributed to the larger banks in the sample. This result confirms our earlier finding, suggesting that size is an important explanatory variable of long-run post-merger performance. Finally, we examine each calendar year to determine if the underperformance is concentrated in certain years of the study, and find evidence that more recent bank mergers are associated with better performance than earlier mergers.

However, the average performance of recent mergers is still worse than that of comparably sized banks.

The reminder of the essay is designed as follows. Section 2.2 reviews related literature. Section 2.3 describes the data and methodology. Section 2.4 reports our empirical results and section 2.5 concludes.

2.3 Review of Literature

The main reasons for mergers are to improve the financial situation of the company concerned and to gain a better position in the market. Banking is becoming an increasingly global industry, which knows no geographic and territorial boundaries. The trend towards mergers in banking is also affected by unprecedented growth in competition, the continued liberalization of capital flows, the integration of national and regional financial systems, and financial innovations.,

The goals of mergers and acquisitions can be divided into strategic goals, which cannot be quantified as a rule, and to quantifiable financial goals, primarily to economies on costs. Other reasons for bank mergers are to extend the range of products and services, increase the market share, diversification of risks and geographic diversification.

The bulk of the empirical studies of the impact of bank mergers on bank performance can broadly be classified into two broad categories. The first group can be found in the banking literature, and comprises what are called “event studies” or ex ante studies, which try to assess the bank merger performance indirectly by analyzing the reactions of the stock market to merger announcements. The second group consists of studies that pursue a direct assessment by analyzing the effects of bank mergers on real firm performance in as far as this can be gauged from internally generated accounting

data, or so called ex post studies. Ex post studies measure bank performance mainly by comparing various financial ratios before and after mergers. Comparing the performance with a relevant control group of banks typically assesses the rates of success or failure.

The "event studies" generally assume that stock markets are efficient, meaning that changes in the share prices of the banks involved, after controlling for market movements in general and systematic risk, represent the value of the event. In this case, the market model is typically used to calculate the expected returns for the bank in question. Systematic changes on the residuals (abnormal returns) from the market model around the event will then show the effects of a merger. An alternative method of examining merger benefits is the use of operating performance measures. Operating performance is measured by comparing the performance banks, based on accounting data, before and after mergers relative to a relevant control group to determine whether mergers results in gains. Merger performance studies reflect the interest in cost cutting and efficiency in the banking industry, particularly through merger.

Evidence from a large number of studies analyzing short-term stock reactions to bank merger announcements indicates that they do not create value for the combined firm and that a target bank's shareholders benefit, and a bidding bank's shareholders generally lose or break even. Houston, James, and Ryngaert (2001) and Becher (2000) report that target shareholders gain at the expense of bidder shareholders.[14] However, these authors find that bank mergers in the 1990s create value for the combined firms. The studies of the short-term reactions to bank mergers in the 1980s show mixed results (James and Weir, 1987; Neely, 1987, and Cornet and De, 1991). In general, the only consensus result of this research is that bidders gain around merger announcements. It is noteworthy that

[14] In that targets gain while bidders lose.

Madura and Wiant (1994) are the only researchers that study abnormal returns of acquirers over a lengthy period following the merger. They find that average cumulative abnormal returns of acquirers, in a sample of 152 acquisitions taking place between 1983 and 1987, were negative during the 36-month period following the merger announcement. Additionally, abnormal returns were negative in nearly every month. Acquirer losses around the time of the announcement may reflect a loss of wealth from an overly generous merger price. Negative abnormal returns in months after the announcement, however, are not likely to be due to the price. They seem more attributable to either the merger achieving fewer benefits than projected, or the market revising downward its expectations for the merger.

A common justification for bank mergers is that they reduce costs and improve operating efficiency, which in turn increases shareholder returns. However, the empirical studies in the existing research on bank mergers do not support this claim. Much of this work shows that bank mergers do not improve bank-operating performance. For example, Berger and Humphrey (1992) and Rhoades (1994) find that there is basically no cost efficiency improvements associated with banks mergers. Almost all of the studies that find no gain in efficiency also find no improvement in profitability, if they include both measures. In contrast, the studies that report at least some evidence of performance improvement do not obtain consistent efficiency and profitability results, or they are unique in some respect, or both. For Example, Frieder and Apilado (1993) analyze a profitability measure but not an efficiency measure, and the profitability measure is based on differences between actual and hypothetical net income. Spindt and Tarhan (1992) find some improvement in return on equity (ROE) from bank mergers but no significant

improvement in return on assets (ROA) or cost efficiency. Corentt and Tehranian (1992) compare pre-merger and post-merger performance of thirty large bank holding companies occurring between 1982 and 1987. They find that cash flow returns, relative to a national group of publicly traded banks that did not engage in merger activity, improve following mergers. They also find that ROE improves, but not ROA. Spong and Shoenhair (1992) find evidence of an improvement in overhead cost efficiency following bank mergers but generally no improvement in ROA or ROE. On the other hand, Peristiani (1993) finds some improvement in ROA following mergers but generally no improvement in cost ratios and efficiency measures. Spindt and Tarhan (1993) find that mergers do exhibit operating gains, but their results may be due to primarily economies of scale.[15]

The work of Linder and Crane (1992) is also noteworthy. They analyze the operating performance of 47 bank-level interstate mergers that took place in New England between 1982 and 1987. Of the 47 mergers in the sample, 25 were consolidations of subsidiaries owned by the same holding company. The authors aggregate bidder and target data one year before the merger and compare it to performance one and two years after the merger. The performance of merged banks is adjusted by the performance of all non-merging banks in the same state as the merging entities. Their results show that mergers do not result in improved operating income, as measured by net interest income plus net non-interest income to assets.

More recently, Rohades (1998) compares bank profitability ratios, such as ROA or ROE before and after mergers relative to peer groups of banks that did not engage in mergers. He finds improved profitability ratios associated with bank mergers. On the

[15] It is unclear whether their results are applicable to large mergers which are mot strongly transforming the banking industry.

other hand, others find no improvements in these ratios (Pilloff, 1996, Akhavein, Berger, and Humphrey,1997).

Another possible motivation behind bank mergers is diversification. Akhavien et al. (1997) report that during periods of industry consolidation, diversification is beneficial. Mergers may produce wealth gains even without increasing cost efficiency by diversification. Berger (1998) finds that bank mergers serve to diversify banks, thereby allowing them to take on more investment risk for a given level of firm risk. However, there is no evidence of a link between this incremental diversification and increased shareholder returns. Overall, the operating performance studies provide substantial evidence that bank mergers do not generally yield performance improvement, in terms of either profitability or cost efficiency.

2.4 Data and Methodology

This section describes the data and methodology used in this study. The merger data come from the M&A database of the Center for Research in Security Prices (CRSP) tapes. To create a sample of mergers during the 1985-1999 period, all firms from the Center for Research in Security Prices (CRSP) tapes that have a delist code in 200s (merger) or 300s (exchange) were selected. To focus on banks, all firms with three-digit SIC codes of 602 (banks) or 671 (holding companies) were chosen. The cut-off year of 1999 is necessary because at least three years of stock return and accounting data should be available for each merger. This resulted in preliminary sample of 1323 bank mergers.

A merger included in the final sample is required to meet the following criteria: (a) both of the merged banks must be traded on the New York Stock Exchange (NYSE), the American Stock Exchange (AMSE), and Nasdaq daily tapes, (b) data for all of the

ratios are available, (c) a single target bank is acquired in the same merger application, (d) both of the merged banks did not engage in another merger three years before or after the merger date. (e) the merger is not assisted by a bank regulator, (f) the target does not involve a failed bank, and finally (g) the merger must occur before 1999. The first criterion eliminates all failed-bank mergers and government assisted bank mergers. The second and third filters allow us to compare the three-year pre- and post-merger performance without the contamination of another merger, also ensuring the availability of banking data for at least two years before the merger date. Finally, we exclude the most recent mergers that do not have at least three years of reported data after the merger date. This process results in a sample of 662 bank mergers. The financial data used to calculate the performance measures for both merged banks and the non-merged banks are collected from COMPUSTAT data tape and the report of the Reports of Condition and Income Report database (Call Report) on the Federal Reserve Bank of Chicago's web page.[16]

Table 2.1

Descriptive statistics for selected variables

			Acquirer Bank	
Variable (million of dollars)	Mean	Std Dev	Minimum	Maximum
Market value of equity	7,210	11,652	11	165,223
Assets	18,905	38,107	244	214,482
			Target Bank	
Market value of equity	2,734	4,523	5	38,629
Assets	3,286	7,448	85	67,095
Value of transaction	326	910	2	13

[16] www.frbchi.org

Table 2.1 provides descriptive statistics for selected variables to our bank mergers sample. As the table shows, the book value of total assets and the market value of equity are expressed in 1999 dollars using the consumer price index. The average value of bank mergers is $326 million. The mean asset value of the acquiring banks is $18,905 million and of the targets is $3,286 million. The mean market value of equity of the acquiring banks is 7,210 and of the targets is 2,734

Our first approach is the operating performance, which permits us to focus specifically on profit, costs, and efficiency. To this end, we analyze changes in accounting profits rates and cost ratios. The financial performances of bank mergers are analyzed over 3-year period pre- and post the merger. The year of the merger is excluded from the analysis, because it is affected by one-time merger costs incurred during that year.[17] Financial performance is measured through the following three ratios; return on assets, return on equity, and cost efficiency ratio. We use the following definitions for this study:

Return on Assets (ROA): net income as percentage of total assets.

Return on Equity (ROE): net income as a percentage of average common shareholder's equity.

Cost Efficiency Ratio (CER): non-interest expenses divided by total assets.

ROA is an indicator of profitability and a good overall indicator a banking organization's performance. This ratio shows the ability of a bank to generate profits from the assets at its disposal.[18] ROE is used as an alternative measure of profitability

[17] Therefore, including the year of the merger makes it hard to compare with results for other years.
[18] ROA is biased upward for some banks due to profits generated from off-balance sheet operations (see Rhoades, 1998).

and reflects the return to owners' investment. CER is a measure of cost control and is perceived as important to find whether bank mergers result cost savings from the merger.

Our second approach utilizes stock return data to measure the long-run performance bank mergers. To this end, two measures are used: (1) 5-year buy and hold returns for both the merged bank and a set of matching banks and (2) Fama and French three-factor model. Also, three benchmarks are used to calculate excess stock returns. The first benchmark is the CRSP value-weighted NYSE-Amex-Nasdaq index. The second benchmark is a non-merger bank index, created by equally weighting all NYSE, Amex, and Nasdaq firms that meet the following restrictions: a Standard Industrial Classification (SIC) code of 602 (banks) or 671 holding companies, listed on CRSP for at least three years before entering the universe. The third measure of excess return is the Fama and French (1993) three-factor time-series regression model. Buy-and-hold returns calculations start on the second CRSP-listed day for the sample and end (at the lower limit) on the five-year anniversary date of the merger or else the firm's delisting date.

Researchers have employed two distinct methodologies when examining the long-run performance of firms (see Lyon, Barber and Tsai (1999)).[19] One method involves careful construction of a "peer" portfolio that is similar to sample firms in all-important respects, except for the fact that the peer portfolio did not experience the event under study. Then buy and hold returns for each firm's subsequent holding period are averaged (or equally-weighted in the portfolio).

As matter of fact, buy-and-hold abnormal returns (BHARs) have become the standard method of measuring long-run abnormal returns (see Barber and Lyon (1997)). BHARs measure the average multi-year return from a strategy of investing in all firms

[19] Loughran and Vijh (1997) use this methodology to analyze the long-run performance of acquisitions.

that complete an event and selling at the end of a pre-specified holding period versus a comparable strategy using otherwise non-event firms. Stated differentially, BHARs permit easy comparisons with earlier analyses of the long-run wealth effects following other financing events. In addition, BHARs measure an investor's experience if s/he were to try to profit from expected performance (Barber and Lyon (1997)).

Following Ritter (1991) and others, we define five-year holding period returns as follows:

$$HPR_i = \prod_{t=1}^{60} (1 + r_{it}) \tag{2.1}$$

where r_{it} is the raw return on firm i in event month t. This measures (HPR) the total returns from a buy-and-hold strategy where a stock is purchased at the first closing market price after engage the merger announcement and held until the earlier of (i) its 5-year anniversary, or (ii) its delisiting. In order to evaluate the holding period returns of bank mergers, a comparison with the matched banks' return is made. More specifically, we compute holding-period returns for each bank engaged in a merger and each of its matched control banks over a three- and a five-year period following the announcement date. Finally, as in Ritter (1991), we compute the wealth relative as a performance measure, defined as

$$WR = \frac{1 + \textit{average five - year total returns on merged banks}}{1 + \textit{average five - year total returns on the matched banks}} \tag{2.2}$$

where the average five-year total return is given by

$$\frac{1}{n}\sum_{i=1}^{n} HPR_i \tag{2.3}$$

We measure buy-and-hold abnormal stock returns (BHAR) as

$$\text{BHAR} = \text{HPR (merged banks)} - \text{HPR (matched banks)} \qquad (2.4)$$

Thus, a wealth relative less than one is evidence that the portfolio of banks conducting mergers has under-performed the portfolio of matched banks; a wealth relative of greater than one can be interpreted as the bank merger sample outperforming a portfolio of a matched banks. Wealth relatives based on three-year returns are also calculated.

An alternative to the control portfolio method inspired by Fama and French (1993) has been employed in several empirical studies.[20] Specifically, Fama and French (1993) find out that a three-factor model may explain the cross-section of stock returns better than other proposed models. The intercept term from estimated regression equations containing the three Fama-French risk factors should be statistically insignificant in the absence of any abnormal long-run performance.

The three-factor model offers the advantage that it does not require size or book-to-market data for sample firms. Removing this requirement has two implications. First, firms without available data on market value of equity or book-to-market ratio can be included on the analysis. Second, some large firms or firms with low book-to-market ratios my in fact have common stock returns that more closely mimic those of small firms or firms with high book-to-market ratios. The three-factor model allows for this possibility since the patterns of returns, rather than the explicit measurement of size or book-to-market, determines whether the returns on a firm's common stock more closely mimic the returns of small firms and/or high book-to-market firms.

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[20] See Loughran and Ritter (1995), Brave and Compers (1997), and Buttimer et al (2001).

We follow Fama and French (1993) and adopt a three- factor model to examine the long-term performance following the bank's announcement of a merger. The model is specified as follows:

$$R_{pt} - R_{ft} = \alpha + \beta_1 (R_{mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \varepsilon_{pt} \quad (2.5)$$

where R_{pt} is the return of bank p's stock on date t, assumed to be normally distributed;.

R_{ft} is the risk-free interest rate on date t, typically using the 3-month T-bill rate in month t;

R_{mt} is the market return on date t, using the return to the CRSP value-weighted composite market index.

SMB_t is the monthly difference in returns between a group of small firms and a group of large ones;

HML_t is the monthly difference in returns between firms with high book-to-market and low book-to-market firms;

ε_{pt} is an error term.

SMB_t is intended to capture a size effect, and HML_t is intended to capture a book-to market effect.[21] Fama-French regression models are estimated for the full sample. This regression yields parameter estimates of $\alpha, \beta_1, \beta_2,$ and β_3. The parameter of interest in this regression is the intercept α. A significant intercept term in (2.5) implies that abnormal returns are associated with the event analyzed. We estimate this Fama-French regression using two alternative portfolio-weighting schemes: value-weighting firms'

[21] For a more detailed discussion of HML and MB see Fama and French (1993).

returns and equally-weighting. Previous researchers have observed that variation in the number of firms included in a different month's portfolio may cause heteroskeasastic residuals in (2.5). We address this concern by reporting OLS and weighted least squares (WLS) coefficient estimates, where the WLS weights equal the square root of the number of firms in the portfolio for that month.

2.5 Results

2.5.1 Long-run operating performance

The most frequently cited motivation for bank mergers is that they improve performance by cutting costs. In order to examine this issue, we collect accounting data for the mergers sample for a period three-years before and after the merger. To measure pre-merger performance, accounting data for the acquiring and acquired banks is combined to find pro forma performance for the merged firms. More specifically, for the year before merger, we find the weighted-sum of the ex ante accounting data of the acquiring and the acquired bank. The weights used are based on total assets for the acquiring and acquired banks before the mergers.[22] Our main objective is to measure the impact of bank mergers on the performance of the combined firms. To this end, we compare the ROA, ROE, and CER ratios in the year preceding the merger with each of the three years following the merger, excluding the merger year itself, for the bidder and the acquired bank. Because some of the difference between pre- and post-merger performance may be due to economy-wide or industry factors, we use a control group of non-merged banks (matched bank). The non-merged banks are defined as banks

[22] The weights are the relative sizes (measured by total assets) of the two banks at the beginning of each year.

comparable in terms of size, which is measured by total assets. This accounts for different market circumstances (or industry trends).

