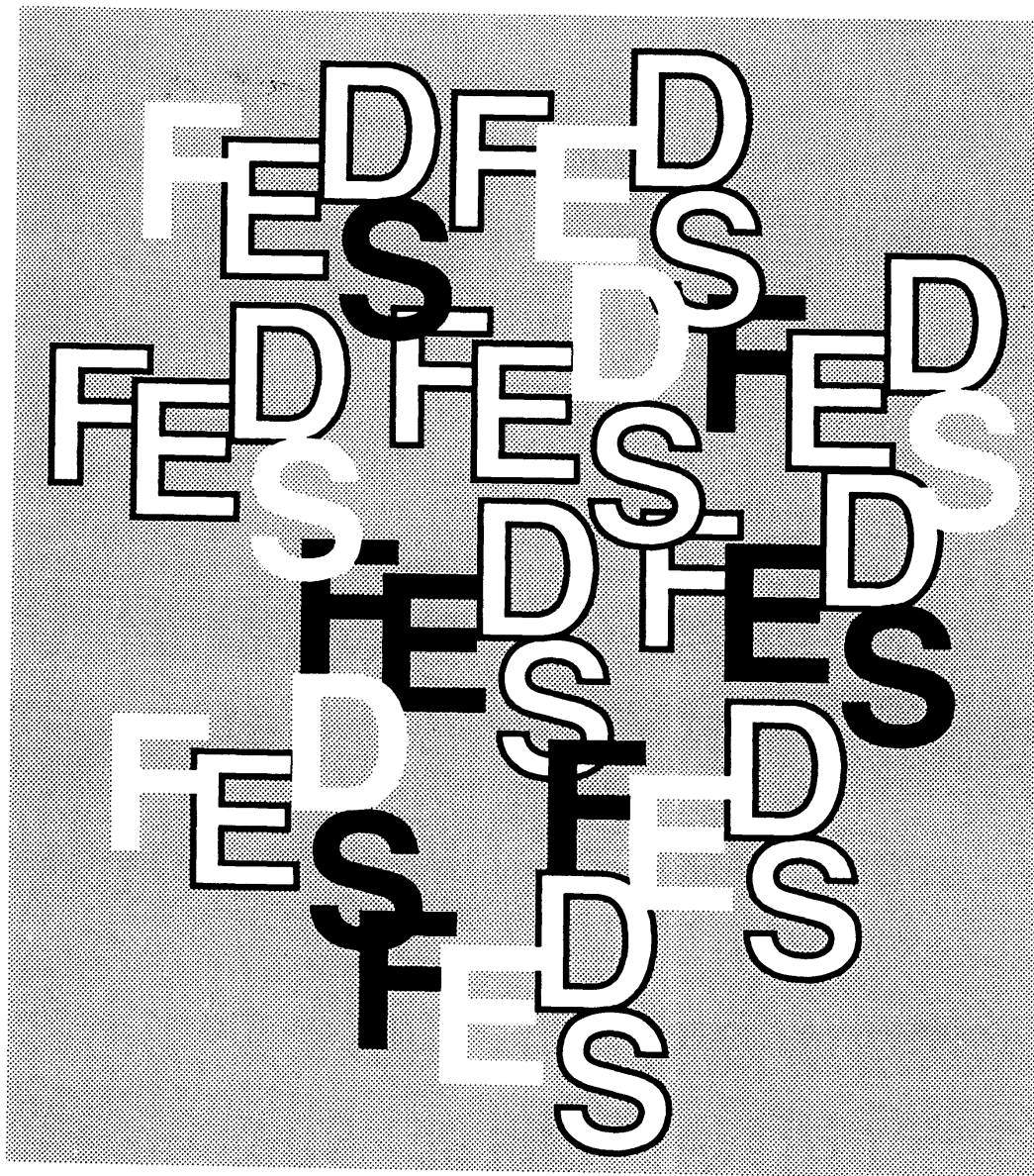


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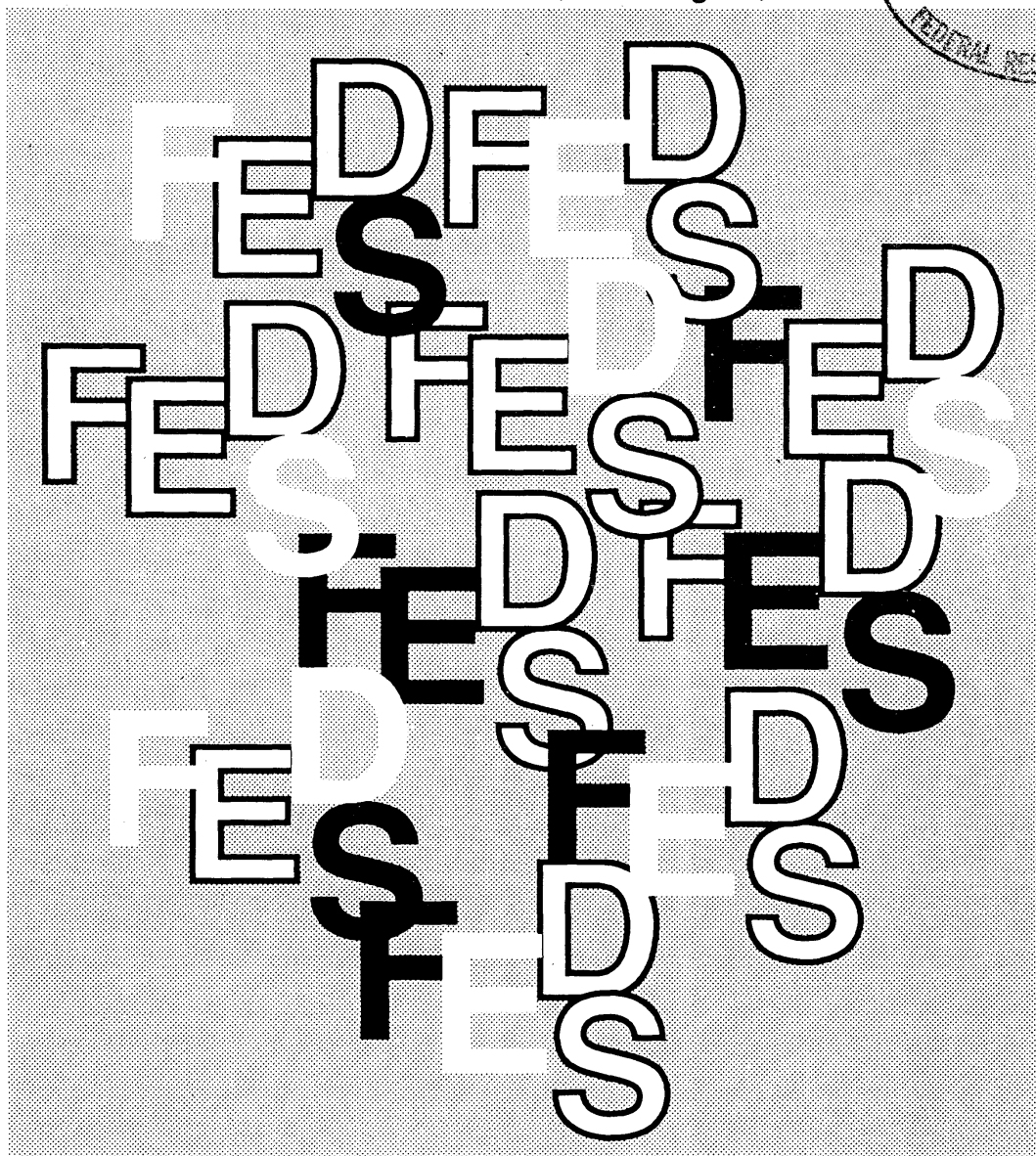
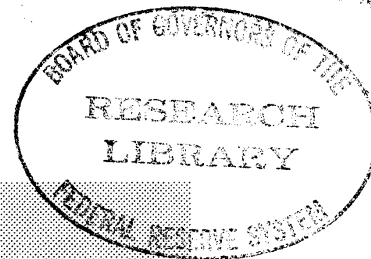
Finance and Economics Discussion Series



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**MEGAMERGERS IN BANKING AND THE USE
OF COST EFFICIENCY AS AN ANTITRUST DEFENSE**

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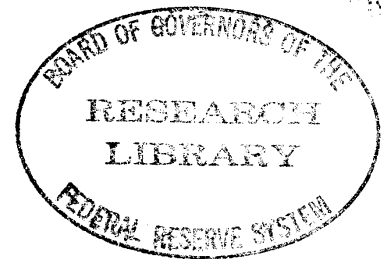
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Abstract

This study provides an empirical examination of the cost efficiency effects of banking megamergers of the 1980s, and whether and when these effects appear to justify relaxation of antitrust concerns. The data suggest that there are substantial potential cost efficiency gains from megamergers that dominate the minor anticompetitive pricing effects from most bank mergers found elsewhere. These potential gains come primarily from improvements in X-efficiency, or superior management of resources, rather than from improvements in scale efficiency, since large banks are usually already in the scale diseconomy region. Despite this potential, we find that megamergers did not result in significant cost efficiency gains on average, although there were individual mergers that were very successful and others that were very unsuccessful. Average measured improvements in X-efficiency were less than 5 percentage points on average, were statistically insignificant, and were more than offset by measured reductions in scale efficiency. We also find that the merger gains that did accrue were essentially unrelated to two conditions thought to predict such gains -- whether the acquiring bank was more efficient than the acquired bank, and whether there was a high degree of deposit market overlap prior to the merger. All of these results also hold when simple financial ratios replace the derived cost efficiency measures. These results suggest (i) that the cost efficiency benefits from megamergers have not been sufficient to justify their use as a general antitrust defense; and (ii) that it is difficult to find simple rules based on prior performance or market overlap to form an effective cost-based antitrust defense.