To measure the post-merger changes in bank operating performance, we compare the post-merger performance of the merged bank relative to its control group of similar sized banks with pre-merger performance of the merged banks to the peer group. Thus, we define change in relative operating performance for the *ith* bank merger as:

$$\Delta R = [R_{Ai} - R_A^{Peer}] - [R_{Bi} - R_B^{Peer}] \qquad (2.6)$$

where ΔR is the difference between pre-merger and post-merger, subscript A stands for after-merger and subscript B stands for before-merger. The absolute performances of each peer group (R^{Peer}) are the average across all banks in the group of the three-year mean of the performance measure before and after the merger. For the merged banks, the absolute performance measures (R_i) are the three-year mean of the performance variable before and after the merger year. It is important to note that subtracting the absolute performance of the peer group from that of the merged banks produces the relative performance of the merged banks before and after the merger. Additionally, subtracting the relative performance of the merged banks before the merger from its relative performance after the merger yields the changes in relative operating performances. A positive ΔROA and ΔROE indicate large profitability is achieved following merger, while negative ΔCER indicates cost saving is achieved after the merger.

2.5.1.1 Return on assets (ROA)

The pre-merger and post-merger return on assets (ROA) for the merged banks is reported in Panel A of Table 2.2.

Table 2.2
Pre-merger, post-merger, and changes in performance for merging banks

	1985-1989	1990-1994	1995-1999	Full Sample
Panel A: ROA(%)				
		All mergers		
Pre-merger	0.06	0.11***	0.17*	0.083
Post-merger	0.08	0.15	0.23**	0.159**
Difference	0.02	0.40	0.06*	0.076
		Large mergers		
Pre-merger	0.11	0.04	0.10	0.072*
Post-merger	0.07*	0.05	0.12	0.66
Difference	-0.04	0.01***	0.01	0.584
		Small mergers		
Pre-merger	0.14	0.17*	0.19	0.171
Post-merger	0.22	.042	0.28**	0.193
Difference	0.08	0.25	0.09	0.022
Panel B: ROE (%)				
		All mergers		
Pre-merger	-1.09	-0.80	-1.40	-1.86*
Post-merger	1.24	1.85	2.3	1.75
Difference	2.33***	2.65*	3.70**	3.61***
		Large mergers		
Pre-merger	-0.06	-0.44*	-2.30	-0.95
Post-merger	1.93**	1.58	0.16	1.34*
Difference	1.99	2.02**	2.46**	2.25***
		Small mergers		
Pre-merger	-0.02	0.01	-0.033	-0.021
Post-merger	0.51	0.85	1.407	0.938
Difference	0.53	0.84***	1.44*	0.959**
Panel C: CER (%)				
		All mergers		
Pre-merger	-0.05**	-0.07**	-0.28*	-0.123
Post-merger	-0.14*	-1.17**	-1.62*	-0.984**
Difference	-0.09	-1.10	-1.34**	-0.861
		Large mergers		
Pre-merger	-0.03*	-0.01**	-0.33**	-0.145
Post-merger	-0.27	-0.19	-1.07	-0.570
Difference	-0.24	-0.18	-0.74***	-0.425
		Small merger		
Pre-merger	-0.12*	-0.38**	-0.18*	-0.233***
Post-merger	-1.78*	-2.22*	-1.24**	-1.759
Difference	-1.66	-1.84**	-1.06*	-1.526

(*,**,***) Differences are significantly different from zero at the 10%5%(1%) level, respectively.
Notes: Before the merger, performance measures for the merged bank are weighted averages of target and acquirer values, with the weights being the relative size of the two banks. All performance measures control for size. Mean differences are the mean values of pair-wise differences in the pre- and post-merger period means.

As we can see from this Panel, there is improvement on ROA following the mergers for the entire sample of 0.076%. This improvement, however, is not statistically different from zero. This finding suggests that mergers are not associated with significant change in return on assets (ROA), implying that managers are unable to generate benefits from bank mergers. To measure the effects of bank mergers over time and to examine the more recent mergers in particular, changes are calculated for three time periods: 1985-1989, 1990-1994, and 1995-1999. For the three periods, there are 119, 198, and 345 banks, respectively. In the 1985-1989 period, during the three years before the mergers the sample mean return on assets (ROA) is 0.06% above the peer group, and for the three years after the mergers, it is 0.08% above the peer group. Although this result shows the merged banks outperforming the peer group, the increase (0.02%) is not statistically significant from zero. A similar result is found when examining pre- and post-ROA merger for the period 1990-1994, indicating ROA is unaffected by merger activity, as ROA shows no significant improvement. Our findings are consistent with those reported by Cornett and Tehranian (1992) and Pilloff (1996). On the other hand, we notice that there is significant improvement in ROA in the 1995-1999 period. The pre-ROA was 0.17% and rose to 0.23% after the mergers. The difference (0.06%) is significantly different from zero. The results for the 1995-1999 mergers suggest that recent banks mergers seem to be more profitable than earlier bank mergers.

2.5.1.2 Return on equity (ROE)

Our second measure of profitability is return on equity (ROE). Panel B of Table 2.2 shows that, following bank merger, there is statistically significant improvement in ROE. All of the entries in Panel B are positive, reflecting strong performance of the

mean sample bank relative to the peer group. This result is consistent with those of Cornett and Tehranian (1992). However, it contrasts with those reported by Pilloff (1996). Table B also details our results over the same three time periods used for ROA. For the 1985-1989 period, the pre-ROE was -1.09% and rose to 1.24% after the merger. For the 1990-1994 period, the pre-ROE was -0.80% and rose to 1.85% after the merger. As for the 1995-1999 period, the pre-ROE was –1.40% and rose to 2.3% after the merger. Clearly, ROE tends to increase significantly following mergers. Another interesting finding in this table is that banks engaged in mergers are, on average, under-performing the peer group before the merger and outperforming it after the merger. This indicates that mergers are able to improve ROE, and it may imply that profitable motivations are driving bank mergers.

2.5.1.3 Efficiency ratio (CER)

Following Cornett and Tehranian (1992) and Rhoades (1998), we examine an operating cost ratio that excludes interest expenses. Berger, Demsetz, and Strahan (1999) argue that cost ratios do not control for input prices, and so a reduction in costs per unit of output or assets can reflect either lower interest expenses due to increased market power in setting deposit interest rates or greater efficiency in input usage. They suggest that cost ratios that exclude interest expenses are not subject to this problem.[23] Therefore, we use cost efficiency in terms of non-interest expenses divided by total assets.

Panel C of Table 2.2 shows pre-merger and post-merger cost ratios as well as changes in cost ratio for the overall period and the three time periods. As we can see from this table, there is no significant improvement in this ratio for the entire sample. Also, there are decreases of 0.09%, 1.1%, and 1.3% in the ratio of non-interest expenses to total

[23] For more details about the drawback of other ratios see Berger, Demsetz, and Strahan (1999).

assets for the 1985-1989, 1990-1994, and 1995-1999 time period, respectively. However, only the decrease of 1.3% is significantly different from zero, suggesting improved efficiency in the 1995-1999 period. For the 1985-1989 and 1990-1994 periods, cost ratios indicate that the merged banks do no better or worse than the peer group in controlling their non-interest expenses as percentage of total assets. This finding is comparable to the results obtained by Cornett and Tehranian (1992). The results presented in this table also confirm our earlier findings reported in Panel A using ROA, suggesting that recent banks mergers seem to be more efficient than earlier bank mergers.

It is worth noting that before the mergers the sample mean cost ratio (non-interest expenses to total assets) is below the peer group, and after the mergers it is also below the peer group. However, looking at the change in the cost ratio, it is not clear that mergers result in significant efficiency except for the recent mergers.

2.5.1.4 Small mergers versus large mergers

In sections 3.1, we examined pre-merger and post-merger performance, as well as changes in operating performance for the 1985-1989, 1990-1994, and 1995-1999 periods and for the full sample. In order to find whether the size of the mergers affects our results, we analyze our results separately for large mergers and small mergers. Ratios of firms both before and after the merger are computed relative to the peer group in order to assess performance changes.

Panel A of Table 2.2 shows that profitability in terms of ROA is largely unrelated to size. There is no systematic pattern in the size distribution of the average ROA ratios. Surprisingly, this is not the case for ROE. There is some evidence that size may matter as we see the distribution of the ROE ratios in Panel B of Table 2.2 Small bank mergers

appear to be less profitable, especially relative to group of largest banks in the respective subsamples. Mergers of large banks achieved higher improvements in ROE compared to small bank mergers. There is significant increase in ROE of 2.25% following large mergers. When we examine large merger across three time periods, we find that they achieved 1.93%, 2.02%, and 2.46% improvement for the 1985-1989,1990-1994, and 1995-1999 periods, respectively. In the case of small bank mergers, improvements were much smaller, averaging around 0.94% for the 1985-1989, 1990-1994, and 1995-1999 periods. Possible explanations are that very small banks rely on a limited range of products to generate revenues and/or have less market power than their larger competitors.

In the case of cost efficiency ratio (CER, Panel C), merged banks seem to have increased their cost efficiency in the years after the mergers (only for 1995-1999 period). This is especially true when the deal occurred between two small banks. Mergers in which small banks are involved show large cost savings compared with the large bank mergers. This sounds intuitively correct, as it is easier to implement cost savings when the overall size of the new banks remains manageable.

2.5.1.5 Cross -sectional analysis of ratio changes

Post-merger performance may be influenced by the pre-merger performance of either the acquirer or target or the relative difference in acquirer and target bank performance. For example, an efficient acquirer may think that it has superior managerial capabilities and thus look for poor performing targets to which its superior management skills may be applied. On the other hand, a weakly performing acquirer may try to find a

merger partner (target) and use the merger as the channel to overcome managerial ineffectiveness and improve its functions.

Table 2.3

Correlations of performance changes with pre-merger performance variables

	$Corr(\Delta R, R_W)$	$Corr(\Delta R, R_{WA})$	$Corr(\Delta R, R_{WT})$
Ratio (R)		(1985-1989)	
ROA=Net Income/Total Assets	0.119	-0.234*	0.475***
ROE= Net Income/Total Equity	0.247	-0.215**	0.469***
CER=Non-interest Expense/Total Assets	0.263	0.152	-0.228**
		(1990-1994)	
ROA=Net Income/Total Assets	0.228	-0.184*	0.323**
ROE= Net Income/Total Equity	0.349	-0.146**	0.277**
CER=Non-interest Expense/Total Assets	0.161	-0.135	-0.169*
		(1995-1999)	
ROA=Net Income/Total Assets	-0.065	-0.93	0.283*
ROE= Net Income/Total Equity	0.155	-1.05**	0.160**
CER=Non-interest Expense/Total Assets	0.072	-0.057	-0.029
		Full sample	
ROA=Net Income/Total Assets	0.315	-0.131*	0.479***
ROE= Net Income/Total Equity	0.058	-0307	0.463***
CER=Non-interest Expense/Total Assets	0.262	-0.154	0.180.

Note: The term ΔR is the difference between pre-merger and post-merger ratio. The term R_W is the weighted difference between acquirer and target ratio. The term R_{WA} is the weighted measure of acquirer pre-merger ratio, and R_{WT} is the weighted measure of target pre-merger ratio. All ratios are control for size.
*,**,*** indicate significant at the 10%,5%, and 1% level, respectively.

In other words, mergers may be used to discipline inefficient managers. According to Berger (1998) the merger enables banks to wake-up management or the merger may be an excuse to restructure both partners (acquirer and target).

To examine whether merger-related improvements are influenced by a merger partner's characteristics, correlations between pre-merger characteristics with changes in post-merger performance are analyzed. Table 2.3 reveals our results that show the relationships between acquirer and target pre-merger ratio and the merger-related changes in those same ratios. As we notice from Table 2.3 (the second column), the ROA_W, ROE_W, CER_W ratios (the relative difference in acquirer and target ratios) have littlie influence on changes in post-merger performance as $Corr(\Delta ROA, ROA_W), Corr(\Delta ROE, ROE_W)$, and $Corr(\Delta CER, CER_W)$ are statistically insignificant. This finding is comparable with those reported by Berger and Humhrey (1992) and Pilloff (1996) who examine the relationship between acquirer-target differences and changes in post-merger performance.[24]

The results in column (3) suggest that acquirer pre-merger ROA, and ROE ratios are correlated to post-merger changes. The correlation between ROA_{WA} (ROE_{WA}) and their respective ΔROA ratios are significantly negative, suggesting that mergers are associated with profitability losses when acquirer profitability is high and therefore contributing to such losses. Stated differently, the greater the acquirer's profitability, the more negative the merger's earnings impact is. On the other hand, a positive correlation exists between ROA_{WT} (ROE_{WT}) and ΔROA (column 4), implying that targets with high profitability are associated with high post-merger gains. Lastly, there is some evidence of

[24] Their sample was limited to banks with assets over $1 billion.

a greater efficiency gain the larger the targets expense ratio is, as $Corr(\Delta CER, CER_{WT})$ is significantly negative. In other words, the high-cost targets are associated with reduced expenses.

2.5.1.6 Performance changes with size

Pilloff (1996) hypothesizes that performance changes may be related to both size and relative size of acquirer and target. To test the influence of a merger partner's size, correlations between changes in performance measures (ratios) and the target's and acquirer's size, and their relative size are examined in Table 2.4. Interestingly, ΔROA and ΔROE (changes in profitability) are positively related to the target size (column 3), while the acquirer's profit characteristic is positive but insignificant (column 2). This result implies that the profits are more likely to increase when the target is larger. The results in column (4) suggest that the larger the relative size of the target is, the more likely profit is to increase. Collectively, these findings indicate that large targets are associated with greater merger gains. Our results are comparable with those reported by Pilloff (1996).

2.5.1.7 Summary of long-run operating performance

Before-and-after merger comparisons are unambiguously favorable with ROE ratio, which is always higher after merger than it is before. This result indicates that bank mergers increase profitability in terms of return on equity (ROE). The comparisons are unfavorable with return on assets ratio (ROA), showing insignificant improvement in the 1985-1989 and 1990-1994 periods. However, ROA increased significantly following the 1995-1999 period, suggesting that recent banks mergers seem to be more profitable (ROA) than earlier bank mergers. The mixed results obtained using profitability ratios

(ROA, ROE) is consistent with those reported by Cornett and Tehranian (1992). They argue that such findings may indicate that improvement in accounting measures of profitability surrounding the merger may be due to management's choice of debt versus equity financing rather than the more efficient management of assets.

Table 2.4

Correlations of performance changes with size and relative size

Ratio Change	$Corr(\Delta R, SIZE_A)$	$Corr(\Delta R, SIZE_T)$	$Corr(\Delta R, RELSIZE)$
		(1985-1989)	
ΔROA	0.155	0.119**	0.261*
ΔROE	0.148	0.059**	0.349***
ΔCER	0.081	0.077	-0.311
		(1990-1994)	
ΔROA	0.199	0.286***	0.163**
ΔROE	0.211	0.356**	0.328**
ΔCER	0.095*	-0.018	-0.304
		(1995-1999)	
ΔROA	0.167	0.233**	0.292*
ΔROE	0.133	0.150*	0.445***
ΔCER	-0.108	-0.220	-0.298
		Full Sample	
ΔROA	0.237	0.168***	0.346***
ΔROE	0.225	0.141*	0.220***
ΔCER	0.039	-0.097	-0.116

Note: The term ΔR is the difference between pre-merger and post-merger ratio. The terms $SIZE_A$ and $SIZE_T$ are the log of acquirer's and target's total assets. Relative size equals target total assets divided by target plus acquirer total assets. Total assets are measured at the end of the year before the merger date. is the weighted difference between acquirer and target ratio. All ratios are control for size.
*,**,*** indicate significant at the 10%,5%, and 1% level, respectively.

ROA is conventionally considered a better indicator of bank's efficiency in asset management, where as ROE is more directly a measure of return to stockholders. Lastly,

before-and-after comparisons are ambiguous with cost ratio measure. Even though there is a decrease in this ratio in the 1985-1989, 1990-1994, and 1995-1999 periods, the decrease is only statistically significant for 1995-1999 subperiod. This implies only more recent bank mergers were able to achieve significant cost cuts. When we analyze our results separately for large mergers and small mergers, we find evidence that mergers of large banks achieved higher improvements in ROE compared to small bank mergers, while mergers in which small banks are involved show large cost savings compared with the large bank mergers. Interestingly, we find evidence that large targets are associated with more successful mergers. Lastly, we find that the following target banks are likely to associate with successful mergers – more profitable targets with higher return on assets (ROA) and/or rerun on equity (ROE).

2.5.2 Long-run stock performance of bank mergers

Although the operating performance of bank mergers deteriorates, it might be that this performance is anticipated by investors and may already be factored into the stock price. We address this issue by examining the long-run stock performance of merged banks. We examine the long-run stock return performance of the mergers in our sample two ways. First, we compute the buy-hold-abnormal returns (BHAR) of the merged banks relative several benchmarks.[25] Second, We use the Fama-French three-factor regression model.