I. Introduction

This study analyzes the cost efficiency implications of megamergers in the U.S. banking industry -- mergers and acquisitions in which both organizations exceed \$1 billion in assets. Such an analysis is important because the consolidated banks arising from these mergers may well dominate the industry of the future and help determine the overall level of intermediation in the economy. From an industrial organization viewpoint, megamergers in banking also provide an important experiment in which to examine the public policy tradeoff between potential *cost* efficiency gains from consolidation and potential *social* efficiency losses from greater exercise of market power. Because megamergers have been relatively rare historically, earlier merger analyses need not generalize to these new combinations among the nation's very largest banks.

In our analysis, we set forth some cost efficiency conditions that likely need to be met for bank mergers to be both privately and socially beneficial and test these conditions using data on U.S. banking megamergers from 1981 to 1989. These conditions relate directly to the relative cost efficiencies of the acquiring and acquired bank. To our knowledge, this is the first study to examine direct measures of the cost efficiency of merger participants either pre- or post-merger -- prior studies have instead focused on simple cost and revenue ratios which can be biased by not controlling for other factors affecting costs, such as product mix and input prices. Moreover, earlier studies generally have not related the ex post efficiency gains from mergers to the ex ante conditions that are most likely to lead to efficiency improvements.

To put the cost efficiency gain-versus-social efficiency loss issue in perspective, banking industry representatives, consultants, and the trade press have suggested that potential cost savings from bank mergers may justify relaxation of the usual antitrust concerns. Savings as high as 30 percent of the operating costs of the acquired institution have been projected for some of the largest mergers. It has been argued that the potential social benefits of this improvement in cost efficiency may offset any potential social costs of the higher prices and lower output levels that are often identified with increased market concentration. The 1992

Department of Justice merger guidelines explicitly allow for some mergers to go unchallenged if there are potential efficiency gains that cannot reasonably be achieved through other means.

The tradeoff between cost efficiency and the possible misallocation of resources associated with market concentration is a well-accepted concept in industrial organization theory. The most common application concerns the realization of substantial scale economies by allowing highly concentrated, often monopolistic, supply of local utilities such as water, power, and telephone services. Antitrust considerations that would normally block formation of a monopoly or tight oligopoly are set aside in favor of the operating cost savings of large-scale production. To reduce the misallocation of resources that might otherwise accompany such concentrated supply, the prices of and service access to these utilities are often regulated.

An argument may be made that since the prices of and access to many banking services are also regulated, any misallocation of resources created by increasing market concentration in this industry may be lessened as well. As to price regulation, there remains in place a prohibition of interest payments on demand deposits, and limits on other bank deposit rates are being reintroduced for many banks through the FDIC Improvement Act. Bank asset prices are also indirectly influenced by risk-based capital requirements, which impose implicit taxes on bank assets by requiring different amounts of capital to be held against assets in specific regulator-determined risk categories [see Avery and Berger (1991)]. Service access is regulated through the Community Reinvestment Act of 1977, which requires that banks provide relatively equal access to loan and deposit services to residents of all neighborhoods, especially poor and moderate income areas. As well, prudential regulation and examiner policies aim to create geographic and industry diversification in bank loan portfolios by assuring that a broad spectrum of customers are served. Lastly, regulators directly control where new banks may be chartered, where banks may expand through branching or holding company acquisition, and which banks may merge with or acquire other banks.

Even if this argument about regulatory control mitigating the problems associated with banking concentration is accepted, however, two additional conditions likely need to be met before relaxation of antitrust considerations could be justified on an economic basis. First,

there must be substantial potential for cost efficiency gains that dominate the effects of market structure in determining bank performance. Studies of scale economies in banking suggest that there are not substantial cost efficiency gains to be made simply by increasing the size of already large banks through mergers. In fact, past evidence suggests that there may be slight scale *diseconomies* associated increasing the size of large banks that may be aggravated by megamergers. On the other hand, a growing literature on 'X-efficiencies' in banking, or variations in costs ascribed to differences in managerial ability, finds that these efficiencies account for cost variations of 20 percent or more and that these differences are stable over time. Thus, there may be substantial cost efficiency gains to be had if banking resources can be shifted from less efficient to more efficient managers. The X-efficiency differences have also been found to dominate the effects of local market concentration on bank profitability.

Second, given that there are *potential* efficiency gains to be had that outweigh market concentration effects, a relaxation of antitrust considerations may still be justified only if the proposed mergers are likely to achieve these efficiency gains. This is most probable if mergers shift banking resources from the control of less efficient management toward more efficient management. Observationally, this implies the *ex ante* necessary condition that the acquiring bank or dominant merger partner be significantly more X-efficient than the acquired bank or subordinate partner. This will improve cost efficiency provided that the more efficient managers raise the efficiency of the consolidated firm toward the acquirer's pre-merger efficiency level *and* this improvement offsets any scale diseconomies that may be generated by the merger. The *ex post* testable implication of this argument is that the mergers in which more efficient banks take over less efficient banks would be the most successful in improving the cost efficiency of the consolidated firm following a merger. In this paper, we examine the X-efficiency and scale efficiency positions of megamerger partners both pre- and post-merger and examine both of these implications -- whether the mergers seem *likely to* generate efficiencies *ex ante* and whether they *actually do* generate efficiencies *ex post*.

A related issue concerns the efficiency implications of 'horizontal' or 'within-market mergers,' mergers between banking organizations situated in the same local markets. Many of

the recently completed megamergers had significant portions of their operations in common markets pre-merger. It has been argued that within-market mergers offer more opportunities for cost savings than traditional 'across-market' mergers because when there are overlapping operations, the least efficient can be eliminated. For example, when branch offices of the merger partners are located near each other, the least efficient offices may be closed and the customers shifted to the better managed offices. We test the implication of this argument that the efficiency gain from mergers should be greater, the higher is the degree of market overlap between the merger partners.

By way of anticipation, the three main results of the study are as follows. First, the *ex ante* choice of megamerger partners often *did* satisfy conditions for being conducive to improving X-efficiency -- in between 55 and 72 percent of the cases, the acquiring bank was more X-efficient than the acquired. Also, most of the mergers had some within-market characteristics -- more than 70 percent of merger partners had some market overlap, and the average overlap enveloped more than one-third of the joint deposits in overlapping local markets. Second, over our sample period, megamergers were *not* very successful on average in improving cost efficiency in banking. The average X-efficiency improvement for all 57 megamergers analyzed was less than 5 percentage points and was not statistically significant. Moreover, because of measured scale diseconomies, the consolidated firm actually performed slightly worse on average after the mergers, although this effect was also small and often not statistically significant. And third, the mergers which were successful in reducing costs *ex post* were *not* particularly associated with the *ex ante* conditions theorized to bring about such improvements. Mergers in which a more X-efficient firm acquired a less X-efficient firm and mergers with greater degrees of market overlap tended to have no greater performance improvements than other mergers. We also give some reasons why our results appear to differ so greatly from those suggested by banking consultants and the trade press and show why this conflict is more apparent than real.

The remainder of the paper is structured as follows. Section II discusses the available information on the effects of efficiency and market structure in banking. Section III reviews

recent academic studies of the effects of bank mergers and why they may differ from the predictions espoused by bank consultants. Section IV gives the specification of our empirical model. Section V describes the data set and efficiency measures employed. Section VI gives the empirical results and Section VII provides our conclusions.

II. Efficiency and Market Structure Effects in Banking

As suggested above, a key condition that needs to be satisfied if antitrust considerations are to be relaxed is that there must be substantial potential cost efficiency gains that dominate the effects of concentration and market structure in banking. Here, we review the available information on scale efficiencies, X-efficiencies, and market structure effects in determining bank performance.

A. Scale Efficiencies. Contrary to the claims made in the trade press and elsewhere, the extant academic literature on scale efficiencies in banking suggest that there are little or no overall cost savings to be made simply by increasing bank size through megamergers. The consensus view is that the average cost curve in banking has a relatively flat U-shape with medium-sized banks being slightly more scale efficient than either large or small banks. Only small banks appear to have potential for scale efficiency gains and the measured economies are usually relatively small, on the order of 5 percent or less [see the surveys by Mester (1987); Clark (1988); and Humphrey (1990)]. The primary uncertainty in this literature is the location of the bottom of the average cost U -- the scale-efficient point. Studies that used only banks with under \$1 billion in assets, studies that used banks of all sizes, and a study that included all banks of over \$100 million usually found that average cost was minimized somewhere between about \$75 million and \$300 million in assets [see Berger, Hanweck, and Humphrey (1987); Ferrier and Lovell (1990); Berger and Humphrey (1991); and Bauer, Berger, and Humphrey (1992)]. Studies that used only banks with over \$1 billion in assets (megabanks) usually found the minimum average cost point to be between \$2 billion and \$10 billion in assets [see Hunter and Timme (1986); Noulas, Ray, and Miller (1990); and Hunter, Timme, and Yang (1990)]. The difference between the two groups of estimates suggests that something may be fundamentally different about the cost function for megabanks. The critical difference

may be that megabanks produce a distinct variety of products (e.g., off-balance sheet activities), that they have different technologies, or that they have more cost dispersion than small banks that confounds the measurement of scale efficiencies.¹ Despite the differences on the location of the scale-efficient point, the fact that almost all estimates place this point below the size of most of the post-megamerger consolidated banks clearly suggests that there are no significant overall scale economies to be gained through megamerger. In most cases, megamerger would at least slightly increase scale *diseconomies*, which presumably owe to the difficulty of managing a larger, and usually more geographically dispersed, enterprise. Although there are some deviations from this consensus in the academic literature, almost no studies predict the type of large scale economy savings from large mergers usually envisioned by banking consultants.²

1. Consistent with these explanations, when banks of all sizes were included in the same cost function, the parameters of the cost function were driven by the observations on banks with under \$1 billion in assets (98 percent of all banks), but the results did not fit the observations on large banks very well. See Berger and Humphrey (1991).

2. Most of the deviations from the consensus findings in the academic literature have involved the use of improperly specified models. Examples of misspecified models are those that: (a) use only operating cost rather than total operating plus interest costs [e.g., Langer (1980); Nelson (1985)]; (b) specify a Cobb-Douglas or some other non-quadratic functional form [e.g., Benston (1972); Clark (1984); Shaffer (1991a)]; or (c) hold the number of branch offices constant when computing scale economies [e.g., Gropper (1991); Shaffer (1991b)]. The use of operating costs alone tends to bias the results toward finding scale economies because banks tend to substitute interest-cost intensive purchased funds for operating cost-intensive core deposits as bank scale increases. Thus, bank loans and assets increase more than proportionately than operating costs, giving an illusion of benefits to scale when all that has changed is the input mix of funds. Ironically, the relatively higher interest costs at larger banks often represent operating costs at the smaller banks from which the funds were purchased. The specification of a Cobb-Douglas or other nonquadratic form does not allow for a U-shaped average cost curve even if one exists in the data [a Box-Cox specification for outputs $(Y^\lambda - 1)/\lambda$ in a nonquadratic form could give a U-shape for very large values of λ , but λ values found in practice tend to be close to zero so that the specification is close to the Cobb-Douglas]. Average costs are forced to be globally upward sloping, flat, or downward sloping, so that if most banks are smaller (larger) than efficient scale, *all* banks will likely be measured as having scale economies (diseconomies). Holding the number of branch offices constant gives the scale effect of expanding output at the *currently existing* offices without allowing for the normal expansion of offices when output expands. If banks maintain additional offices to increase customer convenience and make up the costs of these offices on the revenue side, then there may be measured scale economies at the branch office level and diseconomies at the level of the overall bank. This was found by Benston, Hanweck, and Humphrey (1982); Berger, Hanweck, and Humphrey (1987); and Berger and Humphrey (1991).

Two types of criticisms may be leveled against the scale efficiency literature. First, scale efficiencies are usually measured using data on all of the banks in the sample, rather than just using the data on the X-efficient banks. Scale efficiencies theoretically apply only to the production possibilities frontier, and using the data from banks other than those on the frontier could confound scale effects with differences in X-efficiency. Second, most studies measure only scale *economies*, which take into account only the effects of marginal changes in output near the point of evaluation. Scale *efficiencies* take into account the full difference in average costs between the point of evaluation and the scale-efficient point (the bottom of the U if the average cost function is U-shaped), which may be quite a distance away from the point of evaluation. Fortunately, neither of these potential problems appears to be important empirically. Comparisons of scale effects on and off the X-efficient frontier are generally quite close [see Berger and Humphrey (1991); and Bauer, Berger, and Humphrey (1992)]. Also, comparisons of scale economies with scale efficiencies show that they tend to be within a few percent of each other in most instances. Most importantly, both types of measures suggest that large banks have *already* expanded beyond the point of minimum average cost, so that a megamerger places the consolidated institution even further away from this point [see Berger (1991,1992); and Evanoff and Israilevich (1991)].

The raw data on bank costs are also consistent with the academic scale economies literature. When average cost per dollar of assets (including both operating and interest expense) is plotted by size class, the result is very close to a horizontal line except for the very smallest size classes [see Berger and Humphrey (1991, Figure 1). This suggests little, if any, scale benefits from large size alone. Moreover, since most of the largest banks gained their current sizes primarily through mergers [see Rhoades (1985a)], the raw data suggest that the merger process has not generally produced cost savings for large banks.

The academic literature also provides little or no support for cost savings by changing bank product mix through mergers. Studies of economies of scope, where banks save costs by producing a broader range of outputs, are largely irrelevant for megamergers since both merger partners generally produce the full range of bank outputs that are specified in cost function

studies. Studies of the economies associated with the modest changes in product mix that do exist across bank size classes suggest that these changes are associated with only very small differences in costs, on the order of 1 to 3 percent of costs [see Berger, Hanweck, and Humphrey (1987); and Hunter, Timme, and Yang (1990)].

B. X-Efficiencies. In sharp contrast to the scale efficiency literature, the X-efficiency literature suggests that there are substantial differences in the abilities of managers to control costs in banking. The X-efficiency of a bank is measured by how close its costs or input requirements are to those of a best-practice, fully efficient firm within the data set, holding constant the effects of scale, product mix, input prices, and other exogenous influences on bank costs. An efficient frontier is estimated using one of several methods and all other firms are measured relative to this frontier. There are at least four methods of estimating the efficient frontier: the stochastic econometric, thick frontier, data envelopment analysis, and 'distribution-free' methods.³ Although there is no consensus on exactly how large X-inefficiencies are in banking, there is consensus that they are substantial and that they dominate scale inefficiencies. Most of the studies find that the average X-inefficiencies are on the order of 20 percent or higher for virtually all size classes of banks, as opposed to scale inefficiencies, which are on the order of 5 percent or less and are restricted to the smaller size classes of banks. Once again, the raw data are supportive of the academic econometric results. When average cost per dollar of assets is plotted by bank size class, the difference between banks in the highest and lowest average-cost quartiles within each size class substantially exceeds the difference in average costs across size classes [see Berger and Humphrey (1991, Figure 1)]. This result is consistent with the finding that managerial differences in cost control dominate scale-related differences in costs.

3. Examples of the stochastic econometric method are in Ferrier and Lovell (1990); Timme and Yang (1991); and Bauer, Berger, and Humphrey (1992). Examples of the thick frontier are in Berger and Humphrey (1991); Berger and Humphrey (1992a); and Bauer, Berger, and Humphrey (1992). Examples of data envelopment analysis are in Rangan, Grabowski, Aly, and Pasurka (1988); Aly, Grabowski, Pasurka, and Rangan (1990); Ferrier and Lovell (1990); Elyasiani and Mehdi (1990); Ferrier, Grosskopf, Hayes, and Yaisawarng (1991); and Fixler and Zieschang (1991). Examples of the distribution-free approach are in Berger (1991, 1992) and Bauer, Berger, and Humphrey (1992).

The X-efficiency and scale efficiency literatures together suggest an important condition for the use of cost efficiency as an antitrust defense. Since scale inefficiencies are small, and in many cases would be worsened by a merger as the consolidated bank moved into the scale diseconomy range (particularly so for megamergers), only an improvement in X-efficiency is likely to lower costs significantly. Thus, a virtual necessary condition for significant cost savings to be expected ex ante is that the acquiring institution have demonstrated an ability to achieve a higher level of X-efficiency than the acquired institution. This raises the probability that the management of the consolidated institution will be better able to reduce costs and boost X-efficiency ex post, particularly on the acquired part of the institution. Otherwise, if both institutions are roughly equally efficient ex ante or if a less efficient firm takes over a more efficient firm, costs are not likely to decrease because an equal or worse management will likely be in control.

C. Market Structure Effects on Performance. Another important condition for using cost efficiencies as an antitrust defense is that the proposed merger not result in excessive anticompetitive behavior that offsets any cost efficiency gains. A recent focus of the industrial organization literature has been to determine whether the commonly observed positive relationship between profits and concentration in banking and other industries is due to greater market power or superior cost efficiency of firms in more concentrated markets. Early studies in banking found profitability to be positively related to concentration and attributed this to the structure-conduct-performance (SCP) paradigm [see the surveys by Rhoades (1977,1982) and Gilbert (1984)]. Later studies allowed for the possibility that profits and concentration may be spuriously related under Demsetz's (1973,1974) and Peltzman's (1977) efficient-structure hypothesis. Under this hypothesis, a positive profit-concentration relationship may arise because efficient firms achieve both higher profits and dominant market shares that result in market concentration. Thus, under efficient-structure, higher profits are a result of lower costs from greater efficiency, rather than higher prices from the exercise of market power. If true, such a result would minimize any anticompetitive concerns associated with mergers. This theory was often tested by using market share as a proxy for efficiency, since more efficient

firms have dominant shares under the efficient-structure hypothesis [see Smirlock, Gilligan, and Marshall (1984,1986); Smirlock (1985); and Evanoff and Fortier (1988). Unfortunately, such a test is not definitive -- market share could just as easily represent market power as efficiency if firms with large shares have well-differentiated products and are able to exercise market power in pricing these products [see Shepherd (1982,1986) and Rhoades (1985b)].

Only the most recent studies have tested the effects of market structure on profitability correctly by including direct measures of efficiency in the profit equations, along with the measures of concentration and market share. A cross-section analysis of unit banks in 1987 by Timme and Yang (1991), as well as an analysis of both branching and unit banks for every year of the 1980s by Berger (1991), suggest that efficiency dominates concentration in terms of explaining bank profits. In the profitability regressions, the coefficients of the X-efficiency variables were consistently positive and statistically significant, while the coefficients of concentration were generally either negative or statistically insignificant. These results do not entirely rule out market structure as a source of market power, since the market share variable usually had a relatively small, positive coefficient and was often statistically significant. Since efficiency was already controlled for, the effect of market share should reflect market power, rather than efficiency. The small, positive coefficients of market share suggest that many within-market mergers may result in a minor effective increase in market power for the consolidated firm in selling its differentiated product. However, it appears that any such anticompetitive pricing effects of a within-market merger may be essentially limited to the merger participants, given that the resulting increase in market concentration does not have a positive measured effect on profits of the other firms in the affected markets. Despite these coefficient results, the R^2 s on the profit equations were quite low, less than 10 percent in most cases, suggesting that *neither* efficiency *nor* market structure variables are very important in explaining profits. Other factors, such as regional business cycles, a bank's choice of investment portfolios, its mix of funding sources between core deposits and purchased funds, and measurement error in the accounting figures, likely explain most of the variance in bank profitability and performance.