2.5.2.1 BHAR Results

This section examines the long-run stock performance of merged banks using the BHAR technique. Long-run performance is measured by comparing the returns on merged banks and returns on a benchmark made up of matched banks over periods of

[25] BHAR is similar to the measures used in takeover study of Loughran and Vijh (1997).

three, and five years. Fama and French (1992) document that firm size may influence returns statistics. Therefore, we analyze the long-run stock performance of the aggregate bank merger sample after sorting by size. Table 2.5 divides the sample into two groups on the basis of median market value. Five-year and three-year buy-and-hold returns are calculated over identical time periods for the merger banks and two different benchmarks, the -CRSP value- weighted NYSE-Amex-Nasdaq index and the equally-weighted bank index.

As shown in Panel A of Table 2.5, for the merged banks, the five-year holding period return is 24.5%, while the holding-period return for their peer group is 42.9%. The difference in holding-period returns is –18.4% and is significant at the one percent level. The significance of the raw and abnormal returns is tested by using *t*-statistics.[26] This suggests that the merged banks significantly underperform the CRSP value-weighted NYSE-Amex-Nasdaq index over the five-year holding period by -18.4%. It is interesting to note that this poor performance can be attributed to the larger banks in the sample, which lagged the index by -25.7%. In Panel B, we compare the merger banks to the equally weighted bank index. The results still indicate that merged banks significantly underperform their peer group. However, the difference in holding-period return is lower in this case (-11.3%). Further, the results indicate that the largest banks lagged the bank index by -13.7% over the five-year period. Panel C presents three-year buy-and-hold returns over identical time periods. As we can observe from this Panel, the three-year buy-and-hold return for the merged banks is 15.3% compared to 32.9% for NYSE/ Amex value-weighted index, showing significant (at the one percent level) underperformance of 17.6% over three years.

[26] These statistics have become the standard in the long-run performance literature since Ritter (1991).

Table 2.5

Average BAHR for bank mergers

Size group	Bank mergers returns	Benchmark index returns	Excess returns	(t-statistic)
Panel A : Five-year BAHR, benchmark is value weighted NYSE-Amex-Nasdaq index				
All Banks	24.5%	42.9%	-18.4%	(-2.17)
Small	35.8%	43.4%	-7.6%	(-0.52)
Large	15.6%	41.3%	-25.7%	(-2.92)
Difference				-1.89
Panel B : Five-year BAHR, benchmark is equally weighted bank index				
All banks	22.5%	27.3%	-4.8%	(-1.45)
Small	35.8%	39.5%	-3.7%	(0.32)
Large	15.6%	35.2%	-19.6%	(-1.96)
Difference				-2.04
Panel C: Three-year BAHR, benchmark is value weighted NYSE-Amex-Nasdaq index				
All Banks	15.3%	32.9%	-17.6%	(-3.19)
Small	26.7%	41.5%	-14.6%	(-0.82)
Large	18.6%	39.4%	-20.8%	(-3.92)
Difference				-2.08
Panel D: Three-year BAHR, benchmark is equally weighted bank index				
All banks	15.3%	26.6%	-11.3%	(-1.21)
Small	26.7%	34.8%	-8.1%	(0.55)
Large	18.6%	32.3%	-13.7%	(-2.93)
Difference				-2.56

The results indicate that stockholders of the merged banks suffer statistically significant wealth loss of about 17.6% over the three years following the merger completion.

Consistent with our finding in Panels A and B, the poor performance can be attributed to the larger banks in the sample, which lagged the index by -20.8%. In Panel D of this table, we compare the merger banks to the equally weighted bank index. The results still indicate that merged banks significantly underperform their peer group. However, the difference in holding-period return is lower in this case (-11.3%). Further, the results indicate that the largest banks lagged the bank index by -13.7% over the five-year period.

Table 2.6
Long-run stock returns of bank mergers, relative alternative benchmarks

Benchmarks	Bank mergers returns	Benchmark index returns	Abnormal return	Wealth relative
Panel A : Equal weighted buy-and-hold returns (%)				
CRSP VW	35.24	65.26	-30.02	0.82
CRSP EW	35.24	60.84	-25.60	0.84
NYSE-Amex-Nasdaq VW	35.24	58.62	-23.38	0.85
Matched banks	35.24	46.95	-11.71	0.92
Panel B : Value weighted buy-and-hold returns (%)				
CRSP VW	50.10	67.32	-17.22	0.90
CRSP EW	50.10	63.46	-13.36	0.92
NYSE-Amex-Nasdaq VW	50.10	59.37	-9.27	0.94
Matched banks	50.10	70.33	-20.20	0.88

Note: wealth relative =(1+average five-year total return on merged banks) /(1+average five-year total return on matched banks).

Table 2.6 presents the long-run performance for the sample of bank mergers from an event time strategy in which each merger constitutes an event. In panel A, we weight the returns of the bank mergers and their benchmarks equally. One of our metrics to

measure abnormal returns is the wealth relative. Loughran and Ritter (1995) and Spiess and Affleck-Graves (1995) calculate wealth relatives for the five year period by taking the ratio of one plus the equal-weighted return on the bank merger portfolio over one plus the equal weighted return on the chosen benchmark. Wealth relatives greater than one imply that merged banks have higher returns than their matching banks, while wealth relatives less than one imply underperformance by the merged banks compared to their matching banks. As we can see in panel A (Table 2.6), the five-year wealth relative is less than 1.0 for all benchmarks, ranging from 0.82 to 0.92. The five-year excess returns are all negative, anywhere from -11.71% versus matched banks (peer) to -30.02% versus the CRPS value-weighted index. Stated differently, the average holding-period return for bank mergers is 35.24%, while the average holding-period return for their industry-and-size matched counterparts is 46.24%. This 11% difference is statistically significant at the 0.01 level using a paired t-test (t = 4.82). As alternative measure of long-run performance for merged banks, the five-year wealth relative, gives similar findings. The wealth relative for year 5 is 0.92 indicating substantial merged banks underperform the matched bank control group. Stated differently, a strategy of investing in banks engaged in merger at the close of trading on the day of the merger and holding them for five years would have left the investor with only 92.0 cents relative to each dollar invested in size matched banks that did not engage in merger.

Panel B presents value-weighted results for our sample. In panel B value weighting reduces, but does not eliminate, underperformance. Wealth relatives are now between 0.88 and 0.94 and the excess return is between -9.27% and -20.20%. It is noteworthy that the average holding-period return for bank mergers is 50.10%, while the

average holding-period return for their book-to-market-and-size matched counterparts is 70.30%. This 20.20% difference is statistically significant at the 0.01 level using a paired t-test (t = 5.77). Value-weighted results (Panel B) show that holding this investment for five years would have left the investor with only 88.0 cents relative to each dollar from investment in similar non-bank mergers.

Recent studies of bank mergers such as Becher (2000) and Houston et.al. (1994) find that bank mergers create value for the combined firms, with a statistically significant positive mean. In other words, the announcement of bank mergers has positive impact on shareholder wealth of the combined firm. Unlike the announcement period literature, our findings indicate that there is significantly negative long-run impact on shareholder wealth. In other words, long-run stock returns do not improve following bank mergers. An important aspect of our findings is that the market may overreact at the time of the announcement. As a result, we argue that prior studies that focus on return at the time of announcement may be inadequate, and it may be necessary to examine performance over an extended period following the merger to determine the full impact of that merger.

2.5.2.2 Fama-French three factor model

In order to ascertain that our long-run abnormal returns are not the products of a mis-specified methodology, we apply the Fama and Frecnch (1993) three-factor model. The Fama and French three-factor time-series model has gained acceptance in the literature as a benchmark measure of abnormal returns. Therefore, as additional of robustness, we provide the results for this regression in Table 2.10. Table 2.10 reports the results of the Fama-French three-factor regressions on monthly returns for merged bank in their first five years after merging. We report OLS estimations for both value-weighted

and equal-weighted portfolio returns. Since the number of firms in monthly portfolio varies over time, we also control for potentially heteroskedastic residuals by undertaking weighted least squares (WLS) estimation. Recall that the intercept (α) from this regression measures abnormal returns.

Table 2.7

Fama and French (1993) three-factor regression on monthly returns for bank mergers (five years following merger)

Regression coefficient	α	β_1	β_2	β_3	Adjusted R^2
Panel A: Ordinary lest squares regressions (OLS)					
Value-weighted sample	-0.038***	1.20***	0.34***	0.11*	0.674
(t-statistics)	(-2.72)	(32.45)	(3.62)	(1.83)	
Equal-weighted sample	-0.085***	1.06***	1.34***	0.22**	0.791
(t-statistics)	(-3.32)	(16.12)	(8.23)	(2.42)	
Panel B: Weighted least squares regressions (WLS)					
Value-weighted sample	-0.057**	1.15***	0.38***	0.90**	0.803
(t-statistics)	(-3.24)	(32.35)	(4.04)	(2.32)	
Equal-weighted sample	-0.096**	1.35***	0.91***	0.34**	0.845
(t-statistics)	(-5.21)	(19.07)	(9.06)	(2.63)	

*,**, and *** denote significant at 1%, 5% and 10% levels respectively.

Table 2.7 reports that our sample bank mergers' estimated intercepts are all significantly negative. Intercepts for both equal-weighted and value-weighted samples are significantly negative. Value-weighting the merger banks' subsequent returns yields estimated monthly return of -3.8% using OLS or -5.7% using WLS estimation. The

intercepts' t-statistics (-2.72 and -3.24) indicate that these abnormal returns differ from zero with 99% confidence. It is interesting to note that the negative abnormal return approximately compounds to over 10% in a five-year period. It is not obvious that one should value-weight the portfolio returns. Loughran and Ritter (2000) point out that value-weighting will reduce the extent of measured miss-valuations, which are likely to be more prevalent among small firms. We, therefore, present results for equal-weighted portfolio returns in the second and last rows of Table 2.10. As predicted by Loughran and Ritter (2000), the equal-weighted intercepts (-8.5% and -9.6%) are somewhat larger than those in value weighting.

Table 2.8

Fama and French (1993) three-factor regression on monthly returns for bank mergers (three years following merger)

Regression coefficient	α	β_1	β_2	β_3	Adjusted R^2
Panel A: Ordinary lest squares regressions (OLS)					
Value-weighted sample	-0.019***	3.91***	0.09**	0.10	0.721
(t-statistics)	(1.87)	(20.77)	(2.56)	(1.53)	
Equal-weighted sample	-0.026**	2.16***	.034**	0.042	0.560
(t-statistics)	(2.42)	(60.22)	(2.58)	(0.079)	
Panel B: Weighted least squares regressions (WLS)					
Value-weighted sample	-0.037*	1.55***	0.98***	0.14*	0.841
(t-statistics)	(1.94)	(22.46)	(8.54)	(1.92)	
Equal-weighted sample	-0.045***	1.67***	1.91***	0.23	0.723
(t-statistics)	(5.21)	(33.38)	(10.49)	(1.48)	

*,**, and *** denote significant at 1%, 5% and 10% levels respectively.

Table 2.8 reports results for Fama-French regressions similar to those reported in Table 2.7, but with the time frame reduced to three years following the merger. Shorting the interval for subsequent merger provides a few changes in the results. The full-sample value-weighted intercept is now –1.9% using OLS or 4.5% using WLS estimation. These values are lower than those reported in Table 2.7. However, Table 8 results support the hypothesis that merged banks have negative long-run performance in the first three years after the merger.

Table 2.9

Fama and French (1993) three-factor regression on monthly returns for non-merged banks (three year following merger)

Regression coefficient	α	β_1	β_2	β_3	Adjusted R^2
Panel A: Ordinary lest squares regressions (OLS)					
Value-weighted sample	0.050**	0.09**	0.29***	0.04	0.564
(t-statistics)	(2.47)	(2.17)	(3.56)	(0.65)	
Equal-weighted sample	0.032**	0.08	.044**	0.12***	0.686
(t-statistics)	(2.16)	(1.22)	(3.58)	(2.89)	
Panel B: Weighted least squares regressions (WLS)					
Value-weighted sample	0.075***	1.5*	0.48***	0.14**	0.621
(t-statistics)	(3.76)	(1.75)	(6.14)	(2.32)	
Equal-weighted sample	0.086***	0.12*	0.91***	0.22***	0.754
(t-statistics)	(4.21)	(33.38)	(12.49)	(6.38)	

*,**, and *** denote significant at 1%, 5% and 10% levels respectively.

If the negative intercept in Tables 2.7 and 2.8 is from the three-factor model's inability to fit the type of banks in our merger sample, we should also find negative intercepts for the matched peer banks (non-merged banks). Table 2.9 represents the result of estimating the Fama-French regressions of the style-matched peer banks. The intercept terms are always positive, suggesting positive long-run abnormal returns. For example, Panel A shows that the value-weighting the merger banks' subsequent returns yields estimated monthly return of 5% using OLS or 7.5% using WLS (Panel B). The intercepts' t-statistics (2.47 and 2.16) shows that these abnormal return are statistically significant. These findings are consistent with the hypothesis that bank mergers themselves are associated with poor performance manifested in Tables 2.7 and 2.8.

2.5.2.3 Time-series patterns in the post-bank merger performance

The above results indicate that the stocks of merged banks perform poorly after merger. It can be instructive to examine whether this result pervades our entire sample or is confined to certain years. Accordingly, we examine each calendar year to determine if the under-performance is concentrated in certain years of the study. In Table 2.10, banks are categorized by the year in which the merger occurred. The results indicate that significant underperformance by bank mergers is not concentrated in a particular time period. In the 15 years covered by our sample, all years have three-year matched-bank wealth relatives less than one; that is the average performance of the bank mergers sample in the subsequent three years worse than that of comparable sized banks. Our findings indicate that investors who buy immediately after listing and hold shares for five years will make substantial losses. It is noteworthy that when we examine the wealth

relatives for the most recent bank mergers (during the 1995-1999 period), there is still some evidence of underperformance but it is much smaller. Most three-year wealth relatives are close to one. Therefore, we can conclude that the underperformance has diminished in recent years.

Table 2.10

Long-run stock returns of bank mergers categorized by year of merger

Year	Bank mergers %HPR	Matched banks %HPR	Wealth relative
1985	8.4	33.6	0.81
1986	10.9	34.4	0.83
1987	15.5	41.2	0.82
1988	12.5	40	0.80
1989	24.7	45.2	0.86
1990	32.5	60.6	0.83
1991	28.6	51.3	0.85
1992	30.5	44	0.91
1993	20.2	30.4	0.92
1994	36.4	49.8	0.91
1995	39.9	51.2	0.93
1996	45.3	57.3	0.92
1997	52.3	60.6	0.95
1998	39.2	48.1	0.94
1999	48.6	54.5	0.96

Note: wealth relative =(1+average three-year total return on merged banks) / (1+average three-year total return on matched banks).

2.6 Conclusion

The last decade has witnessed an extraordinary pace of bank merger and acquisitions, dramatically changing the structure of the U.S. banking industry. The

number of banks has notably declined, with fewer smaller banks and more large money center banks. This study analyzes the long-run stock returns and operating performance following bank mergers. A better understanding of the long-run performance of bank mergers may shed some light on the implications of continuing mergers and acquisitions in the banking industry. To this end, we examine the post-merger performance of 662 bank mergers between 1985 and 1999. Accounting data from both pre-merger and post-merger data are used in the analysis and evaluated for evidence of a change in the performance around the merger activity. Particularly, we utilize conventional ratios such as return on assets (ROA) and return on equity (ROE). ROA and ROE capture the profitability of banks (profitability indicators). We also examine an operating cost ratio (CER) that excludes interest expenses. CER is a measure of cost control and is perceived as important to find whether there is cost saving associated with bank mergers. Consistent with previous studies, our findings suggest that the various expected performance and earning benefits of bank mergers may not in fact be realized. The performance effects measured by profitability ratios are mixed. Merged banks show no significant improvement in ROA relative to their peer group, while they have significant improvements in ROE. Also, no significant improvement in CER following the mergers is found. We also find that more recent bank mergers (1995-1999 period) are associated with significant improvement in ROE and CER, suggesting profit and cost efficiency associated with the most recent bank mergers. As for the 1985-1989 and 1990-1994 period, changes in ROE and CER do not indicate that merged banks performed better in the post-merger period. Further, we find evidence that mergers of large banks achieved higher improvements in ROE compared to small bank mergers, while mergers in which

small banks are involved show larger cost savings (CER) compared with the large bank mergers. We also find evidence that large targets are associated with more successful mergers. Lastly, we find that the following target banks are likely to be associated with successful mergers – more profitable targets with higher return on assets (ROA) and/or return on equity (ROE). In other words, large targets are associated with more successful mergers.