Overall, the literature testing the profit-concentration relationship for market structure effects is somewhat less than complete, since only two studies properly controlled for efficient-structure effects.⁴ Nonetheless, the information that is available suggests that anticompetitive market power effects from most bank mergers are not likely to be great in most cases. Mergers only increase concentration in any meaningful sense when they are of the within-market type, and the data indicate that such increases in concentration do not tend to result in generally increased profits for the other banks in the affected markets. The consolidated bank may have some market power gains, but the evidence suggests that these are likely to be small, uncertain, and dominated by any significant changes in X-efficiency. As a caveat, it should be noted that mergers that increase market shares to monopoly or near-monopoly levels could have strong anticompetitive effects, but this cannot be determined from the available data since such mergers rarely occur. Thus, to the extent that significant X-efficiency gains to mergers can be demonstrated, the case for their use as an antitrust defense is relatively strong, provided that market share increases are not extreme. We next turn to the evidence to date on whether in fact past bank mergers have tended to result in cost savings.

III. Recent Studies of Bank Mergers

In this section, we first review the academic studies of the cost effects of bank mergers. We then attempt to reconcile these results with those of banking consultants and the trade press.

A. Academic Studies. The increase in megamergers in recent years has spawned considerable academic research into the cost effects of bank mergers. However, because this interest is still relatively new, these studies are generally still in the working paper stage and are as yet formally unpublished. Some of these studies examine the cost effects of past mergers, while others simulate the effects of potential future mergers. The studies of either

4. Other studies have tested the effects of market power by regressing *prices* rather than profits on concentration [see Berger and Hannan (1989) and Hannan (1991)]. The results tend to show that there are some small but persistent effects of concentration on a least a few selected bank prices, despite the fact that these price effects do not show up well in profit studies. Again, this literature has the problem that the results may be spurious because no measure of efficiency is included in the price regressions. See Berger (1991, p. 3) for a discussion of this issue.

type usually conclude that, contrary to the trade press, mergers are *not* associated with significant improvements in cost ratios or other performance measures [some exceptions are noted below]. However, as shown below, these studies have several shortcomings which may limit their ability to assess the potential for cost improvements from mergers or the likely efficiency implications of future mergers.⁵

Most of the analyses focus on past mergers and base their conclusions largely on comparisons of simple pre-merger and post-merger financial ratios, such as operating costs divided by total assets or operating income (revenue less operating costs) divided by assets. For example, Linder and Crane (1992) examined all 47 bank mergers in the New England area over 1982-87, distinguishing between mergers of newly acquired banks and mergers of previous holding company affiliates. While the latter type of merger had more favorable effects than the former in the two years following the merger, in those cases where absolute operating costs did fall there was also a corresponding drop in assets. This left operating cost and income ratios insignificantly affected relative to the industry, implying little or no efficiency benefits from the mergers. Srinivasin and Wall (1992) performed a similar analysis, comparing operating cost and performance ratios up to four years after a merger while controlling for some changes in product mix. Their sample consisted of 240 banks with at least \$100 million in assets over 1982-86 and represented combinations from across the entire country. The larger, more general sample did not change the basic findings -- Srinivasan and Wall also found that the typical merger did not produce cost savings. Srinivasin (1992) also analyzed the same set of mergers, using the ratio of operating costs to noninterest income plus net interest income and again found no significant cost savings relative to the industry. Rhoades (1990) examined the operating cost/assets ratio pre- and post-acquisition for 13 acquired banks (not the consolidated entities) that each had over \$1 billion in assets over 1981-87. He found no

5. A relatively unexplored effect of mergers concerns the possibility of lower funding costs as a result of greater geographic and industry loan diversification. Other things being equal, mergers should improve asset diversification and lower the variance of returns for consolidated institutions. This would reduce the required rate of return to shareholders and debtholders. There has been some empirical work linking diversification and risk, but it does not usually relate these to funding costs. See Liang and Rhoades (1988,1991); Boyd and Graham (1991); and McAllister and McManus (1992).

significant performance differences relative to nonacquired banks three years prior to the acquisition nor three years after the acquisition. Using a slightly different research design in an earlier study, Rhoades (1986) obtained similar results for 413 acquired banks over 1968-78. These studies also suggest no significant efficiency benefits from megamergers.

In contrast to these findings, there are two studies that find overall benefits from mergers using simple ratio comparisons. Cornett and Tehranian (1992) found net average merger benefits in their sample of 30 large mergers (acquisition prices of at least \$100 million) that took place during 1982-87. They found that the ratio of pre-tax operating income (which excludes interest expenses) to the market value of equity plus book value of subordinated debt increased by a statistically significant 1.2 percentage points for these large merged banks relative to other large banks. However, they also found that return on assets (ROA), the most commonly used measure of bank profitability which includes interest expenses, showed virtually no improvement -- it increased by 0.07 percentage points and was not statistically significant. We argue below that interest expenses should be included in efficiency comparisons because they often represent operating expenses incurred at other banks which substitute for directly incurred operating expenses. Cornett and Tehranian did find that return on book equity (ROE), which differs from ROA only in the denominator, increased by a statistically significant 3.90 percentage points. However, this result is likely due to problems associated with measuring ROE.⁶

Spindt and Tarhan (1991) also found net merger benefits when examining the median differences in performance between merging banks and nonmerging peers for a sample of 394

6. One such problem is that reported book equity values are sometimes negative, which makes ROE nonsensical. In other cases, measured equity is positive, but so close to zero that ROE is misleadingly large. Berger (1991) attempted to circumvent these problems by substituting the value of one percent of assets for equity into the denominator when reported equity was negative or less than one percent. Another problem is that in 1987, most large banks made large loan loss provisions to cover past LDC losses [see Grammatikos and Saunders (1990) and Musumeci and Sinkey (1990)]. This dramatically raised ROEs for many of these banks because the denominator contracted more than the numerator, yielding the misleading result that ROE rose because large losses were realized. This may help explain why Cornett and Tehranian found ROE improvements, but not ROA improvements -- the unusual events of 1987 may have raised the post-consolidation ROEs of some of the banks in their sample, but it did not affect their pre-consolidation ROEs, since their merger sample ends in 1987.

mergers that took place in 1986. They found that the median difference in ROE between merging and nonmerging banks was negative and statistically significant in the two years before a merger (1984-85), whereas it was positive and statistically significant in the two years after the mergers (1987-88). However, their other performance measures, including ROA, usually did not have statistically significant median differences, although the trends suggested that mergers were beneficial.⁷ The most likely reason for their measured merger benefits may be scale economies rather than any synergies from mergers. The average size of the acquired banks in their sample was only about \$25 million in assets, while their consolidated institutions averaged about \$130 million. Thus, their mergers shifted resources toward more efficient size, consistent with the scale efficiency literature described above. These same benefits might have been achieved through growth or closure of the small banks, rather than through mergers. There is also the possibility that their result is an artifact of using the mergers from only one year (1986), instead of five to six years as in the other studies. In our results below, we find that measured benefits from mergers do vary somewhat over time. Nevertheless, even if their benefits do represent X-efficiency and they do persist over time, they may not have substantive predictive power for the benefits of megamergers, since their sample is dominated by small-bank mergers which differ in terms of ownership structure and other characteristics.

The simulation studies of bank mergers take a different approach. They predict the potential effects of future mergers by substituting the hypothetical consolidated bank values of deposit and loan outputs into estimated cost functions and examine the behavior of predicted costs. These simulations in effect map out the scale and product mix economies and diseconomies associated with bank combinations, and form crude tests of cost subadditivity. Shaffer (1991b) estimated a cost function for 210 large banks over 1984-89 and computed changes in predicted costs among some 20,500 random pairings. For each pairing, the

7. Spindt and Tarhan's statistically significant benefits could be concentrated in their ROE variable because of the measurement problems mentioned in a preceding footnote. However, the problem of 1987 LDC loan loss provisions is not likely to affect their results, since their sample consists of mostly small banks that do not have concentrations of LDC debt.

predicted total costs for producing the sum of the service outputs of the two banks (post-merger) was compared with the sum of the predicted total costs of the two banks separately (pre-merger). The average random merger reduced costs by only 0.2 percent, consistent with the scale economy literature that changing size does not matter much for most banks. However, when the pairings were restricted to the largest banks, those with over \$10 billion in assets, costs were raised by nearly 11 percent. This is consistent with the scale diseconomies for large banks found in the literature above. Savage (1991) improved upon this technique by allowing for cost savings and efficiency gains through closing of overlapping branch offices as well as simply randomly combining bank outputs. He found that mergers of relatively small banks reduced predicted operating costs slightly, but, similar to Shaffer, mergers of relatively large banks increased predicted costs. Using the cost function of Berger and Humphrey (1991), Savage found that merging a bank having \$20 billion in assets and 300 branches with one having \$10 billion and 200 branches created scale diseconomies and increased costs by 8.3 percent, close to Shaffer's 11 percent. However, when Savage assumed that half of the branches of the acquired bank could be closed because of market overlap, the cost increase from the scale diseconomies was reduced by more than half, leaving consolidated costs 3.7 percent above the total unmerged costs. If the branch closings result in a loss of \$2 billion of the consolidated \$30 billion in assets (20 percent of the acquired bank), total consolidated costs are 2.9 percent below pre-merger costs, but average costs actually increase by 4.1 percent because of the smaller asset base. Savage also showed that the potential for overlapping branch closings in the U.S. is relatively limited. He found that the 72 potential in-state mergers among the 41 largest branching banks in the U.S. could result in the closing of only 2.7 percent of the nation's 58,603 banking offices, assuming that half of the branches in overlapping zip codes were closed. Thus, the simulation literature suggests a loss of cost efficiency for large merging banks due to scale diseconomies, with only limited offsetting benefits from closing overlapping branch offices.