Our second objective is to evaluate the long-run stock return following bank mergers. Such an evaluation of the long-run stock performance has been made possible by new, improved long horizon methodologies that have been applied to a variety of corporate events, including mergers. Buy-and-hold abnormal returns (BHARs) and Fama and French (1993) three-factor model are used to measure long-run performance effects. To our knowledge, this first study to examine the long-run performance of merged banks using those two techniques. The results of long-run stock returns show that merged banks have under-performed their peer group of non-merged banks. One possible explanation of this underperformance (large negative returns after mergers) is that the market is slow to adjust to the merger event. If so, the long-run stock returns performance reflects that part of the net present value of the merger to the acquirer that is not captured by the announcement period return. This poor performance can be attributed to the larger banks in the sample. This result confirms our earlier finding, suggesting that size is an important explanatory variable of long-run post-merger performance. Finally, we partition our sample by time period, and find evidence that more recent bank mergers are associated with better performance than earlier mergers. However, the average performance of

recent mergers is still worse than that of comparably sized banks. Taken as a whole, the empirical findings indicate long-run benefits from bank mergers appear to be absent.

CHAPTER 3

THE IMPACT OF MERGERS AND ACQUISTIONS ON THE EFFICIENCY OF THE U.S BANKING INDUSTRY

3.1 Abstract

Using the Stochastic Frontier approach, this study investigates the cost efficiency and profit efficiency effects of bank mergers on the U.S banking industry. The relative efficiencies of the acquiring, acquired and merged banks are estimated relative to their peers. The effects of the mergers are then examined by comparing the pre-merger and post-merger cost and profit efficiency levels of the merged banks with control groups of non-merged banks. The empirical results indicate that mergers seem to have improved cost and profit efficiency of the banks involved in the 1990s. On the contrary, significant cost efficiency gains were absent in the 1980s, while a significant increase in profit efficiency occurred relative to other banks. Principally, evidence shows that both the acquiring and acquired banks have lower efficiency levels relative to their peer group prior to the merger. Following the merger the combined banks increased their efficiency to or beyond levels consistent with industry peers. In addition, prior to the mergers, the acquiring banks were at least marginally more efficient than the acquired bank based on both cost and profit efficiency. Collectively, these findings are consistent with the hypothesis that mergers are used to discipline inefficient managers.

The non-parametric technique of Data Envelopment Analysis is used to evaluate the production structure of the merged and non-merged banks. The empirical evidence appears to indicate that merged banks have lower costs than non-merged banks because they are using the most efficient technology available (technical efficiency), and they are using the cost minimizing input mix (allocative efficiency). Additionally, managers of merged banks are relatively better at choosing the proper input mix given the prices, suggesting that mangers of non-merged banks waste more resources than mangers of merged banks. The results suggest that there is an economic rational for future mergers in the banking industry. Mergers seem to allow efficient banks to gain control of weaker banks, thus helping to increase input efficiency. Also, mergers may allow the banking industry to take advantage of the opportunities created by improved technology.

3.2 Introduction

One of the most commonly researched events studied in banking is the merger. Over the past decade, the U.S. banking industry has registered a record level of consolidation as through mergers and acquisitions. As a result, bank regulators and anti-trust authorities, among others, are interested in gaining a better understanding of the potential welfare consequences of bank mergers. Specifically, they are interested in knowing whether or not bank mergers improve efficiency of the combined firms. Bank mergers may increase efficiency by allowing the bank to achieve economies of scale or by achieving a combined output that is more profitable than before. Moreover, bank mergers may lead to efficiency gains by changing the input-output mix in a manner that optimizes costs and/ or revenues.

Bank mergers have stimulated much research, which can be broadly divided into two areas: event studies and assessment of pre-merger and post-merger operating performance. Event studies examine the impact of merger announcements on share price[27]. The results of these event studies have a set of well-known problems (Berger, 1998). It is unclear what event window is most appropriate. If the event period is important, the window selected for analysis may influence results substantially. Furthermore, it is uncertain how many days after the announcement date are sufficient to enable the market to fully trade on information regarding the proposed transaction. Another problem may arise from not capturing the effect of information leakage. Lastly, it is impossible to determine whether changes in market values are caused by changes in market power or changes in efficiency.

The use of the operating performance methodology can take various formats. In this regard, Berger, Demstez, and Strahan (1999) make a distinction between static and dynamic analyses. Static analysis is defined as studies that relate to the potential consequences of mergers to certain characteristics of financial institutions that are associated with the mergers, such as institution's size. Static analysis does not use data on mergers and, hence, does not provide direct information on the effects of mergers. However, they may be useful in predicting the consequences of mergers, for example, in terms if realizable scale and scope economies.

One the other hand, dynamic analysis is defined as studies that compare the operating performance of financial institutions pre-merger and post-merger, or compare the behavior of recently merged banks with other banks that have not engaged in mergers. As reported in Berger at al. (1999), dynamic analysis is more comprehensive

[27] The market's interpretation of the value gains/losses from merger activity.

than static analysis. They recommend, among other recommendations, that future research should focus on dynamic analysis methods that evaluate the impact of bank mergers by comparing the behavior of merged banks with a relevant peer group of non-merged banks. One method of dynamic analysis involves analyzing the changes in both the cost and profit efficiency of banks following mergers. A number of studies have measured bank performance by employing financial ratios (Rhoades (1986,1990), Srinivasin(1992) and Pilloff(1996)). To measure cost efficiency, studies compare simple cost ratios, such as the operating costs to total assets ratio, and typically find no substantial change in cost performance associated with bank mergers. However, the use of these financial ratios has some drawbacks; including the fact such ratios do not consider the input price and output mix.[28] Also, they ignore the current market value of the bank and do not reflect economic value-maximization. In addition, the selection of the weights of these ratios is highly subjective

In view of the abovementioned shortcomings, this essay adopts a frontier approach[29] to examine the cost efficiency effects of bank mergers. The frontier methodology involves econometrically estimating an efficient cost frontier for a cross-section of banks. For a given bank, cost efficiency is measured as the deviation between the actual cost and the minimum cost point on the frontier. Profit efficiency models not merely require that services be produced at a minimum cost, they also involve the maximization of revenues. Rogers (1998) finds that profit efficiency is not positively correlated with cost efficiency, suggesting the possibility that cost and revenue inefficiencies may be negatively correlated. This finding indicates that a bank with higher

[28] See Berger and Humphrey, 1992.
[29] Berger and Humphrey (1997) recommend the use of the frontier approach to overcome the limitation of the financial ratio approach.

costs may compensate for this apparent inefficiency by achieving higher revenues than its competitors. A bank may realize these revenues either by employing a different composition of its vector of production or through the benefit of greater market power in pricing derived from specialization. Therefore, a measurement of cost inefficiency may be contaminated by the composition of the output; an output vector of higher quality could be more costly but not necessary inefficient. As a result, profit efficiency analysis provides a more important source of information for bank management than the partial vision offered by only analyzing cost efficiency. Moreover, the estimation of a frontier profit function can capture productive specialization, allowing the higher revenues received by banks that produce differentiated or higher quality outputs to compensate for the higher costs incurred.

As a further test of our hypotheses, Data Envelopment Analysis (DEA) is utilized to compare the behavior of merged banks with other banks that have not engaged in mergers. DEA decomposes cost (input saving) efficiency into allocative efficiency and technical efficiency, where allocative inefficiency is defined as a decline in performance due to an ineffective production plan, while technical inefficiency is defined as the poor implementation of this production plan. DEA also allows us to decompose technical efficiency into pure technical efficiency and scale efficiency. These decompositions enhance our understanding of the sources of efficiency and inefficiency that may be associated with bank mergers. To the best of the researcher's knowledge, there are no previous studies that have used DEA analysis to identify the sources of efficiency gains, if any, associated with mergers in the U.S. banking industry.

This essay not only examines the cost efficiency but also the profit efficiency effects of bank mergers. In addition, the sources of efficiency gains associated with bank mergers are investigated. This analysis spans a longer time period than previous research, with the advantage of considering more recent bank mergers. For this purpose, the Stochastic Frontier Approach (SFA) is employed to estimate the cost and profit efficiencies given a data sample that extends over (1986-2000). To the best of the researcher's knowledge, there is only one essay (Akhavein, Berger, and Humphrey 1997) that investigates the profit efficiency effects of bank mergers. However, the analysis was limited to the bank "mega mergers" of the 1980s between banking institutions with assets over US $1 billion.

This analysis differs from previous studies of bank mergers in two different important aspects. First, it investigates bank mergers of all sizes. Prior empirical studies of efficiencies in bank mergers have either examined large bank mergers, or fully neglected merger's size. Second, this essay attempts to identify the existence and the magnitude of efficiency gains from bank mergers employing a parametric approach and non-parametric approach. Equally important, this study contributes to the current literature by offering a new and fresh perspective on the economic rational for the proliferation of mergers over the period under study. It seems especially important to be able to offer insight into the behavior of merged banks in recent years. Secondly, there are very few studies that look at the profit efficiency effects of bank mergers. Moreover, very little research attention has been focused on examining bank mergers of all size. It is important to compare the economic impact of small bank mergers to that of large mergers. The final contribution of this analysis is the identification of the sources of

efficiency gains associated with bank mergers. DEA analyzes the relative efficiency and managerial performance of productivity units of merged banks and non-merged banks, with the same multiple inputs and multiple outputs.

The results of the Stochastic Frontier Approach (SFA) indicate that merged banks have achieved greater post-merger gains in the 1990s in both cost and profit efficiency as compared to non-merged banks. Furthermore, while merged banks significantly increased their profit in the 1980s, there were no significant increases in cost efficiency from bank mergers activity during that time period. Another result from the SFA suggests that if merged banks and non-merged banks use the same production technologies, the average merged banks would operate closer to their efficient level than average non-merged banks. Moreover, it is found that prior to merging, the acquiring banks are more efficient on average than the acquired banks; and that generally after the merger the combined bank is able to adhere to the higher efficiency levels. However, prior to the mergers, both the acquiring and acquired banks have a somewhat lower efficiency level than their peer group. This finding is consistent with the conventional corporate finance of a market takeover's explanation of mergers (well-managed banks acquire poorly-managed banks and consequently improve their efficiency). The essay's most striking result is that small bank mergers operate more efficiently in terms of cost but less efficiently in terms of profit than large bank mergers. This difference may suggest the existence of monopoly power in the banking industry where large bank mergers can realize greater profits, despite having greater costs. Finally, as an alternative check of the efficiency effects of mergers, the Data Envelopment Analysis (DEA) is used to analyze the efficiency of the

merged and non-merged banks, allowing investigating whether merged and non-merged banks have different levels of efficiency.

The results indicate that the most significant source of efficiency gains among merged banks versus non-merged banks is the technical efficiency; suggesting that merged banks are on average more technically efficient than non-merged banks. Technical efficiency reflects the ability of managers to control costs and is measured by how close bank costs are to those of fully efficient banks when the effects of scale, product mix and other exogenous variables that may influence banking costs, are considered. In short, SFA results provide statistical evidence that, on average, bank mergers do result in an increase in cost and profit efficiency post-merger relative to other banks. Moreover, DEA results suggest merged banks are more efficient than non-merged banks because not only they deploy their resources efficiently, but also tend to choose the "right mix" of resources to manage. Mergers seem to allow stronger bank to gain control of weaker banks, thus helping to increase input efficiency. Mergers also allow the banking industry to take advantage of the opportunities created by improved technology and deregulation.

The reminder of the essay is designed as follows. Section 3.2 reviews related literature. Section 3.3 provides the estimation of efficiency. Section 3.4 summarizes the methodology. Section 3.5 describes the data and definition of variables. Section 3.6 reports our empirical results and section 3.7 concludes.

3.3 Review of Literature

A Bank acquires another bank for several reasons, including market power, diversification, and managers' preferences. But the most frequently cited reason for

recent bank mergers is efficiency improvement. There is considerable confusion, however, about whether and how bank mergers improve efficiency. In theory, pruning fixed expenses (e.g., by eliminating overlapping braches offices or duplicate bank office system) can create scale economies by allocating the overhead of a single bank across the activities of two previously independent banks. However, the empirical literature finds that scale economies are limited to the smallest banks and are not available in many bank mergers.

Therefore, several studies have focused on improvement efficiency.[30] Improvement in efficiency (movements toward the optimal point on the best-practice efficient frontier) may be accomplished through mergers by improving the cost and profit efficiencies. A bank is cost efficient if it minimizes costs for a given quantity of output, and it is profit efficient if it maximizes profits for a given combination of inputs and outputs. There are several ways in which mergers can improve efficiency. First, for example, if the bidder bank is more efficient ex ante and tends to bring the efficiency of the target up to its own level by spreading its superior managerial expertise or policies and procedures over more resources. Alternatively, the merger event itself may have the effect of awakening to the need for improvement or may be used as an excuse to implement substantial unpleasant restructuring. Second, the larger banks that result from mergers may gain access to cost-saving technologies or spread their fixed costs over a larger base, thus reducing average costs. Third, efficiency may be improved by exploiting of economies of scope.[31] Finally, mergers may improve the managerial efficiency.

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[30] See Berger and Humphrey (1992, 1994), and DeYoung (1997).

[31] The deal may allow the merging parties to enter new markets and cross-sell their products to a wider customer base.

In this essay we consider both cost and profit efficiency. Cost efficiency improvements occur when a bank moves closer to what a "frontier-efficient" or best practice bank's cost (the most efficiently managed banks) would be for producing the same output bundle using the same input prices and other environmental conditions. Profit efficiency improvements occur when a bank moves closer to the profit of a best-practice bank under the same conditions. Profit efficiency is a more inclusive concept than cost efficiency. Profit efficiency incorporates cost efficiency, the effects of scale, scope, and product mix on both costs and revenues, and to some degree the effects of changes in the risk-expected return tradeoff. Profit efficiency also corresponds better to the concept of value maximization than cost efficiency, since value is determined from both costs and revenues.

The literature suggests that there is a substantial potential for efficiency improvements from the mergers of banks. Average inefficiencies on the order of about 20% of costs and about 50% potential profits are typical found (Berger and Humphrey 1997). Simulation results also indicate that large efficiency gains are possible if the best-practice bidders reform the practices of inefficient targets (See Savage 1991, Shaver 1993). But the issue of whether or not mergers actually lead to efficiency gains has not been conclusively resolved.

Early research suggests that many banks engage in mergers for the purpose of improving efficiency. For example, Berger and Humphrey (1992) study the 57 U.S. banking mega-mergers from 1981 to 1989. They estimate a neo- classical cost function, which allows them to consider only two types of efficiencies, namely scale economics, and X-efficiency. Berger and Humphrey produce two main results. First, if more efficient

banks take over less efficient banks, a merger may create substantial efficiency gains. First, the ex ante choice of merger partners often did satisfy the condition for being conductive to improving efficiency. In 55 to 72 percent of the cases, the bidder bank was more cost efficient than the target bank. Second, the mergers were not successful on average in improving cost efficiency. The average efficiency improvement was less than five percentage points and was not statistically significant. Moreover, because of diseconomies of scale, the combined firms actually performed slightly worse on average after the mergers, although also this effect was small and often not statistically significant. They conclude that the diseconomies created by the megamergers easily offset any x-efficiency gains, resulting in a decline in cost efficiency. On the other hand, DeYoung (1997) find that 58% of a sample of 348 deals in 1987 and 1989 (employing a thick-frontier cost function) generates small cost efficiencies. Although some of these gains were due to mergers involving insolvent targets (where support from the FDIC might have helped in improving the bank's performance), 61% of the solvent bank purchases also generate cost efficiencies. Moreover, the results of DeYoung (1997) indicate that mergers of equal-sized banks capture smaller than average cost efficiencies, and that bidders that are experienced dealmakers obtain larger average improvements. Peristiani (1993) studies in-market mergers, or mergers in which there is some local market overlap prior to merger. He reports that bidder banks are more profitable than targets. However, he finds that generally no efficiency gains were created. Using simulation, Shaffer (1993) finds that large X-efficiency gains are possible if the best practice banks merger and reform the practices of the least efficient banks.

More recently, some studies have found that bidder banks are more efficient ex ante than targets (Altunbas, Maude, and Molyneux 1995, and Pilloff and Santomero 1998). It has also been found that bidder banks bid more for targets when the merger would lead to significant diversification gains, consistent with a motive to improve the risk-expected return tradeoff and increase profit efficiency (Benston, Hunter and Wall 1995).

A number of studies measure the change in cost efficiency after mergers. Most of the studies generally show very little or no cost efficiency improvement on average from the mergers of the 1980s, on the order of 5% of costs or less (Berger and Humphery 1992, Rhoades 1993, Peristiani 1997). A parentally, the potential gains from consolidation branches, or computer operations, etc., may have been offset by managerial inefficiencies or problems in integrating systems. Studies using 1990s data are mixed, but sometimes showed more cost efficiency gains (Berger and Humphery 1992, and Rhoades 1993). Rhoades (1998) examines the efficiency effects of nine bank mergers. He findings suggest that the cost efficiency effects of mergers may depend on the motivation behind the mergers and the consolidation process

Although the main stream research focuses on cost efficiency, few studies have tried to cover all possible effects of mergers (also on the income side) by using a profit function. Studies of profit efficiency usually paint a more favorable picture of mergers. Studies of the profit efficiency effects of mergers from the 1980s and early 1990s found that mergers improved profit efficiency, and that this improvement could be linked to an increased diversification of risks and an improved risk-expected return tradeoff (Akhavein, Berger, and Humphrey 1997, Berger 1998). After the merger, the banks

tended to shift their asset portfolios from securities to loans, hold more assets and loans per dollar of equity, and raised additional uninsured purchased funds at reduced rates, consistent with a more diversified portfolio. The most recent analyses find unexploited scale economics even for fairly large bank sizes (Berger and Mester, 1997, Berger and Humphrey, 1997). The prospects of scale efficiency gains appear to be greater in the 1990s than in the 1980s. This finding is usually ascribed to technological progress, regulatory changes and the beneficial effects of lower interest rates (Berger et al., 1999). In addition, Berger et al. report that mergers may be geared to exploit economies of scale or scope, improve the X-efficiency of the merged banks, may enable the merged banks to exercise increased market power. Moreover, it may simply be motivated by the management's desire to increase size. Consequently, bank mergers may cause diverging effects on cost and profit efficiency, as well as on loan and deposit pricing.

In this essay, we deeply examine the effects of bank mergers by investigating the production and cost structure of banks involved in mergers. To this end, we estimate cost and profit efficiencies using the stochastic frontier approach. The estimation of cost and profit efficiency allows us to distinguish between improvements in efficiency versus market power effects. This distinction is impossible to accomplish with simple cost and profit ratios. Also, this enables us to evaluate whether and by how much bank mergers affect cost and profit efficiencies.

Because there is still no consensus in the literature regarding the valuation consequences of bank mergers, we believe that it is important to continue to carefully evaluate the performance of banks engaged in mergers using a variety of samples and empirical methodologies. In our view, to complete this picture we believe that it would be

valuable to deeply examine the impact of bank mergers by estimating the production and the cost structure of banks involved in mergers. Also, we think that quantifying efficiency gains from bank mergers is an extremely important step towards analyzing the trade-off between the gains and the potential adverse effects of bank mergers. Therefore, we provide a comprehensive investigation of the cost efficiency and the profit efficiency effects of bank mergers. In doing this, we adopt the frontier approach which provides an overall, objectively determined, numerical score and a ranking, something that is not available with other methods. For example, accounting data ignores the current market value of the bank and does not reflect economic value-maximizing behavior. In addition, these financial ratios do not consider the input price and the output mix (See Berger and Humphrey, 1992), and the selection of the weights of financial ratios is subjective.

3.3.1 Efficiency Estimation

The measurement of bank efficiency is a controversial issue. Accounting ratios are the initiated approach to measure the efficiency of banks. It is the most intuitive way to measure bank efficiency. However, DeYoung (1997) points out that accounting-based ratios are misleading. The statistical-based efficient cost frontier approach has better accuracy in bank cost efficiency measurement. If a bank systematically incurs relatively higher costs than other banks in a competitive environment, it is considered inefficient.

In the survey of Berger, Hunter, and Timme (1993), there are several econometric and linear programming techniques that have been proposed for estimating efficiency. They are Stochastic Frontier Approach (SFA), Thick Frontier Approach (TFA), Data Envelopment Analysis (DEA), and distribution-Free Approach (DFA).[32] DEA has the

[32] The Stochastic Frontier Approach is also called Econometric Frontier Approach (EFA). SFA, TFA, and DFA are parametric approach while DEA is a nonparametric approach.

advantage of being a flexible, a nonparametric technique that makes no assumptions about the form of the production function. Instead, it estimates an empirical best practice frontier from the observed inputs/outputs of individual decision-making units (DMUs), which replicates their individual behavior rather than the average sample estimate of conventional production functions. A DMU is found to be efficient when comparisons with other units indicate no inefficiency in the utilization of inputs/outputs, as measured by its position relative to the efficient frontier. The DEA best practice frontier is generally piecewise linear and approximates the true production function. DEA is so-named because the data from the best practice DMUs generate the production frontier and thereby "envelopes" the data from other DMUs.[33]

The nonparametric approach generally emphasizes the technological optimization rather than economic optimization, and does not correspond to the cost and profit efficiency concepts discussed by Berger and Mester (1997). Parametric approaches are the stochastic econometric frontier approach (SFA). SFA employs a composite error structure in which inefficiencies are assumed to follow an asymmetric distribution, usually the half-normal distribution, while random errors are normally distributed, and both are orthogonal to the cost function's exogenous variables (Berger and Mester, 1997).[34] All frontier approaches use the same sequence of estimate frontier efficiency. First, the best practice bank is benchmarked. In this stage, the frontier approach uses accounting data of multiple input and output variables to form an efficient frontier and locate the best practice bank across the sample. Second, all other banks are compared to the constructed benchmark and are then assigned an efficiency score. At this stage, the

[33] DEA and its applications are treated usefully and extensively in Fried, Lovell, and Scmidt (1993).
[34] Unlike SFA, DEA does not for the presence of a random error term. Hence, DEA attributes any deviation from the efficient frontier as being purely as associated with inefficiency.

frontier approach calculates individual inefficiency scores for the banks located outside of the frontier in terms of their deviations from the best practice bank. Thus, frontier efficiency measures the observed bank's deviation in performance from that of the best practice bank in the frontier. Then, each observed bank is compared to the benchmark and assigned an individual efficiency score. Efficiency ranges over the (0,1] interval, and is equal to one for the best practice in the sample. Also, a deviation from a score of 1 shows the degree to which an inefficient bank can improve its efficiency relative to the best practice bank. On the cost side, a bank is cost efficient if it minimizes costs for a given quantity of output. On profit side, it is profit efficient if it maximizes profit for a given combination of inputs and outputs.

In this study, to be comprehensive, we use SFA to form the efficiency frontier and examine the effects of bank mergers on cost and profit efficiency. Then, we estimate cost efficiency and profit efficiency for the merging bank (acquiring, acquired, or consolidated) relative to its peer group. The peer group banks are defined as the group of banks that belong to the same type and are comparable in term of size, measured by total assets. In addition, we employ DEA to investigate and identify the sources of efficiency gains, if any, associated with mergers in the U.S. banking industry.

3.4 Methodology

The analysis of cost and profit efficiency takes size and technology as given and focuses on how production factors are combined, by comparing a bank's actual costs or profits with the costs or profits of the best practice banks. Mergers may increase efficiency, by transferring superior managerial skills from the bidder to the target. However, the opposite may also happen, for example when the managers of the bidder enter into new

geographic or product markets or when the merger is motivated by empire building strategies pursued by relatively inefficient managers.

There are several approaches to estimate cost and profit efficiency. The simplest approach consists of comparing financial ratios that describe costs and profitability.35 However, this methodology does not consider the input price and output mix. Therefore, another complex approach has employed in the literature to control that drawback. This allows us to measure cost and profit efficiency by comparing the best practice of the industry, as determined by statistical techniques, taking into account for each bank: the inputs, outputs and the prices it faces. One approach estimates a stochastic frontier (a combination of inputs, outputs and prices) along with how all efficient banks would operate, and the distance of each actual bank from the frontier is taken as a measure of its (in) efficiency.

Given the fact that the production technology of the fully efficient firm in a banking industry is not known, it should be estimated from observations in practice. We employ Stochastic Frontier Approach (SFA) to evaluate whether and buy how much bank mergers affect cost efficiency and profit efficiency. I will analyze both cost and profit efficiencies. The type of profit efficiency method employed in this study is the non-standard profit efficiency model, which is the latest development in the literature (Berger and Mester, 1997, and DeYoung and Hasan, 1998, Khumbakar et al., 2001). Further, we use Data Envelopment Analysis (DEA) to investigate the sources of efficiency gain, if any, associated with bank mergers.

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[35] Operating costs over gross income and return on equity.

3.4.1 Parametric cost efficiency

Cost efficiency measures how well the observed bank manages its costs relative to the best practice bank. Cost efficiency can be estimated by employing either a nonparametric or a parametric approach. Nonparametric cost efficiency is estimated by using linear programming techniques. Whereas, the Stochastic Frontier Approach (SFA) is a parametric approach used in recent studies to estimate efficiency in financial institutions. SFA assumes that inefficiencies observe an asymmetric half-normal distribution, and random errors are normally distributed. The underlying reason for half-normal distribution assumption is that inefficiencies cannot be negative.36 Actually, cost efficiency is derived from a cost function in which variable costs depend on the input prices, quantities of variable output, random error, and inefficiency. Cost efficiency models seek to minimize costs by employing the optimal levels of inputs by assuming given bank current input prices and output quantities. Thus, the inefficiency is caused by the excess use of inputs or produces too less outputs. Also, it assumes that banks are cost minimizing firms; their production process can be represented by the stochastic frontier cost function

$$C = C(Y, P, t, \beta) + u + v \qquad (3.1)$$

where

C: represents variable cost.

Y: represents the output vector.

P: represents the input price vector.

T: represents time and capture possible technological changes.

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[36] It is impossible for a bank to waste more than 100% of the resources it is currently using.

β : represents the vector of parameters to be estimated.

u: represents the one-side, non negative, stochastic element that represents cost inefficiency.[37]

v: represents the classical random error term, independent from u.

Also, the cost function can be expressed in logarithmic terms, assuming that the efficiency and random error terms are multiplicity separable from the remaining arguments of the cost function.

$$\ln C = f(Y,P) + \ln u + \ln v \qquad (3.2)$$

Clearly, from equation (3.2), we need to specify a relationship (function) between bank production and bank cost in order to estimate the inefficiency. We use the translog function forms to estimate cost structure of banks and to derive the measure of bank inefficiency.[38] The translong function has been widely used to analyze the cost characteristics of depository institutions.[39] The translog variable function is given by the following:

$$\ln C_{st} = \alpha_0 + \sum_{i=1}^{4} \alpha_i \ln Y_{ist} + \sum_{i=1}^{3} \beta_i \ln P_{ist} + \frac{1}{2}\sum_{i=1}^{4}\sum_{j=1}^{4} \sigma_{ij} \ln Y_{ist} \ln Y_{jst} +$$

$$\frac{1}{2}\sum_{k=1}^{3}\sum_{l=1}^{3} \delta_{kl} \ln P_{kst} \ln P_{lst} + \sum_{k=1}^{3}\sum_{i=1}^{4} \mu_{ki} \ln P_{kst} \ln Y_{ist} + v_{st} + u_{st} \qquad (3.3)$$

where

C_{st} = variable cost for observation s in year t.

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[37] We assume that u follows the half-normal distribution. This assumption has been standard in the literature.

[38] The translong function is also used as the cost equation in Mester (1987) and English et al. (1993).

[39] See the survey of Berger, Hunter, and Timme (1993).

Y_{ist} = output i (i=1,2,3,4) for observation s in year t.

P_{kst} = price of input k (k=1,2,3) for observation s in year t.

Greek symbols = parameters to be estimated.

v_{st} = cost inefficiency for observation s in year t.

u_{st} = random error term.

Cost efficiency is defined as a measure of how far a bank's actual cost is from the best practice bank's cost (most cost efficient banks) if they were to produce the same output. Cost efficiency score attains values over (0,1]. A score of 0.6 for a bank implies that it is about 60% cost efficient, i.e., it wastes about 40% of its costs relative to a bank on the frontier facing similar conditions. Our main objective is to investigate the efficiency effects of bank mergers. In doing this the above model will be estimated for the merging banks and for a relevant peer group of non-merging banks. This will allow us to detect if there is any efficiency gain from mergers.

3.4.2 Alternative profit efficiency

DeYoung and Nolle (1996) indicate that cost-based models might misrepresent the nature and the extent of inefficiency in banks. For instance, banks might create more revenue by increasing costs. Thus, revenue efficiency might lead to cost inefficiency. If revenue efficiency overcomes cost inefficiency, banks will be more profitable. Berger and Mester (1999) and Berger DeYoung (2002) recommend profit maximization is superior to cost minimization for the study of firm performance because the profit function more completely addresses the economic goals of firms and their owners, who take revenue into account as well as costs. Profit efficiency is based on the economic goal of profit maximization, which requires the same amount of managerial attention to raise a

managerial dollar of revenues as to reduce a managerial dollar of costs. Thus, profit efficiency may better capture the sources of efficiency gains, if any, associated with bank mergers.

There are two ways to estimate the profit efficiency; standard profit function and alternative profit function. Alternative profit efficiency measures how close a bank is to generating maximum profits given its output levels instead of output prices, unlike the standard profit efficiency concept. While the standard function is specified in terms of input prices and output prices, the alternative profit function is specified in terms of input prices and output quantities. Alternative profit efficiency is derived from a profit function with the same right-hand-side variable as the cost function and is estimated using the same functional form. As indicated by Berger and Mester (1997,1999), alternative profit efficiency is particularly closer to reality when some of the standard assumptions of perfect markets do not hold.[40] They compare the two approaches and conclude that the alternative profit function is the better measurement. Berger and Mester (1997) report four conditions that alternative profit efficiency may provide better information. They are (i) substantial unmeasured differences in the quality of banking services, (ii) banks cannot achieve every output scale and product mix, (iii) output markets are not perfectly competitive, and (iv) output prices are not accurately measured. Since we estimate the efficiency for merging banks and for a relevant peer group of non-merging banks in the U.S, substantial differences in the bank's service quality exist. Not all banks can achieve every output scale and product mix. Under the regulation in the banking industry, we cannot say that the output markets are perfectly competitive. Output prices are not

[40] In the case of banking sector, whenever the assumption of perfect competition in pricing is questionable, or when there are differences of production quality among the banks in the sample.

available to all sizes of the banks. Therefore, only alternative profit efficiency is estimated in this study.

More recently, Berger and DeYoung (2002) employ alternative profit function rather than the standard profit function to test the effects of geographic expansion on bank efficiency because of the data availability and better bank profit explanation. They report that output prices are difficult to measure accurately for banks, and because of output quantities are relatively fixed in the short-run and cannot respond quickly to changing prices as is assumed in the standard profit function, vary across banks more output prices and thus better explain differences in bank profits. In this study, we conduct the test by using the SFA approach to evaluate whether and how much bank mergers affect cost efficiency and profit efficiency. The type of profit efficiency method employed in this study is the alternative profit function.

In log form, alternative profit function can be written as follows:

$$\ln(\pi + a) = \ln C(Y, P, t, \beta) + u_{\pi} + v_{\pi} \qquad (3.4)$$

Indeed, the alternative profit function employs the same independent variables as the cost function, as shown below:

$$\ln(\pi + a) = \alpha_0 + \sum_{i=1}^{4} \alpha_i \ln Y_{ist} + \sum_{i=1}^{3} \beta_i \ln P_{ist} + \frac{1}{2} \sum_{i=1}^{4} \sum_{j=1}^{4} \sigma_{ij} \ln Y_{ist} \ln Y_{jst} +$$

$$\frac{1}{2} \sum_{k=1}^{3} \sum_{l=1}^{3} \delta_{kl} \ln P_{kst} \ln P_{lst} + \sum_{k=1}^{3} \sum_{i=1}^{4} \mu_{ki} \ln P_{kst} \ln Y_{ist} + v_{st} + u_{st} \qquad (3.5)$$

where, π represents net profits of the bank *b*; a is a constant added to the profits of each bank so that natural log is taken of a positive number since minimum profits are typically negative; and all other variables are as explained previously in the equation (3.3). Profit efficiency measures how close a bank is generating maximum profits given its output

levels. A 70% profit efficiency score for a bank suggests that it would earn about 30% more profits than what it is making now if it were operating on the efficient frontier.

3.4.3 Data Envelopment Analysis (DEA)

Data Envelopment Analysis (DEA) is a mathematical programming technique originally proposed by Charnes et al. (1978). It is a methodology for analyzing the relative efficiency and managerial performance of productivity units having the same multiple inputs and multiple outputs. DEA allows us to compare the relative efficiency of banks by determining efficient banks as benchmarks and by measuring the inefficiencies in input combinations (slack variables) in other banks relative to the benchmark. The most important advantage of DEA over traditional econometric frontier studies is that it is a non-parametric, deterministic method and therefore does not require a prior assumption about the analytical form of the production function. Also, it constructs the best practice production function solely on the basis of observed data, and therefore, the probability of a misspecification of the production technology is zero. On the other hand, the main disadvantage of DEA is that, being a non-parametric method, it is more sensitive to possible miss-measurement problems.[41]

DEA has become widely popular in measuring efficiency in national banking industries. For example, in Sherman and Gold (1985), Rangan et al. (1988), Ferrier and Lovell (1990), Aly et al. (1990) and Berger et al (1993). The method uses linear programming techniques in the estimation of frontier functions; banks on the frontier are considered efficient. Other banks are compared with the best practice units and inefficiency levels are computed using the estimated frontier. For a bank facing input

[41] DEA is sensitive to extreme observations and measurement errors (the basic assumption is that random errors do not exist and that all deviations from the frontier indicate inefficiency.

price vector p_k and producing the output vector y_k, c_k^* is the cost minimizing input vector. Cost efficiency is computed as $C_k = p_k c_k^* / p_k x_k$, that is C_k = minimum cost / actual cost.

For the case of a bank producing four outputs with three inputs, minimum cost is calculated by the following linear programming:

$Min \sum \mathrm{p_{ik}} x_{ik}$ s.t.