It is difficult to draw strong conclusions from this literature because of some methodological shortcomings. The studies that focus on simple performance ratios often base some or all of their conclusions on the use of operating cost ratios that exclude interest expenses

[e.g., Linder and Crane (1992); Srinivasan and Wall (1992); Srinivasin (1992); Rhoades (1986, 1990); Cornett and Tehranian (1992); and Savage (1992)]. Operating cost comparisons provide only an incomplete and possibly inaccurate description of the ultimate resource use involved in producing the merging banks' output because operating expenses account for only about 30 percent of total bank costs. The remaining 70 percent of costs are interest expenses, which often represent operating costs expended elsewhere in the financial system to raise funds, such as when the interest expenses are paid to borrow the excess core deposits of another bank through the federal funds market. This is especially true for large banks, which often rely on purchased funds for much of their funding. The usually smaller bank or thrift that raised the funds incurred operating expenses which should not be ignored in efficiency comparisons. In addition, some interest expenses paid to consumers reflect tradeoffs between price and service or between customer-incurred costs and bank-incurred operating costs. For example, a bank that provides fewer branch offices may pay higher interest instead of incurring some operating costs in order to compensate their customers for the inconvenience.⁸ In effect, the extra interest is payment for the extra transportation costs that customers incur in using a bank with fewer offices. Operating-cost-only comparisons will incorrectly treat such substitutions between interest payments and service as reflecting efficiency differences. An additional concern is that some inefficiencies may be embedded in the interest rates paid by banks (e.g., not changing rates as fast as the market, holding an excessively high cost set of maturities, etc.), and these will not be captured by operating cost comparisons.⁹

Perhaps the most important problem with operating cost comparisons is that they may bias the measured results toward showing false benefits from mergers. A commonly observed relationship in banking is that as banks grow larger, they tend to substitute interest cost-intensive purchased funds for operating cost-intensive core deposits. This may be especially true for within-market mergers, where branch offices that generate core deposits are often sold

8. See Heffeman (1992) for an estimation of the tradeoff between fewer branch offices and higher deposit interest rates paid in local markets in England.

9. See Berger and Humphrey (1991) for specific estimates of these inefficiencies.

or closed to avoid antitrust problems or to raise funds. When core deposits fall more than assets, funding mix shifts toward purchased funds. As a consequence, the operating cost ratios decline, but this does not necessarily represent an increase in efficiency or a reduction in real resource use. As noted above, it may simply reflect a change in the allocation among banks of the operating costs to raise the funds. In addition, to the extent that consumer interest rates must be raised to offset the loss of branch office convenience, these extra interest expenses represent true customer-incurred costs that are not captured in operating cost comparisons. In order to eliminate these biases toward finding mergers beneficial, total operating plus interest expenses must be analyzed.¹⁰

Another shortcoming with this literature is that the simple cost ratios may be relatively poor substitutes for direct measures of efficiency, which can be obtained using any of the four available measurement methods noted above. This creates two problems. First, the use of simple cost ratios does not control for the very real differences in product mix produced by the banks and input prices faced by the banks. As examples, commercial loans should be more costly to research and process than Treasury securities, and input prices should be greater in metropolitan areas than rural areas. However, the use of cost-to-asset ratios implicitly assumes that \$1 of assets should entail the same costs independent of what the asset is or what local input prices are. In contrast, a direct measure of efficiency controls econometrically for differences in product mix and input prices.

The second problem with using cost ratios in place of direct efficiency measures is that they cannot distinguish between X-efficiency and scale efficiency effects. Such a distinction may be important for looking ahead as to which mergers are likely to be successful in terms of performance improvements. For example, Spindt and Tarhan found an improvement in ROE

10. Cornett and Tehranian (1992) base their exclusion of interest expenses on the arguments made in a nonbanking study by Healy, Palepu, and Ruback (1992). They make the valid argument that leverage and therefore interest expenses will change with mergers, depending upon the method of financing the acquisition. However, such an argument is not very relevant to banking, where leverage is very high and typically does not change much with mergers among large banks, generally staying near regulatory limits. It is therefore likely that interest expense changes in banking are more driven by the proportion of funding coming from core deposits versus purchased funds than by any merger-related debt expenses (if they occur).

for merged banks, but their sample consisted primarily of small banks. If their results largely reflect scale efficiency improvement, this is unlikely to be replicated for large bank mergers, where no scale economies can be expected. However, if their results reflect X-efficiency improvements, this might be replicated for megamergers provided that differences in ownership structure and other characteristics do not interfere. Thus, in order to predict the effects of future mergers, both X- and scale efficiencies must be analyzed.

The simulation studies have a slightly different problem -- they incorporate the scale and product mix effects, but ignore the X-efficiency implications of mergers. Unfortunately, the predicted part of the cost function used in these studies does not incorporate the X-efficiency of the individual merger participants. As a result, these simulation results cannot be used to examine the most promising source of future cost savings -- X-efficiency gains when a more efficient bank acquires a less efficient bank.

The cost ratio and simulation studies also have an important difficulty in common. These studies typically do not differentiate between mergers that are the most likely and the least likely to produce cost savings. Rather, they generally examine an entire pool of mergers or potential mergers from a given time period, region, or size group. As discussed above, the data on bank costs and profits strongly suggest that the mergers that are most likely to improve performance are those in which a more X-efficient bank acquires a less X-efficient bank. The existing studies usually simply pool together mergers in which efficient banks acquire inefficient banks and inefficient banks acquire efficient banks, creating the possibility that true efficiency gains for some mergers will be masked by inefficiency losses for others. Similarly, most of the studies [some exceptions noted below] ignore the distinction between within-market and across-market mergers. If there are additional benefits from merging within a market as claimed by the trade press, these benefits may be masked because many prior merger partners had most of their assets in nonoverlapping markets.

In our empirical analysis below, we differentiate both of these types of effects in order to determine whether there is potential for significant cost improvements that have been captured

by subsets of past mergers -- that is, mergers in which more efficient banks acquired less efficient banks and mergers in which market overlap was large. These mergers where the potential for efficiency gain is greatest may also provide a superior forecast of future savings if, as widely believed, current and future mergers are more geared towards performance improvement whereas past mergers were more geared towards growth and market extension.

B. Academic Versus Consultant Analyses of Bank Mergers. The academic findings of little or no improvements in cost and performance ratios associated with bank mergers and little or no scale economies for the largest banks seemingly conflict with the widely reported consultant studies which have forecast considerable cost savings from large bank mergers. As noted in the introduction, savings as high as 30 percent of the operating expenses of the acquired institution have been projected for some recently announced megamergers. Upon closer inspection, however, it is seen that the conflict between consultant studies and academic analyses is more apparent than real.

Consultant studies typically: (i) focus on the *potential* for cost savings prior to a merger, which may exceed actual savings; (ii) concentrate attention on bank operations where scale economies or other merger benefits are known to exist (e.g., in back-office check processing and deposit accounting operations), but neglect areas where scale diseconomies or other efficiency losses from mergers may exist (e.g., difficulties in timely coordination and management of resources in a larger and more geographically dispersed institution); (iii) suggest organizational changes which *could* reduce costs (reducing the number of middle-level managers, closing marginal branches, outsourcing data-processing operations), but which are not always completely implemented; (iv) often refer to the subset of the most successful mergers, rather than examining the overall set of both successful and unsuccessful mergers; and (v) tend to put merger benefits in terms that seem large, but may actually be small relative to the total costs of the consolidated firm. In effect, consultant studies tend to focus on the upper bound of potential cost savings and to be concerned with those aspects of bank costs

which are subject to quantification and measurement before a merger occurs.¹¹ In contrast, academic studies typically: (i) focus on the *realized* cost savings from mergers using ex post historical data, rather than ex ante potential effects; (ii) examine the costs of a bank as a *whole*, rather than concentrate only on specific bank operations; (iii) include data on both banks that do and do not make the suggested organizational changes to reduce costs; (iv) examine the general case for bank mergers by measuring the average benefits across both successful and unsuccessful mergers; and (v) put merger benefits and losses in terms of the standard ratios used to examine bank performance in the rest of the academic literature.

These first four stylized differences in approach between consultants and academics may be viewed as 'sample selection' problem in which consultants tend to focus on the benefits and not the costs of mergers, while the academics treat the two more equally. However, difference (v), in which the same figures may be reported in terms that make them seem either large or small, may be most telling quantitatively in interpreting why consultants and academics seem to be reaching disparate conclusions. To see this, assume that the frequently quoted media claims of savings of 30 percent of the acquired bank's operating costs are correct. Assume further that the typical acquired bank is one-third of the size of the consolidated assets of the merging banks (or half as large as the bank that acquires it). This is reasonable, since the acquired institutions averaged between 27 and 30 percent of the total of the acquiring plus acquired institutions' assets in our data set of megamergers discussed below. The 30 percent of the acquired bank's operating costs then amount to 10 percent of the consolidated bank's operating costs. Further, recall that the costs of operating branches and back office functions constitute only about 30 percent of total bank costs. Therefore, the savings of 10 percent of consolidated operating costs amounts to only 3 percent of consolidated total costs. Moreover, it is not always clear that these estimates take full account of the shrinkage in size of the consolidated bank relative to the pre-merger sum of the two partners. Often, branch closings and

11. For example, see Keefe, Bruyette, and Woods and Ernst and Young, who surveyed consolidated banks and found an average savings of 35 percent of the acquired bank's data processing and back-office operations expense within six to nine months after the mergers. See also Bryan (1991, pp.12-13), who estimated savings of as much as 20 percent of the noninterest expenses of large banks through the merger process if interstate branching were permitted.

sales pursuant to a merger, as well as changes in lending policies result in runoffs of deposits and assets that reduces the size of the consolidated bank. For example, in the 1986 Wells Fargo-Crocker merger, Wells Fargo's consolidated assets were 10.75 percent lower in real terms and its deposits were 6.24 percent lower in real terms in 1987 than were the combined assets and deposits of Wells Fargo and Crocker in 1985. If the size of the consolidated firm decreases sufficiently, it could offset the 3 percent operating cost savings and result in an *increase* in average costs and a decrease in efficiency that would be correctly reported by a properly specified academic study.