$y_{jk} \leq \sum_k \mu_k y_{jk}$, j = 1,2,3,4.

$x_{ik} \geq \sum_k \mu_k x_{ik}$, i = 1,2,3,4.

$\mu \geq 0$,k = 1.2,…..,n.

$\sum_k \mu_k = 1$

where p_i = price of input I; x_i = input I; y_j = output j; μ_k = intensity variables which allows convex combinations of observed input and output quantities; k is the bank index and n is the sample number of observations.

3.4.5 Data and definition of variables

This section describes the data and variables used in this study. All information necessary for estimating both cost and profit efficiency is obtained from the Reports of Condition and Income Report database (Call Report) on the Federal Reserve Bank of Chicago's web page.[42] We use data from the 1986-2000 interval to analyze the effects of mergers of U.S. banks. Our merger sample is also obtained from the merger file at the Federal Reserve Bank of Chicago. The initial sample consists of 2552 mergers that are

[42] www.frbchi.org

selected from the same web page. A merger included in the final sample is required to meet the following criteria: (a) both of the merged banks must be healthy institutions at the time of the merger, (b) data for all of the variables in the model are available, (c) a single target bank is acquired in the same merger application, (d) both of the merged banks did not engage in another merger two years before or after the merger date. (e) the merger is not assisted by a bank regulator, (f) the target does not involve a failed bank, and finally (g) the merger must occur before 1999. The first criterion eliminates all failed-bank mergers and government assisted bank mergers. The second and third filters allow us to compare the two-year pre- and post-merger efficiency without the contamination of another merger, also ensuring the availability of banking data for at least two years before the merger date. Finally we exclude the most recent mergers that do not have at least three years of reported data after the merger date. This process results in a sample of 1640 bank mergers.

'A Reliable' efficiency prediction requires appropriate definitions and certain assumptions regarding the measurement of input, output, and input price vectors. The exclusion of certain important bank inputs and /or outputs might bias the final efficiency measures by constructing of the frontier (the locus of the efficient combination of inputs and outputs). In choosing which variables to specify as outputs versus inputs, one should decide on the nature of banking technology. In literature on the theory of banking, there are two main approaches competing with each other in this regard: the "production approach" and the" asset approach" or "intermediation approach" of Sealey and Lindley (1977). The production approach considers banks as firms producing services to customers; being deposit-holders as well as borrowers, using labor and capital as inputs.

As a consequence, this theory generally excludes interest costs from total costs and uses operating costs as a dependent variable.

Table 3.1
Variables employed in measuring the cost and alternative profit efficiency

Symbol	Variable Name	Definition
	Dependent Variables	
C	Total cost	Operating expenses plus interest expense, includes costs of purchased funds, deposits, and labor
π	Profits	Profits, which include revenues from loans and securities less costs
	Variable Output	
	Quantities	
y_1	Real estate loans	
y_2	**Individual loans**	The dollar value of loans to individual for household, family, and other personal expenditure also, includes installment and credit card and related plans.
y_3	Business loans	Include all other individual loans and real estate loans
y_4	Securities	All non-financial assets (Gross total assets, GTW- $y_1 - y_2 - y_3 -$ physical capital*)
	Variable Output Prices	
p_1	Price of labor	Salaries and employee benefits divided by the number of full-time-equivalent employees
p_2	**Price of purchased funds**	Interest paid on large time deposits, foreign deposits, federal funds purchased and all other liabilities except core deposits, divided by the total dollar values of these funds
p_3	Price of deposits	Interest paid on domestic transactions accounts, and time and savings, divided by the total dollar values of these deposits.

* : Physical capital includes premises and other fixed assets.

Like many studies on bank efficiency (e.g., DeYoung and Nolle 1998; Beger and Mester, 1997; DeYoung and Hasan, 1998), we use the asset approach. Under this approach, the

banks play the role of the financial intermediary between depositors and borrowers, where deposits are viewed as an input to produce loans. Stated differently, all liabilities (core deposits and purchased funds) and financial equity capital provide funds and are considered to be inputs that generate costs. All assets (loan and securities) using bank funds and are considered to be outputs that generate revenues. Physical inputs (labor and premises) are specified as inputs that generate costs. Accordingly, the specifications for all variables in (3) and (4) are the following:

C: operating expenses plus interest expense, includes costs of purchased funds, deposits, and labor.

π : profits, which include revenues from loans and securities less costs.

y_k : bank output quantities; (k=1) real estate loans, (k=2) individual loans, (k=3) business loans, and (k=4) securities. [43]

p_l : bank input price; (l=1) price of labor, (l=2) price of purchased funds (foreign deposits, federal funds purchased, all other liabilities except core deposits) , and (l=3) price of deposits (domestic transactions accounts, time and savings).

Table 3.1 reports the definition of all the variables used in the cost and profit functions. The price of labor includes salaries and employee benefits divided by the number of full-time-equivalent employees. Price of purchased funds is interest paid on large time deposits, foreign deposits, federal funds purchased and all other liabilities except core deposits, divided by the total dollar values of these funds. Price of deposits is defined as interest paid on domestic transaction accounts, and time and savings, divided by the total dollar values of these deposits. Table 3.2 gives the sample means and

[43] Individual loans include installment and credit card and related plans. Business loans include all other than individual loans and real estate loans. Securities are all non-financial assets.

standard deviations of all variables for 1987, 1993, and 1999. Although the continuous variables are generally expressed in natural logs in (3) and (5), following Berger and Mester (1999), we report the means and standard deviations of the levels to be more informative. There are no strange surprises; securities represent the largest output share, followed by business loans. Price variability is lower than input variability, suggesting competition in the input markets.

Table 3.2
Sample statistics of variables

Years	1987		1993		1999	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Dependent Variables						
C	39,028	364,199	36,693	255,041	67,400	742,995
π	4,543	35,898	5,674	36,922	13,263	137,682
Variable Output Quantities						
y_1	97,654	671,674	133,993	868,577	287,848	2,864,242
y_2	56,162	373,205	58,293	373,835	92,900	931,515
y_3	95,340	798,387	85,204	725,949	187,597	2,442,498
y_4	203,421	1,746,428	243,853	1,793,622	472,966	6,204,781
Variable Output Prices						
p_1	25.49	6.18	31.19	10.73	40.46	11.08
p_2	0.0397	0.1109	0.0316	0.1431	0.0309	0.0537
p_3	0.0510	0.0073	0.0526	1.145	0.0344	0.0065

3.5 Results

The first method we use to examine the efficiency effects of bank mergers is to compare the cost and profit efficiency for merged and non-merged banks. The non-merged banks are defined as banks comparable in terms of size, which is measured by total assets. Two approaches are applied to estimate the efficiency levels, the first of which being the Stochastic Frontier Approach (SFA). The second approach is the Data envelopment Analysis (DEA).

Table 3.3
The ML cost and profit frontier parameter estimates

	Cost function	Profit function		Cost function	Profit function
Coefficient			Coefficient		
a_0	0.276**	8.629*	$\mu_{y1,p1}$	-0.882	-.981
a_{y1}	-2.922	0.359	$\mu_{y1,p3}$	-.121*	-2.902
a_{y2}	-0.798	-0.108	$\mu_{y2,p1}$	-.508	0.603
a_{y3}	1.725	1.402	$\mu_{y2,p3}$	0.421	0.366
a_{y4}	1.277*	-3.185	$\mu_{y3,p1}$	0.771	-0.253
β_{p1}	-1.893	-0.1460**	$\mu_{y3,p3}$	-.428	0.952**
β_{p2}	2.563	0.110	$\mu_{y4,p1}$	.208	2.650
$a_{y1,y1}$	-0.495	0.136	$\mu_{y4,p3}$	-.109	0.831
$a_{y2,y2}$	-.0098	-0.907			
$a_{y3,y3}$	0.321	-0.135			
$a_{y4,y4}$	-0.327	0.191			
$a_{y1,y2}$	0.174	-0.583			
$a_{y1,y3}$	0.482**	-0.116			
$a_{y1,y4}$	-0.326	0.532			
$a_{y2,y3}$	0.176	0.377			
$a_{y2,y4}$	-0.335	0.368			
$a_{y3,y4}$	-0.543*	0.657			
$\beta_{p1,p1}$	0.822	-0.148**			
$\beta_{p3,p3}$	0.115	0.589**			
$\beta_{p1,p3}$	0.265**	0.181*			

Log likelihood are 7.78 and 3.65 for the cost and profit functions respectively.

3.5.1 Results from parametric efficiency

3.5.1.1 Cost efficiency

In this section, the results of estimating Equation (3.3) for cost efficiency and its equivalent for profit efficiency are presented. The empirical results of the estimated models are presented in Table 3.3. It is important to recall that the independent variables

in the cost and non-standard profit functions are identical. These variables are able to explain more of the profit variations than of the cost variations across the sample under study. The adjusted R^2s for the cost and profit OLS models are around 92% and 81%, respectively. Clearly, the alternative profit function fits the data nearly as well as the cost function. The stochastic cost and profit efficiency scores are part of the composite error (residual) of either a profit or cost function model. However, because all variables are in logs, we need to take the anti-log of the residuals:

INEFF (Inefficiency) = exp (residual)-1

In order to find the cost and profit efficiency scores, we convert the INEFF to EFF (efficiency)

$$EFF = 1/(1+INEFF) \quad (3.6)$$

Table 3.4
Summary statistics for the stochastic cost efficiency of the non-merged and merged banks

	Non-merged banks		Merged banks		Difference	
	Mean	S.D.	Mean	S.D.	Mean	*t*-stat
1987	0.737	0.0056	0.726	0.0029	0.011	0.26
1988	0.745	0.0084	0.734	0.0030	0.014	4.64***
1989	0.782	0.0062	0.766	0.0029	0.016	0.08
1990	0.813	0.0065	0.789	0.0033	0.024	2.29**
1991	0.824	0.0053	0.874	0.0040	-0.050	3.42***
1992	0.855	0.0048	0.881	0.0055	-0.026	8.06***
1993	0.858	0.0052	0.899	0.0064	-0.041	1.66*
1994	0.869	0.0046	0.897	0.0067	-0.028	3.65***
1995	0.856	0.0039	0.937	0.0532	-0.081	0.80
1996	0.873	0.0031	0.966	0.0034	-0.093	1.68*
1997	0.877	0.0026	0.960	0.0041	-0.092	12.43***
1998	0.886	0.0028	0.978	0.0092	-0.113	5.43***
1999	0.894	0.0033	0.979	0.0048	-0.085	1.65*
1987-99	0.825	0.0066	0.894	0.0027	-0.069	2.21**

Note: Non-parametric wilcoxon test is used to test difference in means assuming unequal variances across groups. The results are qualitatively the same whether variances are assumed to be equal.
*** Significant at the 0.01 level.
** Significant at the 0.05 level.
* Significant at the 0.10 level.

Summary statistics of the cost efficiency scores for both merged and non-merged banks during the period 1987-1999 are given in Table 3.4. This breakout of the time period gives a rigorous check for our findings. The results show a reading of (0.894) for merged banks on average, rendering them more cost efficient than non-merged banks (0.825). This could signify that 89% of resources used would have been sufficient for merged banks to produce the services they generated, while 82% of resources would have been sufficient for non-merged banks to generate their services. Stated differently, merged banks waste about 12% of total costs relative to a best-practice bank, while non-merged banks waste about 21% of costs relative to best-practice banks. On the other hand, it would be possible for merged banks to reduce costs by about 12% simply by eliminating X-inefficiencies, while it would be possible for non- merged banks to reduce costs by about 21%. It is worth noting that for both merged and non-merged banks, cost efficiency is not significant for 1985 and 1995. The results for the non-merged banks are comparable to the results obtained by Berger et al. (1998) and consistent with the results reported by Berger and Mester (1997).[44] The mean cost efficiency for merged banks rises from 0.726 in 1987 to 0.979 in 1999, while it rises from 0.737 to 0.894 for non-merged banks over the same time span. It is also noticeable form Table 3.4 that the period (1987-1990) is a relatively poor period for merged banks compared with the non-merged banks. For the period (1987-1990), non-merged banks have a higher cost efficiency than merged banks (0.822 against 0.744). This finding is consistent with the results reported by Peristiani (1997) who finds evidence of a small but significant deterioration of the average efficiency for merged banks relative to non-merged banks in the period (1980-1990). This result is also comparable to the results obtained by Berger and Humphery

[44] Berger and Mester (1997) find that the average cost efficiency for bank in U.S. is around 87%.

(1992) and Rhoades (1993).[45] However, during the period (1991-1999), merging banks tended to have a higher cost efficiency as compared to non-merging banks (0.940 against 0.853). The difference in cost efficiency between merged and non-merged is also economically significant, suggesting a cost efficiency improvement on average from the mergers of the 1990s.

Table 3.5
Summary statistics for the stochastic profit efficiency of the non-merged and merged banks

	Non-merged banks		Merged banks		Difference	
Year	Mean	S.D.	Mean	S.D.	Mean	*t*-stat
1987	0.5044	0.3143	0.5483	0.2882	-0.046	3.43***
1988	0.5192	0.4822	0.5316	0.3355	-0.0124	2.55**
1989	0.5386	0.3076	0.5792	0.2477	-0.0072	0.36
1990	0.4473	0.4358	0.5803	0.2885	-0.1330	1.56*
1991	0.5097	0.5213	0.5932	0.2206	-0.0835	9.56***
1992	0.5478	0.3271	0.5997	0.3426	-0.0519	7.28***
1993	0.5610	0.5028	0.5882	0.4152	-0.0272	10.27***
1994	0.5683	0.3372	0.6189	0.3284	-0.0326	1.69**
1995	0.5732	0.3294	0.6425	0.2257	-0.0693	0.19
1996	0.5796	0.3615	0.6517	0.2922	-0.0721	7.44***
1997	0.5841	0.2744	0.6962	0.2152	-0.1121	2.15*
1998	0.5868	0.2236	0.7604	0.1692	-0.1736	3.22***
1999	0.5915	0.2431	0.7731	0.1587	-0.1816	6.16***
1987-99	0.5246	0.3246	0.6741	0.2633	-0.1495	1.65*

Note: Non-parametric wilcoxon test is used to test t difference in means assuming unequal variances across groups. The results are qualitatively the same whether variances are assumed to be equal.
*** Significant at the 0.01 level.
** Significant at the 0.05 level.
* Significant at the 0.10 level.

3.5.1.2 Profit Efficiency

Table 3.5 shows mean and standard deviations for the sample bank's profit efficiency. The first observation refers to a considerably lower average profit efficiency score than the average cost efficiency score. This finding is consistent with the results

[45] These studies find no cost efficiency improvement on average from the mergers of the 1980s.

reported in Berger and Mester (1997) and Rogers (1998). In measuring bank efficiency using various econometric efficient frontier models, the authors report that U.S. banks have an average cost efficiency of about 86% and an average profit efficiency of about 56%. This suggests that banks manage costs relatively efficiently, but have significant inefficiencies in their profit generation. The mean profit efficiency from the alternative function for non-merged banks is around 0.525, while the mean profit efficiency for merged-banks is around 0.674. The difference in profit efficiency between merged and non-merged is also statistically significant.

Table 3.6
Pre-merger and post-merger cost and profit efficiency

Year of merger	1987	1993	1999
Cost efficiency			
Year preceding merger (t-1)	0.789	0.895	0.924
Years following mergers			
t+1	0.723	0.898	0.959
t+2	0.740	0.923	0.962
t+3	0.761	0.945	0.978
Profit efficiency			
Year preceding merger (t-1)	0.496	0.553	0.571
Years following mergers			
t+1	0.585	0.683	0.731
t+2	0.652	0.695	0.785
t+3	0.689	0.742	0.833

Notes: The pre-merger cost (profit) efficiency level is the combined cost (profit) level of the acquired and acquiring banks weighted by their asset size.

Clearly, merged banks have higher profit efficiency than non-merged banks by approximately 15 points. An average profit efficiency of 67.4% for merged banks indicates that the average merged bank earns only an estimated 67.4% of the profits of a best practice bank producing the same output bundle under the same environmental conditions. Stated differently, merged banks are closer to the best practice frontier than those of non-merged banks. In addition, it is noticed from Table 3.6 that merged and non-merged banks' profit efficiency is not significantly different for 1989 and 1995.

The results seem to match the motivations given by practitioners for mergers-which are largely related to improvement in cost and profit efficiency. These results may indicate that expected efficiency gains might be achieved; however, these results could be liable to a number of drawbacks. There may be selection bias in the peer group sample of non-merging banks that serve as a benchmark for comparison. Moreover, even if a peer sample could be constructed perfectly, the mergers of their competitors might influence the performance of the non-merging banks indirectly. The former could react to mergers of their rivals by improving their efficiency, or by widening the range of products offered to their customers. Therefore, measured gains from mergers relative to the control sample could understate actual gains. The gains from mergers may only emerge fully after some time. If this is the case, a short post-merger period analysis fails to account for the efficiency gains of the mergers. As a result, following sections will focus on the pre-merger and post-merger cost and profit efficiency with a view to giving a more in-depth analysis of the efficiency effects of banks mergers.