These differences in approach may go a long way toward explaining why consultant studies and the conventional wisdom in banking differ from academic studies regarding the effects of mergers. Many consultants and bank equity security analysts are also of the general view that few mergers have realized their full potential for cost savings. Stock market event studies of bank mergers have shown that merger announcements typically result in a fall in the equity value of the acquiring firm, a rise in the value of the acquired firm, and no significant gain in the combined value of the two firms [see Baradwaj, Dubofsky, and Fraser (1992); Hawawini and Swary (1989); and Hannan and Wolken (1989)]. The finding of no significant gain in combined value suggests that the market believes that, on average, there are not likely to be substantial gains realized from mergers, and the finding of losses for acquiring firms suggests that the market believes that, on average, acquiring firms tend to overpay for acquisitions in anticipation of more merger benefits than are likely to be realized.

Thus, the conflict between the consultant and academic studies is more apparent than real. The consultants focus on potential cost savings, on areas of the bank where they are likely to occur, and on mergers where procedures to implement these changes needed to achieve these benefits have taken place. In contrast, academics focus on realized cost savings, on cost changes from all areas of the banks (when properly specified), and on mergers that were both successful and unsuccessful in implementing cost saving procedures. Moreover, the

two groups tend to report cost savings in percentages of different bases (operating costs of acquired firms versus total costs of consolidated firms), so that the exact same cost saving may be a much larger percentage in consultant studies.

IV. Empirical Model Specification

The evidence reviewed thus far indicates that overall cost efficiency gains from megamergers have yet to be effectively established or refuted. Most of the academic studies that use cost ratios or simulations have indicated little or no cost savings, but these studies have methodological problems and they often do not address the issue of mergers between the largest banks specifically. The consultant studies also appear to tell only part of the story. Moreover, there has been very little effort expended in examining whether certain types of merger pairings, such as more efficient banks acquiring less efficient banks or mergers between banks in overlapping markets, are more successful than other merger pairings, as theory seems to suggest. The empirical analysis here tries to address these issues by directly measuring efficiency improvements following mergers and relating them to the ex ante conditions that theory predicts should lead to the greatest improvements.

One of our key regression equations relates the ex post improvement in efficiency after a merger to the ex ante difference in efficiency between the acquiring and acquired banks and to the market overlap between the merging banks:

$$\begin{aligned} X\text{-EFF}_c - [w_1 X\text{-EFF}_1 + w_2 X\text{-EFF}_2] = \\ \alpha + \beta w_2 [X\text{-EFF}_1 - X\text{-EFF}_2] + \gamma \text{OVERLAP} + Z'\delta + \varepsilon, \end{aligned} \quad (1)$$

or

$$X\text{-EFF_IMP} = \alpha + \beta \text{WDIF_X-EFF} + \gamma \text{OVERLAP} + Z'\delta + \varepsilon, \quad (2)$$

where $X\text{-EFF}_c$ is the measured X-efficiency of the consolidated bank after the merger; $X\text{-EFF}_1$ and $X\text{-EFF}_2$ are the pre-merger efficiencies of the acquiring and acquired institutions, respectively; w_1 and w_2 are weights for the sizes of banks 1 and 2 before the merger such that $w_1 + w_2 = 1$; OVERLAP is the degree of ex ante deposit market overlap between the merging banks; Z is a vector of other ex ante variables that may affect the success of the merger; α , β , γ , and δ

are coefficients, and ε is a random error term. As shown below, we will also experiment with other measures of performance in place of the X-EFF measures.

The logic of this formulation is as follows. The dependent variable, X-EFF_IMP, is the X-efficiency improvement after the merger -- the efficiency of the consolidated bank less the weighted average of the efficiencies of the acquirer and acquired. The weights are needed because if there is no improvement, the consolidated firm would presumably have the weighted average efficiency of the two merging firms. In the absence of any better scalar measure of bank size, we form the weights using total assets (TA), so that $w_i = TA_i / (TA_1 + TA_2)$, $i = 1, 2$.

The first exogenous variable, WDIF_X-EFF, is the weighted difference in X-efficiency between the acquiring bank and the acquired bank. Under our hypothesis espoused above, the ex post efficiency gain should be positively related to the ex ante difference in efficiencies, $[X-EFF_1 - X-EFF_2]$. The greater is this difference, the greater is the potential for ex post efficiency gains from the acquirer raising the efficiency of the consolidated firm towards its own ex ante level. The w_2 weight on the $[X-EFF_1 - X-EFF_2]$ term is needed because the overall efficiency improvement should be directly proportional to the share of the consolidated firm that has room for improvement. Thus, if the consolidated firm's efficiency is raised all the way to the level of the acquirer, the improvement in the consolidated firm (the dependent variable) will equal $w_2[X-EFF_1 - X-EFF_2]$. In this setup, the coefficient β in equations (1) and (2) is the proportion of this potential improvement that is achieved ex post.¹² In cases in which the acquirer takes over two or more firms within a short time interval, the X-EFF variables in equation (1) are adapted to be consistent with this formulation, so that β reflects the proportion of the potential improvement if all of the acquired parts of the consolidated firm were brought up to the efficiency level of the acquirer.¹³

12. Note that this relationship also holds when the acquiring firm is less efficient than the acquired. In such cases, β reflects how far the efficiency of the consolidated firm has fallen towards that of the acquirer. We test below whether β differs according to whether WDIF_X-EFF is positive or negative.

13. If firm 1 takes over firms 2 through n, X-EFF_IMP becomes $X-EFF_c - [w_1 X-EFF_1 + w_2 \sum_{j=2}^n v_j X-EFF_j]$, where $w_2 = [\sum_{j=2}^n TA_j] / [\sum_{k=1}^n TA_k]$ and $v_j = TA_j / [\sum_{k=2}^n TA_k]$, and WDIF_X-EFF becomes $w_2 [X-EFF_1 - \sum_{j=2}^n v_j X-EFF_j]$.

Because efficiencies are measured over different time intervals when the overall performance of the industry may vary, each X-EFF is measured by its rank relative to a peer group of megabanks over its same time interval (discussed further below). Thus, to the extent that average bank performance worsened or the dispersion of costs increased over the 1980s as found by other studies [see Bauer, Berger and Humphrey (1992) and Berger and Humphrey (1992b)], we neutralize the tendency of efficiency improvements to be negative and the tendency of later mergers to appear worse than the earlier ones. This does not fundamentally alter the interpretation of the coefficient β -- it simply becomes the proportion of the potential improvement in the rank of efficiency that is achieved *ex post*. In the empirical analysis, we also tried using the numerical deviations from the means of the appropriate peer groups with similar result, but for our purposes rank is preferred because it is neutral with respect to changes in cost dispersion over time as well as to changes in the overall trend of costs.

The OVERLAP variable is included in order to capture the potential benefits specifically related to within-market mergers. As discussed above, it has been argued that banks that merge in overlapping markets can improve efficiency by choosing the more efficient of the redundant managers, branch offices, and back-office operations and closing the less efficient in each market. OVERLAP is defined as the proportion of the total deposits of both firms that are in branches in the same Metropolitan Statistical Area (MSA) or non-MSA county. Alternatively, OVERLAP is defined in terms of the proportion of branches that are in the same local markets. Note that MSAs and non-MSA counties are the standard local banking market definitions, and that deposits and branches are the only banking variables publicly available for these markets. When more than one bank is acquired, OVERLAP measures the proportion of deposits or branches of all of the involved banks that have overlap with one or more of the other banks.

The Z vector contains variables to control for other *ex ante* influences on the success of a merger. One such variable is the degree of retail orientation of the banks. Arguments have been made that commercial banks have become less competitive with nonbank sources of funding and direct investments over time because of financial and technical innovations. As a result, the banking industry should have reduced overall deposits and assets, but it has not

done so because of access to deposit insurance or other reasons. If so, the potential for closing branches and improving cost efficiency from mergers is greater, the higher is the degree to which the merging banks fund their asset portfolios through deposits, as opposed to purchased funds which are usually bought at the corporate, rather than branch level. We specify the variable RETAIL, which equals the ex ante sum of the deposits of merging banks divided by the sum of their total assets. It may be expected that the larger is RETAIL, the greater are the potential savings from branch closings.

We also include a measure of the ex ante scale of the merging firms to control for the scale economies or diseconomies that may be created by the merger. Rather than simply include a variable that measures size, such as total assets, we express the scale measure directly as a function of scale efficiency potential. As background, scale efficiencies (S-EFF) are defined as the ratio of the predicted average cost of a fully scale efficient firm (at the bottom of the U-shaped average cost curve) to the predicted average cost for the firm itself, holding product mix constant.¹⁴ S-EFF varies over (0,1] like any other efficiency variable and increases up to the scale efficient point and decreases thereafter. To create a single variable that monotonically measures the degree to which scale economies are exhausted ex ante, we form SCALE, which equals S-EFF if the firm is below efficient scale and $(2 - \text{S-EFF})$ if the firm is above efficient scale. Thus, the larger is SCALE, the less is the potential for scale economy cost decreases from mergers and the greater is the potential for scale diseconomy cost increases.