3.5.1.3 Pre-merger and post-merger efficiency

This section examines the efficiency effects of bank mergers by comparing the pre-merger and post-merger cost and profit efficiency. The pre-merger and post-merger efficiency for the merging banks are reported in Table 3.6. We compare the cost and profit efficiency in the year preceding the merger with each of the three years following the merger, excluding the merger year itself. For the year before merger, we find the weighted-sum of the ex ante efficiency of the acquiring bank and the acquired bank. The weights used are based on total assets for the acquiring and acquired banks before the mergers. Before–and-after merger comparisons are favorable the profit efficiency, which is higher after mergers than before. Profit efficiency tends to increase significantly after mergers. In 1987, the profit efficiency increased from 0.496(prior to merger) to 0.585 (one year after merger) and remains to increase for two years. In 1993, the profit efficiency moved from 0.553 to 0.683. In 1999, the profit efficiency climbed from 0.571(prior to merger) to 0.731(post-merger). On the other hand, before-and-after comparisons are unfavorable for cost efficiency. For some reason, 1987 mergers performed poorly, and 1990s mergers did quite well. It is worth noting that the average cost efficiency does not improve following mergers in 1987, while there is considerable improvement in profit efficiency. These observations suggest that some of the motivations behind bank mergers may have changed in the 1990s. This finding is consistent with those of Berger and Humphery (1992), Rhoades (1993) and Akhavein et al. (1997).

Table 3.7
Changes in cost efficiency for merging banks

Year	1987		1993		1999	
	Merging	Peer group	Merging	Peer group	**Merging**	Peer group
	All mergers					
Pre- merger	0.789	0.783	0.895	0.874	0.924	0.929
Post-merger	0.741	.810	0.922	0.892	0.978	0.946
Changes	-0.048	0.27	0.027**	0.018*	0.054*	0.017
	Large mergers					
Pre- merger	0.771	0.779	0.793	0.883	0.911	0.875
Post-merger	0.735	0.822	0.795	0.892	0.929	0.886
Changes	-0.036*	0.043	0.013**	0.009	0.018**	0.011*
	Small mergers					
Pre- merger	0.793	0.791	0.856	0.878	0.946	0.921
Post-merger	0.775	0.806	0.887	0.871	0.983	0.945
Changes	-0.018*	0.015	0.028*	-.007	0.037**	0.024

*(**) Changes are significantly different from zero at the 5%(1%) level.
Notes: The pre-merger cost (profit) efficiency level is the combined cost (profit) level of the acquired and acquiring banks weighted by their asset size.
Small mergers include all mergers in which both the acquirer's total assets and the total of the acquired banks' total assets are below the median value ($450 million). Large mergers are those mergers above the median .On average, over the sample period around 55% of the mergers are small mergers and 45% are large mergers.

3.5.1.4 Changes in cost and profit efficiency

An alternative way to analyze the impact of mergers on bank efficiency is to find changes in cost efficiency (CE) and profit efficiency (PE) from one year before the

merger to each of three post-merger years. These changes are calculated for the merging and non-merging banks.[46]

Also, we focus on the combined firm relative to a control group. The control group is particularly important in our analysis because it permits an assessment of whether any observed changes in the combined firm simply reflect changes in the economic environment or instead are unique to the merger events. Therefore, efficiency is estimated for each bank involved in a merger: (i) the acquiring bank during the available years before the merger, (ii) the acquired bank during the available years before the merger and (iii) the merging bank during the available years after the merger. The ex post change in CE of the merged banks (ΔCE) is the difference between the CE of the merged banks (CE_m) and weighted-sum of the ex ante CE of the acquirer bank (CE_1) and acquired bank (CE_2), that is

$$\Delta CE = (CE_m) - (w_1(CE_1)_{t-1} + w_2(CE_2)_{t-1})$$

where w_1 and w_2 are weights for the acquiring and acquired banks before the merger such that $w_1 + w_2 = 1$. The weights used are based on total assets (TA), so that $w_i = TA_i / (TA_1 + TA_2)$, where i is 1 for the acquiring bank and 2 for the acquired bank. For non-merging banks, the change in CE is

$\Delta CE = CE_t - CE_{t-1}$. Similarly, we find the changes in profit efficiency.

Table 3.8 displays the changes in profit efficiency. We notice that there are statistically significant improvements in profit efficiency for the 1987, 1993 and 1999

[46] Garden and Ralston (1999) apply this calculation to find the efficiency changes of credit union mergers.

mergers. Our findings are consistent with those reported by Berger (1998), who provides similar evidence associated with megamergers.[47]

Table 3.8
Changes in profit efficiency for merging banks (1987-1999)

Year	1987		1993		1999	
	Mergers	Peer group	Mergers	Peer group	Mergers	Peer group
			All Mergers			
Pre- merger	0.496	0.514	0.553	0.566	0.571	0.582
Post-merger	0.654	0.532	0.700	0.589	0.783	0.669
Changes	0.158*	0.018	0.147**	0.023*	0.212*	0.087
			Large Mergers			
Pre- merger	0.516	0.493	0.564	0.570	0.583	0.591
Post-merger	0.640	0.511	0.707	0.581	0.745	0.626
Changes	0.124**	0.018*	0.143**	0.011	0.162*	0.035
			Small Mergers			
Pre- merger	0.485	0.520	0.539	0.568	0.579	0.583
Post-merger	0.523	0.488	0.573	0.572	0.633	0.590
Changes	0.038**	-0.032	0.034*	0.046	0.054**	0.007*

*(**) Changes are significantly different from zero at the 5%(1%) level.
Notes: The pre-merger cost (profit) efficiency level is the combined cost (profit) level of the acquired and acquiring banks weighted by their asset size.
Small mergers include all mergers in which both the acquirer's total assets and the total of the acquired banks' total assets are below the median value ($450 million). Large mergers are those mergers above the median .On average, over the sample period around 55% of the mergers are small mergers and 45% are large mergers.

[47] His sample was limited to banks with assets over $1 billion.

Clearly, profit efficiency tends to increase significantly after mergers. For 1987 mergers, the pre-merger profit efficiency was 0.496 and rose to 0.654 for the merging banks after the merger. For 1993 mergers, the pre-merger profit efficiency was 0.553 and rose to 0.700 for the merging banks after the merger. As for 1999, the pre-merger profit efficiency was 0.571 and rose to 0.783. Another interesting finding in this table is that banks engaged in mergers are less profit efficient on average than their peer group prior to merger. However, they become more profit efficient than the peer group after the merger. This indicates that mergers are able to improve the profit efficiency, and it suggests that profit efficiency motivations were driving U.S. bank mergers in the 1980s and 1990s.

Table 3.7 reveals pre-merger and post-merger cost efficiencies as well as the changes in cost efficiency for the 1987, 1993 and 1999 mergers. As we can see from this table, the improvement in cost efficiency is significant only for the 1993 and 1999 mergers. The results presented in this table also confirm our earlier findings that banks that engaged in mergers in the 1990s were more cost efficient on average than other banks and they were able to improve their cost efficiency level following the mergers. Notably, comparing the cost and profit efficiency improvements of merging banks with the improvement of its peer group suggests that this is a merger related improvement in efficiency and not a result of the economic environment of the banks. The spreading of fixed costs, such as branch offices, computer equipment, and customer information across several financial products and services, would constitute the most likely rational for such gains.

3.5.1.5 Small mergers versus large mergers

In order to find whether size of the mergers affects our results, we analyze our results separately for large mergers and small mergers. Cost and profit efficiency levels of firms both before and after the merger are computed relative to the peer group in order to assess performance changes. In the case of cost efficiency (Table 3.7), our findings can be almost completely attributed to the subsample of small banks. Mergers in which small banks are involved show larger improvements compared with the large bank mergers. For 1993 mergers, small banks mergers moved from a score of 0.856 to score of 0.887, registering a significant 5% increase. On the other hand, large banks show a significant improvement of only 1.5%. Small bank mergers in 1999, moved from a score of 0.946 up to 0.983, yielding a 4% increase in cost efficiency level. Large banks record an increase of only 1.8%. Our results indicate that when small banks combine, there is improvement on average in cost efficiency. These findings suggest that small banks may have taken an advantage in the merger market, including easier integration of computer and accounting systems and fewer internal struggles for control. As for the profit efficiency (Table 3.8), the results in general indicate that banks involved in mergers have a higher profit efficiency level compared to the group of non-merging peer banks. Large merging banks are chiefly responsible for this finding. Mergers of large banks recorded higher improvements in profit efficiency compared to the small bank mergers. They achieved 24%, 26% and 27% improvements for the 1987,1993 and 1999 mergers respectively. These results suggest that when large banks are merged, the average result is considerable improvement in profit efficiency. In the case of small bank mergers, improvements were much smaller, averaging around 7.0% for the 1987, 1993 and 1999

mergers. In short, our results indicate that bank mergers appear to significantly improve profit efficiency relative to other banks. Improvements also appear to be greater in the 1990s. Another interesting finding from the above analysis is that large banks are less efficient in cost efficiency terms compare to small ones. There are a couple of possible explanations for this finding. First, the large majority of non-performing loans are concentrated mainly in large banks. Further, it is worth noting that there is a substantial difference between the cost and profit efficiency estimates. Large banks are more efficient in profit terms than small banks. Larger banks may have the ability to exercise monopoly power, which allows them to earn more profits despite having relatively high costs.

Table 3. 9
Pre- merger cost efficiency for acquiring and acquired banks

	1987		1993		1999	
	Mergers	Peer group	Mergers	Peer group	Mergers	Peer group
			All mergers			
Acquiring bank	0.776	0.753	0.889*	0.863**	0.964*	0.913*
Acquired bank	0.790	0.688	0.872*	0.877**	0.892*	0.895**
			Large mergers			
Acquiring bank	0.783*	0.786	0.796**	0.891*	0.923**	0.986**
Acquired bank	0.769	0.772	0.782**	0.886**	0.844*	0.888*
			Small mergers			
Acquiring bank	0.787	0.799	0.852*	0.873**	0.957*	0.989*
Acquired bank	0.795*	0.810	0.854**	0.795**	0.874*	0.895*

***** (**) Paired difference test results show that acquiring and acquired banks have significantly lower cost efficiency compared to their peers i.e. significantly different from zero at the 5%(1%) level.
Notes: The pre-merger cost (profit) efficiency level is the combined cost (profit) level of the acquired and acquiring banks weighted by their asset size.

3.5.1.6 Acquiring and acquired cost and profit efficiency

In this section, we investigate the cost and profit efficiency levels for both the acquiring and acquired banks. Tables 3.9 and 3.10 report both cost and profit efficiency estimates, respectively.

The samples of both small and large merging banks show a relatively low pre-merger efficiency level. For example, large bank mergers in 1987 have a pre-merger profit efficiency of 0.536 against 0.562 for the peer group (Table 3.10).

Table 3.10
Pre- merger profit efficiency for acquiring and acquired banks

	1987		1993		1999	
	Mergers	Peer group	Mergers	Peer group	Mergers	Peer group
			All mergers			
Acquiring bank	0.522*	0.535	0.559**	0.566	0.580*	0.599
Acquired bank	0.482**	0.511	0.537*	0.548	0.536*	0.562
			Large mergers			
Acquiring bank	0.536**	0.562	0.571*	0.582	0.591*	0.616
Acquired bank	0.497**	0.516	0.519*	0.533	0.558**	0.583
			Small mergers			
Acquiring bank	0.498*	0.536	0.545*	0.576	0.584*	0.624
Acquired bank	0.443*	0.519	0.487**	0.512	0.505*	0.547

***** (**) Paired difference test results show that acquiring and acquired banks have significantly lower profit efficiency compared to their peers i.e. significantly different from zero at the 5%(1%) level.
Notes: Small mergers include all mergers in which both the acquirer's total assets and the total of the acquired banks' total assets are below the median value ($450 million). Large mergers are those mergers above the median .On average, over the sample period around 55% of the mergers are small mergers and 45% are large mergers.

Interestingly, acquiring banks have a somewhat higher efficiency level than the acquired banks (0.536 against 0.497). Notably, the acquired banks are characterized by considerably significantly lower profit efficiency than the peer group (0.497 against 0.512). This finding holds for the 1993 and 1999 mergers including the large and small bank mergers (Tables 3.9 and 3.10). Collectively, the results reported in Tables 3.7-3.10 are consistent with the relative low efficiency hypothesis. Under this hypothesis, greater merger efficiency gains are predicted if the acquiring bank is more efficient than the acquired bank or both banks have poor performance prior to the merger. According to Berger (1998) the merger enables banks to wake-up management or the merger may be an excuse to restructure both banks. This suggests that management abilities may be spread over more resources. Another interesting interpretation for our results is that the acquiring bank tends to bring the acquired towards to it's own level of efficiency. Stated differently, the transferring of successful managerial policies and operating procedures over more resources (acquired bank) have the improved the combined bank's performance.

3.5.2 Results from non-parametric efficiency (DEA)

3.5.2.1 Comparison between merged and non-merged banks

In this section we use the DEA frontier approach to investigate the sources of efficiency gains associated with bank mergers. DEA will allow us to further characterize the efficiency effects of bank mergers. Particularly, it allows us to decompose cost efficiency (CE) into its components technical (TE) and allocative efficiency (AE).[48] CE measures possible reductions in cost that can be achieved if a bank is technically as well

[48] Cost and technical efficiency allow us to back out levels of allocative efficiency using the relationship: CE = TE*AE, where CE=cost efficiency, TE=technical efficiency, and AE=allocative efficiency.

as allocatively efficient.[49] The level of technical efficiency (TE) of a particular bank is characterized by the relationship between observed production and some ideal or potential production. More specifically, TE is just one component of overall cost efficiency. However, in order to become cost efficient, a bank must first be technically efficient. Profit maximization requires a firm to produce the maximum output given the level of inputs employed (i.e. be technical efficient), use the right mix of inputs in light of the relative price of each input (i.e. input allocative efficient) and produce the right mix of outputs given the set of prices (i.e. be output allocative efficient).[50] In other words, a bank is said to be technically efficient if it operates on the efficient frontier and allocatively efficient if it is properly choosing the correct mix of inputs given the input prices. Technical efficiency can be decomposed to pure technical efficiency (PTE), with a proportional reduction in input usage until inputs are not wasted, and scale efficiency (SE), proportional reduction until the bank achieves constant return to scale. Pure technical inefficiency results from using more inputs than necessary (input waste), while scale inefficiency occurs if the bank does not operate at constant return to scale.

To understand the potential consequences of enhanced bank mergers, we estimate five different measures of non-parametric efficiency scores (X-efficiencies); namely allocative efficiency, technical efficiency, pure technical efficiency, scale efficiency, and over all cost efficiency. All of these point estimates attain values between zero and one for the least and the most efficient units in the sample. The summary statistics (see Table 3.11) show several statistically significant differences between the merged banks and non-merged banks. Consistent with the results of the SFA analysis, the average values of

[49] See Elyasiani and Mehdian (1990) for more details.
[50] TE = PTE*SE.

the estimates indicate that the merged banks are, on average, more cost efficient than non-merged banks (0.844 against 0.779). However, the differences are statistically significant only for 1993 and 1999.

Table 3.11

Mean efficiency measures of merged banks and non-merged banks

	Measures				
	CE	AE	TE	PTE	SE
Group			**1987**		
Merged banks	0.717	0.872	0.823	0.846	0.973
Non-merged banks	0.683	0.854	0.800	0.838	0.952
			Tests for differences		
t-stat	1.19	-0.22	2.17**	1.60	2.27**
			1993		
Merged banks	0.828	0.961	0.862	0.893	0.965
Non-merged banks	0.789	0.952	0.829	0.876	0.947
			Tests for differences		
t-stat	2.622***	3.94***	2.09**	2.44**	0.68
			1999		
Merged banks	0.856	0.982	0.873	0.901	0.969
Non-merged banks	0.896	0.964	0.837	0.892	0.939
			Tests for differences		
t-stat	8.71*	2.88**	1.603	1.65**	7.56***
			Full sample		
Merged banks	0.844	0.924	0.906	0.948	0.956
Non-merged banks	0.779	0.912	0.855	0.910	0.938
			Tests for differences		
t-stat	1.96**	4.11**	1.67*	3.65***	0.24

Note: CE: Cost efficiency, AE: Allocative efficiency, TE: Technical efficiency, PTE: pure technical efficiency, SE: Scale efficiency.
*** Significant at the 0.01 level.
** Significant at the 0.05 level.
* Significant at the 0.10 level.

The results suggest that merged (non-merged) banks could have produced the same level of output using only 84.4% (77.9%) of the inputs actually used. Apparently, the average input waste (inefficiency) is lower for the merged banks (18.5% against 28.4%). These results also hold for 1993 and 1999. For example, merged banks in 1993 have a higher cost efficiency score (0.828) than non-merged banks (0.789). It is worth noting that there is room for significant cost savings if both groups utilize their productive inputs more efficiently.