We also include variables describing the local banking market structures of the merging firms. CONC and SHARE are the weighted averages of the Herfindahl index of concentration and the market shares of the merging firms, respectively, taken across all the markets in which the banks have branches.¹⁵ The purpose is to control for any part of measured efficiency that may reflect market power of the banks over their depositors. It has been shown elsewhere that

14. See Berger (1992) for details.

15. See Berger (1991) for details.

banks in more concentrated markets pay lower rates on some deposit categories, although these differences do not seem to affect profits and costs in a substantial way.¹⁶

We also specify four other ex post performance measures in place of X-EFF_IMP on the left-hand-side of equation (2) for completeness and to test for robustness. Thus, we estimate:

$$\text{PERF_IMP} = \alpha + \beta \text{WDIF_X-EFF} + \gamma \text{OVERLAP} + Z'\delta + \varepsilon, \quad (3)$$

where PERF is an alternative measure of bank performance and PERF_IMP is computed in the same manner as X-EFF_IMP. These alternative performance measures allow us to check the robustness of our results and in some cases compare our results to the literature, which relies on simple financial ratios. As in equations (1) and (2), the dependent variables measure changes in ex post performance, while the independent variables measure ex ante conditions.

The first alternative is total efficiency (T-EFF), which is the product of X-efficiency and scale efficiency (X-EFF • S-EFF). T-EFF is a more complete measure of performance that also takes into account the estimated effects of the merger on scale efficiency. T-EFF_IMP is expected to be lower than X-EFF_IMP on average since the literature suggests that most megamergers would place the consolidated bank well into the scale diseconomy region, lowering the S-EFF component.

The second alternative measure of ex post performance specified is the improvement in profitability, as measured by ROA. This is even more inclusive than T-EFF because it includes revenue as well as cost effects of the mergers. The main disadvantages of this variable are that it does not control for product mix and input prices as the efficiency measures do, and that it may incorporate market power effects on revenues (if any) of mergers. We also examined ROE, which yielded qualitatively similar results, but we do not report them because of the belief that ROA has a better-measured denominator.

The third and fourth alternatives are simple cost ratios. ATC measures average total costs per dollar of assets, including both operating and interest expenses. This suffers relative

16. See Berger and Hannan (1989) for an example in which concentration affects deposit rates and see Berger (1991) and Timme and Yang (1991) for examples in which concentration has little effect on profits.

to the direct efficiency measures because it does not control for product mix and input prices, but it is less likely to be affected by market power than ROA because it excludes revenues. AOC is average operating costs per dollar of assets. This variable is included primarily because it is a key variable often employed in other academic studies and in virtually all consultant and trade press discussions of merger benefits. However, as discussed above, operating cost ratios are likely to be inaccurate and biased towards finding false benefits from mergers because of the exclusion of interest expenses that often represent real resource use elsewhere in the system. The one benefit of AOC is that it excludes any effects of market power on deposit interest rates, but as we have seen earlier, market power effects are quantitatively small and are dominated by efficiency differences in explaining variations in bank profitability. All of the PERF_IMP variables are measured as improvements in the rank of the consolidated bank relative to the peer group of megabanks over the same time intervals to avoid the problem of aggregate bank performance variance over time.

The final set of regressions run are of the form:

$$\text{PERF_IMP} = \alpha + \beta \text{WDIF_PERF} + \gamma \text{OVERLAP} + Z' \delta + \varepsilon, \quad (4)$$

where WDIF_PERF is the ex ante weighted difference in performance between the acquiring and acquired banks and is computed in the same manner as WDIF_X-EFF. Again, we use T-EFF, ROA, ATC, and AOC as performance indicators, regressing the ex post improvement in each on the ex ante weighted difference in the same measure. As is the case for equation (3), equation (4) allows for completeness and a check of robustness and measurement error in the efficiency measures. Once again, all of the performance variables are measures as ranks relative to the appropriate peer groups of megabanks.

V. The Data Set and Efficiency Measures

In this section, we describe the data set of megamergers analyzed in this study as well as the methods used to estimate the efficiency measures.

A. The Megamerger Data. We apply the model specified above to U.S. banking megamergers of the 1980s. Data were collected on all mergers between banking organizations in

which both partners had at least \$1 billion in banking assets at the time of the merger over the period 1981-1989. There were 114 such mergers. For the purposes of this study, the banks within a holding company were treated as a single unit. It is assumed that holding companies should act as a unit and maximize joint profits, minimize joint costs, etc., and the primary reasons for having multiple banks within a holding company are the current prohibition on interstate branching and (mostly) past restrictions on intrastate branching. Such an assumption is really necessary in order to do an extensive analysis of megamergers, since the vast majority of large mergers are between holding companies, rather than between banks. Moreover, the claims made by consultants and trade press often imply that cost efficiency improvements can be made throughout a holding company. As a result, we perform our tests on banking data aggregated to the holding company level. That is, we sum together the costs, revenues, outputs, etc., for all the commercial banks within a holding company and treat it as a single unit.¹⁷

The number of megamergers that could be fully analyzed was reduced by data considerations. The main difficulties relate to having enough observations before and after a merger that are both available and unpolluted by the effects of other megamergers by the same banks. The Call Report information used to create the variables was collected on an annual basis from 1980 to 1990. The model was estimated under three different assumptions about the lag time needed to absorb the acquisition costs of the merger itself (legal expenses, severance pay, sales of redundant operations, etc.) and gain the potential benefits from the mergers.

In Data Set 1, we left out only the year of the merger -- the ex post efficiency and performance indicators were based on all the years following the merger until either another megamerger occurred or the year 1990 was reached. The ex ante efficiency, scale, and other performance measures were based on all the years going backward in time prior to the merger

17. An additional reason for performing the analysis at the holding company level is that it is standard procedure in banking research and policy analysis to assume that prices are set at the holding company level and to analyze market structure variables, such as concentration and market share, at that level as well. This is not meant to imply that a holding company would not set different prices across its various markets -- rather that it would make a joint decision about the prices set by all its affiliates within each market.

until either another megamerger or the year 1980 was reached. In the usual case in which exactly two banks merged, this would often involve computing the performance or efficiency variables over three time intervals -- the appropriate years after the merger for the consolidated bank and the appropriate years prior to the merger for both the acquiring and acquired bank separately. For example, suppose A acquired B in 1988, and A acquired C in 1984. For the 1988 A-B merger, the ex post data would be on A's performance over 1989-90, the ex ante data on the acquiring bank would be on A's performance over 1985-87, and the ex ante acquired bank data would be on B over 1980-87. If data were unavailable for any of these sets of dates, the merger was not used in the regression analysis. A number of mergers were also excluded because one of the parties was a foreign bank or a thrift institution for which data were not collected. In cases where a megabank acquired other megabanks in the same or contiguous years, these were combined into a single megamerger for purposes of the analysis. These procedures left a total of 57 observations for Data Set 1, of which 46 were simple mergers of two banks (e.g., A acquired B), 10 were constructed from two mergers among three banks (e.g., A acquired B and C in the same or consecutive years), and 1 which was constructed from three mergers among four banks (e.g., A acquired B, C, and D in the same or consecutive years). Thus, 69 of the original 114 mergers are used in the analysis, although they appear in only 57 observations. Of the 45 excluded mergers, 12 were left out because a thrift was purchased, 11 were left out because one of the parties was a foreign institution, and the remaining 22 had one of the three required data subsets missing (no ex post data, no ex ante data for the acquirer, no ex ante data for the acquired).

In Data Set 2, we excluded data from 2 years for each megamerger, the year of the merger plus the following year. We applied this rule both for the ex post performance data and for the ex ante efficiency and other variables, leaving off data in the year after an earlier megamerger. In the example above, for the 1988 A-B merger, the ex post data on A would be from 1990 alone, the ex ante data on A would be over 1986-87, and the ex ante data on B would still be over 1980-87. Some data were lost in this procedure, including all of the 1989 mergers. This left 34 observations. In Data Set 3, we excluded an additional year of data after

each megamerger. In our example above, the 1988 A-B merger would be excluded, since there are no usable years after the merger. Only 20 observations were available for Data Set 3.

There are two potential dangers in deleting the data in the years immediately following a merger besides the obvious loss of observations. The first danger is that too many of the transition costs of the merger, which represent the expenditure of real resources, may be excluded. Ideally, to judge the benefits from mergers, one would take the present value of *all* future cost changes after the merger, including the transition costs. The exclusion of some of the transition costs may be justified on the basis of the fact that we do not have information on the benefits from the years far into the future, but this does not justify excluding all of the transition costs. The second danger is the potential bias in the exclusions. If the banks that gain the most from merging are also those that merged the most often, then there is a downward bias in measured performance from excluding years after a merger, because this procedure tends to leave out the banks that merge the most often. For example, a bank that has a megamerger every other year would be included in Data Set 1, but would be excluded from Data Sets 2 and 3. Fortunately, the empirical results are quite uniform across the three data sets, suggesting that these distinctions and biases might not be significant or they tend to cancel each other out.