Since the cost efficiency measure (CE) is a composted of technical efficiency (TE) and allocative efficiency (AE), the relative sizes of these measures provide evidence as the to the source of cost efficiency. The empirical results show that, in general, the technical component is relatively more important than the allocative component as a source of cost inefficiency. This implies that inefficiency in banks may be explained by the wasting of inputs rather than by choosing the incorrect input combinations. This finding is consistent with results reported by Berger and Humphery (1991). The average allocative inefficiency is about 1% for the merged banks, whereas average allocative inefficiency is about 4% for the non-merged banks.[51] The average technical inefficiency is about 10.4% for the merged banks, while average technical inefficiency is about 17.0% for the non-merged banks. Technical inefficiencies refer to the proportional of overuse of inputs while other inefficiencies due to the wrong mix of inputs are allocative. Because the ultimate responsibility for the transformation process is in hands of the management, X-efficiencies are often seen as a measure of managerial quality. Collectively, these results indicate that merged banks have lower costs than non-merged banks because they

[51] The relation between efficiency (E) and inefficiency (IE) is IE = (1-E) / E. This relation can be derived from Eq.(6) in page 21.

are using the most efficient technology (technical efficiency) and they are using the cost minimizing input mix (allocative efficiency). Also, managers of merged banks are relatively better than managers of non-merged banks at choosing the proper input mix given the available prices. Stated differently, managers of non-merged banks waste more resources than managers of merged banks.

To gain more understanding of the sources of efficiency, we look at the components of technical efficiency (TE). We notice that, in general, the major source of technical inefficiency is pure technical inefficiency and not scale inefficiency, suggesting that banks tend to lose little output due to scale efficiency. Overall, average scale efficiency for the merging banks is higher than those of the non-merged banks (0.956 versus 0.908), suggesting that merged banks produce at more efficient scale than non-merged banks, leading to lower unit costs and higher profits. Also, average pure technical efficiency for the merged banks is higher than that of non-merged banks (0.948 versus 0.910). These observations indicate that managers of merged banks are more efficient than managers of non-merged banks. Our results provide strong evidence that merged banks achieve greater gains in cost, technical, allocative, pure technical, and scale efficiency than non-merged banks, implying that the restructuring of the banking industry has produced significant efficiency gains. To sum up, the results of the DEA analysis indicate that merged banks have achieved greater post-merger gains in efficiency than non-merged banks. Efficiency gains may derive from the fact that merged banks gain access to cost-saving technologies or spread their fixed cost over a larger base, thus reducing average costs. Finally, mergers may have improved managerial efficiency, by transferring superior managerial skills from the acquiring banks to the acquired banks.

3.5.2.2 Productivity growth

The use of DEA permits us to compute the Malmquist index (MI), which is the standard technique for measuring the evolution of the productivity and efficiency over time. The Malmquist index approach is applied to analyze changes in productivity over time for merged banks and non-merged banks. According to Malmquist analysis, it is possible to separate shifts in frontier (technical change) from improvement in efficiency relative to the frontier (technical efficiency changes). Therefore, the product of the technical efficiency change (ΔTE), which is how much closer a bank gets to the efficient frontier (catching up effect or falling behind), and technological change (ΔTC), which is how much the benchmark production frontier shifts at each bank's observed input mix (technical innovation or shock), is measured by the Malmquist index (MI).[52] To illustrate, a reading of MI greater than 1 indicates that total factor productivity progress has occurred, while a reading of MI less than 1 indicates productivity loss.

ΔTE (ΔTC) between two periods t and t+1 can be computed as technical efficiency (technological efficiency) at time t+1 divided by technical efficiency (technological efficiency) at time t. A ratio of technical and/or technological change can attain a value greater than or less than one. A ratio takes a value greater one implies that the bank has experienced technical and/or technological progress between periods t and t+1, while a ratio less than one means the opposite. We then decompose the technical efficiency changes into changes in pure technical (ΔPTE) and scale efficiency (ΔSE), and distinguish between pure technical change and changes in scale of technology.

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[52] For more detail see Ferrier (1993).

To illustrate the Malmquist concept, consider the single-input, single-output case shown in Figure1. The curves labeled PFt and PFt+1 represent the production frontiers in periods t and t+1, respectively. There are two input-output combinations in this case: (Ojt, Ijt) for period t, and (Oj,t+1, Ij,t+1) for period t+1. Note that technological changes and improvements in technical efficiency occur between the two periods. An efficient bank should produce more output per unit of input in period t+1 compared to period t. Conversely, the same output (Ojt) can be obtained using less input (A instead of C) in the period t+1. Thus, technological change occurs, and is measured by $\Delta TC = (OD/OB) * (OC/OA)$. Technical efficiency changes depend on how close the firm operates relative to the production frontier, and this can be denoted by $\Delta TE = (OB/OI_{j,t+1})/(OC/OI_{j,t})$.

Figure 1: Technical and Technological Efficiency Change (Malmquist Productivity Index)

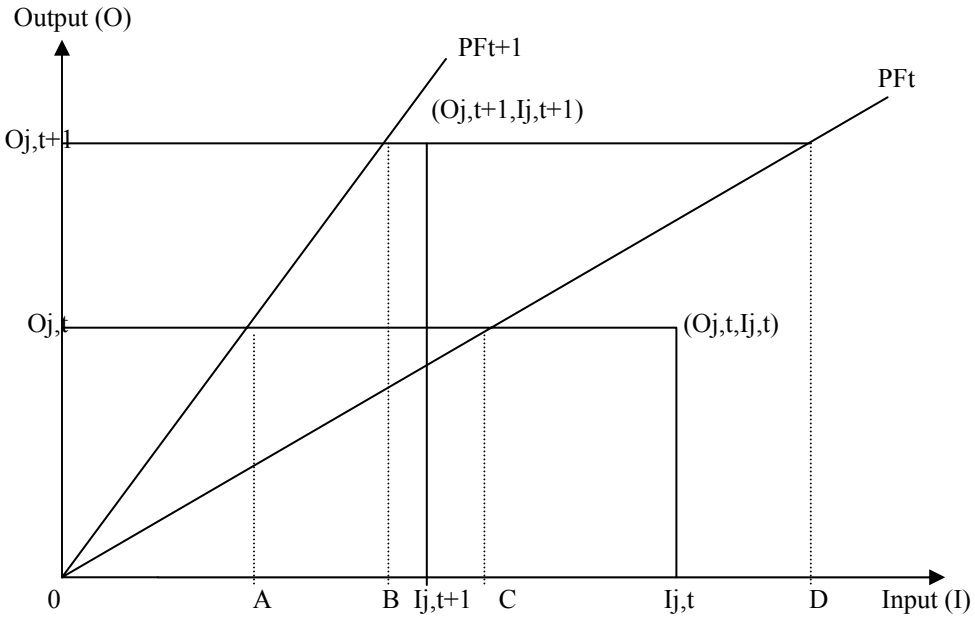

Table 3.12

Productivity and efficiency changes for merged banks and non-merged banks

	Measures				
	MI	TE	TC	PTE	SE
Group			**1987/1988**		
Merged banks	0.969	0.963	1.007	1.044	0.922
Non-merged banks	0.951	0.968	0.981	1.026	0.945
			Tests for differences		
t-stat	0.83	-0.012	2.35**	0.54	-0.33
			1993/1994		
Merged banks	1.043	0.997	1.046	1.036	0.962
Non-merged banks	1.029	1.031	0.998	1.069	0.965
			Tests for differences		
t-stat	1.81**	-1.66**	1.96**	-0.77	-1.03
			1999/2000		
Merged banks	1.113	1.035	1.075	1.022	1.013
Non-merged banks	1.054	1.030	1.023	1.026	1.004
			Tests for differences		
t-stat	2.56***	1.04	1.56*	-0.09	1.36*
			Average (1987-2000)		
Merged banks	1.147	1.045	1.098	1.030	1.015
Non-merged banks	1.072	1.052	1.019	1.039	1.013
			Tests for differences		
t-stat	3.07**	0.94	5.02*	0.14	0.06

Note: MI: Change in productivity (Malmquist index of productivity); TE: Change in technical efficiency; TC: Technological change; PTE: Change in pure technical efficiency, and SE: Change in scale efficiency.
*** Significant at the 0.01 level.
** Significant at the 0.05 level.
* Significant at the 0.10 level.

Table 3.12 reports results from measuring productivity progress of merged banks and non-merged banks. The results reveal that merged banks have experienced 14.7% productivity growth over the sample period, while the non-merged banks have registered

only 7.2% productivity growth. This finding indicates that merged banks experienced significantly larger gains in total factor productivity over the sample compared to non-merged banks, consistent with the argument that mergers lead to efficiency gains. Given that the Malmquist index of productivity change (MI) is a multiplicative composite of technical change and technological change, the major cause of productivity improvements can be determined by comparing the values of technical change and technological change indexes. Put differently, the overall gain in productivity can be the result of technical efficiency increases, technological advancement, or both.

The findings show that merged banks were capable of achieving such productivity primarily from becoming more technological advanced (9.8%), than from being more technically efficient (only 4.5%). In the case of non-merged banks, the overall gain in productivity over the period is composed of an average technical efficiency increase (movement toward the frontier) of 5.2%, and an average technological innovation of 1.9%. The outcome of the analysis indicates that merged banks were especially successful at incorporating new technological advancement into their operations. Interestingly, efficiency increases in each types of bank (merged and non-merged) seem to be driven by the improvement in PTE rather than SE, implying that the management of banking operations has improved for these banks. For example, the mean efficiency increase for merged banks is 4.5%, with a pure efficiency increase (PTE) of 3.0%, and a scale efficiency increase (SE) of 1.5%. As regards non-merged banks, the mean efficiency increase is 5.2%, with a PTE increase of 3.9%, and a SE increase of 1.2%. A similar result is found between 1999 and 2000 (the merged banks have achieved higher productivity growth than non-merged banks). Between 1993 and 1994, productivity

growth for merged banks was 4.3% due to technological innovations (4.6%) which offset a slight decline in efficiency (-0.3%.). The level of productivity growth for non-merged banks is comparable (2.9%) but is due to efficiency increases (3.1%) rather than technological change (-0.2%). Finally, the average merged bank experienced a productivity loss between 1987 and 1988 (by about – 3.0%) due to an efficiency decrease (-3.7%) which offset a slight increase in technology (0.7%). The level of productivity loss for non-merged banks is higher (-4.9%) and is a result of efficiency decrease (-3.1%) and technological regress (-1.9%). Collectively, the results in Table 3.12 indicate that merged banks experienced significantly larger gains in total factor productivity over the sample than did non-merged banks.

Table 3.13

Spearman rank order(s) correlation coefficients among efficiency estimates and proxy-measured of performance

	CE	AE	TE	PTE	SE	AVCR	ROA
AE	0.752**						
TE	0.642***	0.468**	0.723*				
PTE	0.563**	0.332*	0.688***				
SE	0.603*	0.564***	0.702**	0.544***			
AVCR	-0.171**	-0.209*	-0.462**	-0.08*	-0.273*		
ROA	0.135*	0.196*	0.341**	0.140*	0.042**	-0.288**	
ROE	0.294**	0.254***	0.181*	0.23**	0.207*	-0.216*	0.386***

a: Spearman correlation coefficient of tests for zero correlation. AVCR is average cost (Total cost / Total assets). ROA is return on assets (Net income / Total assets). REQ is return on equity (Net income / equity). : CE: Cost efficiency, AE: Allocative efficiency, TE: Technical efficiency, PTE: pure technical efficiency, SE: Scale efficiency.

*** Significant at the 0.01 level.

** Significant at the 0.05 level.

* Significant at the 0.10 level

3.5.2.3 Efficiency correlates

To examine the consistency, robustness, and reasonability of the efficiency results we calculate several rank correlations with standard accounting variables that may be considered raw-data measurements of performance. We calculated rank-order Spearman correlation coefficients to examine the possible relationship among the X-efficiency measures and accounting measures of performance. The Spearman (s) correlation coefficients are presented in Table 3.13.

The null hypothesis is that the correlation coefficient between the two variables is zero. As the results indicate, the Spearman [s] correlation coefficients are all significantly different from zero, indicating that there is a strong association among the X-efficiency measures and proxy measures of performance. Cost efficiency (CE) is positively and statistically significantly associated with other X-efficiency measures; namely, AE, TE, PTE, and SE ($\rho_{CE,AE}=0.752$, $\rho_{CE,TE}=0.642$, $\rho_{CE,PTE}=.563$,$\rho_{CE,SE}=0.603$, respectively). TE is more related to SE than to PTE ($\rho_{TE,SE}=0.702$ versus $\rho_{TE,PTE}=0.688$*),*confirming the dominant effect of scale efficiency in determining the technical efficiency of the banks in our sample, which we stated earlier. The correlation between the efficiencies and each of the financial ratios follow the expected pattern. The five measures of efficiency are negatively and significantly correlated with the average cost ratio (AVCR), and positively and significantly correlated with the standard profitability ratios ROA and ROE. This finding is consistent with results reported by Berger and Mester (1997) and Elyasiani et al. (1994). The efficiency correlates confirm that our efficiency measures are robust and are not simply the consequences of our methods.

3.6 Conclusion

The recent wave of bank mergers has raised concern with its effect on efficiency. This essay utilizes the Stochastic Frontier Approach to examine the efficiency effects of bank mergers by comparing the pre-merger and post-merger cost and profit efficiency. The results provide statistical evidence that bank mergers do results in an increase in cost and profit efficiency following 1993 and 1999 mergers, using a control group of non-merged banks to account for different market circumstances. This result holds in a subsample of large and small bank mergers. However, small bank mergers record greater cost efficiency improvement than the large banks. We find no evidence of cost efficiency improvement following the 1987 mergers. This finding is comparable to the results obtained by Peristiani (1997), who finds evidence of a small but significant deterioration of average efficiency for merged banks relative to non-merged banks in the period 1980-1990. The results for the 1987 mergers, in terms of cost efficiency, are also consistent with the findings of Berger and Humphrey (1992) bank mergers in the 1980s had no significant effects on cost efficiency. It is noteworthy that for the 1987 mergers, the acquiring banks are more cost efficient than their merging partners, but this does not result in cost efficiency improvement following 1987 mergers. One interesting explanation for this result is that the managers were not able to transfer this cost efficiency to the merged firm.

With respect to profit efficiency, we find that mergers tend to improve profit efficiency for both large and small banks. However, large bank mergers are associated with larger improvement than the small bank mergers. This finding is consistent with that reported by Berger (1998), who investigates the effect of megamergers on profit

efficiency and finds a significant increase in profit efficiency following megamergers. It is worth mentioning that the empirical results report significant profit efficiency improvements associated with the 1987 mergers, while the cost efficiency is hardly affected by the mergers. One possible explanation for this result is that merger benefits may be located mainly at the revenue side instead of the input side of the banking firm. This would support the view that mergers are driven by strategic motivations rather than only by cost reductions. Also, as argued by Berger and Mester (1997), "profit efficiency is superior to the cost efficiency concept for evaluating the overall performance of the bank (p. 900)". With imperfect competition, cost minimizing is not equivalent to profit maximization, and the latter may be the more important driver of the structure of the banking industry.

It is also noteworthy that acquiring banks are more profit efficient on average than acquired banks, prior to merger, and that generally, after the merger the merging bank is able to adhere to the high efficiency. However, prior to the mergers, both the acquiring and acquired banks have a somewhat lower efficiency level than their peer group. This finding is consistent with the hypothesis that mergers are used to "wake-up" inefficient managements. In addition, our results suggest that merger events enable efficient (acquiring) banks to improve the performance of inefficient (acquired) banks. This supports the traditional market for corporate takeovers explanation of mergers (well-managed banks acquire poorly-managed banks and consequently improve their efficiency). One of the main findings of this study is that small bank mergers operate more efficiently in terms of cost but less efficiently in terms of profit. This difference may suggest the existence of monopoly power in the banking industry where large bank

mergers can realize greater profits, while also having greater costs. Put differently, small banks rely on a limited range of products to generate revenue and/or have less market power than their larger competitors.

Finally, as an alternate way to analyze the efficiency effects of mergers, we use Data Envelopment Analysis (DEA). Overall, the analysis leads to a conclusion that the most significant cause of efficiency among merged banks versus non-merged banks is the technical efficiency, suggesting that merged banks are on average more technical efficient than merged banks. Technical efficiency reflects the ability of managers to control costs and is measured by how close its costs are to those of fully efficient banks when the effects of scale, product mix and other exogenous variables, which may influence banking costs, are considered. Another possibility is that mergers introduce new production methods and optimize the use of inputs, increasing efficiency.

The overall conclusion is that bank mergers appear to be driven for the most part by economically practical objectives and have beneficial effects on the efficiency in the banking industry. Superior management or production technology may have reduced costs more for merged banks more than for non-merged banks and subsequently reap higher profits. Also, improvements in information processing and credit scoring may have resulted in greater costs reductions for the merged banks.

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