B. Efficiency Measurement. The X-efficiency variables used in the empirical analysis are measured using the 'distribution-free' approach.¹⁸ A translog cost function specifying five outputs and four input prices is estimated separately for each year from 1980 to 1990 for all U.S. commercial banks (consolidated by holding company) that had at least \$1 billion in banking assets for at least one of these years. Both banks that did and did not merge were included. The only excluded observations were the data on megamerger participants in the year of the merger, based on the presumption that such data may overcount transition costs. This data set, which includes the banks that participated in megamergers (except for the year of their merger) and their peers, forms the universe of banks against which the efficiency of the merging banks is measured. The average annual size of the data sets used in the cost function was 296. It

18. For a complete description of this method, see Berger (1992), under Method 1.

grew from 301 banks in 1980 to a high of 335 banks in 1983 and then fell towards its low of 244 banks in 1990. The attrition was created primarily by the megamergers themselves.¹⁹

For each year, the cost function estimated is of the form:

$$\begin{aligned} \ln TC = & \theta + \sum_{j=1}^5 \phi_j \ln Y_j + 1/2 \sum_{j=1}^5 \sum_{k=1}^5 \phi_{jk} \ln Y_j \ln Y_k + \sum_{n=1}^4 \omega_n \ln w_n + \\ & 1/2 \sum_{n=1}^4 \sum_{p=1}^4 \omega_{np} \ln w_n \ln w_p + \sum_{j=1}^5 \sum_{n=1}^4 \rho_{jn} \ln Y_j \ln w_n + \\ & \theta_1 \text{UNIT} + \theta_2 \text{LIMIT} + \mu \end{aligned} \quad (5)$$

where the dependent variable $\ln TC$ measures the log of total costs (operating and interest); the Y_j indicate the dollar amounts of the outputs: demand deposits, retail time and savings deposits ($\leq \$100,000$), real estate loans, commercial and industrial loans, and installment loans; the w_n represent the input prices for labor, physical capital, deposit interest, and purchased funds interest; UNIT and LIMIT are dummies for whether the bank is in a unit banking or limited branching state; and μ is a composite error term which includes both an X-efficiency factor for each individual bank which is assumed to be constant over time and a random error which varies over time as well as across banks. Scale efficiencies (S-EFF) are formed for each bank using the predicted part of the cost function.²⁰

The distribution-free approach measures the X-efficiency of each bank over the appropriate time period before or after a megamerger by comparing that bank's average cost function residual over time $\hat{\mu}_i$, with the average residuals for each of the members of its peer

19. Banks that were below \$1 billion in every year were excluded from the analysis because, as noted above, small and large banks often do not appear to fit on the same cost function. However, a few smaller banks were included by virtue of the fact that they became large at some other point in time. The reason for this inclusion is to provide a universe that includes all banks participating in megamergers and their peers, some of which were below \$1 billion in assets over some part of the sample period.

20. Equation (5) was estimated for most of the years using OLS. However, for the early years, the estimated cost functions were poorly behaved -- the average cost curves had inverted U shapes, which are theoretically unacceptable. For these years, an SUR procedure was tried in which input cost shares were estimated jointly with the cost function and the standard cross-equation restrictions were imposed. The reported results reflect the use of SUR for 1980-82 and OLS for 1983-89 to compute the X-efficiency residuals, but continuing problems with an inverted U-shape average cost curve required that scale efficiencies be computed for 1981 and 1983 by combining the output and input price values for those years with the coefficient estimates for the following years.

group over the same time interval, $\hat{\mu}_j$, $j \neq i$. The bank with the lowest average residual $\hat{\mu}_{\min}$ is assumed to define the efficient frontier for that time interval, and each bank is then ranked according to its closeness to this frontier.

This method corresponds well with the original definition of X-efficiency as accounting for differences in costs that cannot be explained by differences in scale or other observable characteristics [see Leibenstein (1966)]. Previous research has tested whether measured X-efficiencies in banking truly reflect efficiency versus omitted factors – such as product quality, risk-taking behavior, or measurement errors in input prices. These studies have found that the measured X-efficiencies *do* appear primarily to reflect true efficiencies [see Berger and Humphrey (1991) and Berger (1991)].

In the analysis below, we primarily measure X-EFF and all the other performance variables (T-EFF, ROA, ATC, AOC) by their rank relative to their peers for the appropriate time interval, rather than trying to use exact measures. That is, we measure each variable as $1 - [(\text{rank} - 1) / (N - 1)]$, where N is the number of banks in the peer group (including the bank being evaluated). This scaling is such that the best-practice bank in the group is assigned a rank of 1, the worst bank in the group is assigned a rank of 0, and all the other banks are distributed uniformly between 0 and 1. Thus, if a bank had the median average cost function residual over the time interval for which it was examined, it would have a X-EFF rank of .5. Ranks are used in part because regulatory and macroeconomic changes over time affect the distribution of bank costs such that it is unreasonable to expect banks to remain the same distance from the efficient frontier over time. In addition, there may be statistical problems in comparing efficiency ratios that are derived from different numbers of annual observations of costs over time because the amount of random error that averages out may vary considerably. Fortunately, a robustness check in which X-EFF and the other performance variables were measured as numerical deviations from the means of their peers yielded very similar results. Note that unlike much of the previous merger literature, the procedure used to calculate X-EFF i) includes both operating and interest expenses; ii) controls for product mix and input price effects; and iii) distinguishes between X-efficiency and scale efficiency effects.

VI. Empirical Results

In describing the empirical results, we first focus on the distributions of the simple ex post performance improvement variables and the ex ante condition variables that theory suggests should influence the success of a merger. Panel A of Table 1 shows the averages and ranges of the ex post improvement variables for the three data sets that exclude different numbers of years after a merger. The average improvement in X-efficiency rank after a merger (X-EFF_IMP), is small, between 1.9 and 4.7 percentage points for all three data sets, and is not statistically significantly different from zero at the 10 percent significance level. That is, abstracting from bank scale, product mix, and input prices, the rank of the consolidated bank relative to other megabanks after the merger was on average 1.9 to 4.7 percentage points higher than the weighted average of the merging banks relative to their peers before the merger. This magnitude means that if the merging banks were on average 50th best out of 100, they would be expected to rise to between about 48th and 45th best after consolidation, but because of the lack of statistical significance, one cannot rule out that the true expectation is for no gain or even a fall in rank. Also, there was almost an even split between the number of banks that improved and declined in performance -- X-EFF_IMP was positive in 32 of 57 cases, 17 of 34 cases, and 9 of 20 cases, depending upon the data set employed (not shown in table). Note that this finding of little or no average gain in X-EFF does not mean that some mergers were not very successful or very unsuccessful in improving their individual efficiencies. As shown in the minimum and maximum figures in parentheses, the consolidated bank in the most successful merger improved its X-EFF rank by about 80 percentage points, while X-EFF rank of the consolidated bank in the least successful merger declined between about 50 and 70 percent.

As discussed above, total efficiency (T-EFF) is simply X-efficiency times scale efficiency ($X-EFF \cdot S-EFF$). The average improvement in T-EFF rank after a merger (T-EFF_IMP), is slightly negative, between -2.5 and -11.3 percentage points, and is statistically significant for two of the three data sets. Apparently, the average loss in scale efficiency more than offsets the small average gain in X-efficiency. The finding that T-EFF_IMP is lower than

X-EFF_IMP is not unexpected, given that most of the consolidated banks are well into the scale diseconomy region and should suffer declines in S-EFF from further increases in size.

The return on assets and average total cost rank improvements (ROA_IMP and ATC_IMP) are also small and negative, but are not statistically significant. These results suggest that the finding of little or no average gain from megamergers is robust. Surprisingly, the average operating cost rank improvement (AOC_IMP) indicates the worst performance of all from megamergers. AOC_IMP ranges between -7.5 and -14.3 percentage points and is statistically significant in all three data sets. The finding that operating costs fare the most poorly is surprising given the bias described above toward substituting interest costs for operating costs when banks merge.²¹

A check of the robustness of these findings over time suggests that there is no dominating trend, but that there are differences across individual years. Dividing the 1980s into 1981-85 and 1986-89 shows no material differences.²² For example, in Data Set 1, the average X-EFF_IMP is 4.25 and 4.88 percentage points for the early and late intervals, respectively. The other four ex post measures are all negative for both intervals, except that ATC_IMP is a small positive 1.13 percentage points for the early interval. There are some measured differences across individual years, with average X-EFF_IMP and the other measures slightly positive for some years and slightly negative for others, but the infrequency of observations makes it difficult to determine whether this reflects real changes or random error.

Overall, the ex post performance results suggest that there were no significant cost efficiency benefits from the megamergers of the 1980s on average. This result is robust across performance measures, data sets, and time periods, and is consistent with most of the academic literature. However, there do appear to be some very successful individual mergers as well as some very unsuccessful ones.

21. The result that measured operating cost losses increase with the number of years excluded after the merger is consistent with the bias noted above that measured merger improvements may worsen as the mergers of the more active acquirers are excluded.

22. Exceptions are in Data Set 3, which only has 3 observations in the early time interval and so is unreliable for comparisons.

Panel B of Table 1 shows the summary information on the key ex ante condition variables -- the difference in ex ante performance between the acquiring and acquired bank and their degree of deposit market overlap. The data suggest that the potential for merger success in improving efficiency is quite favorable in most cases. The weighted difference in X-efficiency rank between the acquiring and acquired banks (WDIF_X-EFF) averages between about 9 and 19 percentage points. This suggests that better banks do take over worse banks on average, and that the acquirers could improve the X-EFF rank of consolidated banks by 9 to 19 percentage points on average if they restructured it so that it had the same rank as the acquiring bank had ex ante.²³ The variable WDIF_X-EFF(+) indicates that for between 55 and 72 percent of the cases, the acquirer has a higher X-EFF rank than the acquired, suggesting that well over half of the mergers may have the potential to improve managerial quality by simply bringing the acquired part of the consolidated bank up to the level of the acquirer. The weighted differences in the other performance measures (WDIF_T-EFF, WDIF_ROA, WDIF_ATC, WDIF_AOC) show perhaps even greater quality differences between the acquiring and acquired banks -- these alternative measures show weighted differences between 14 and 25 percent. The OVERLAP and OVERLAP(+) variables also suggest that there is considerable deposit market overlap between the merger partners, creating the potential for efficiency improvements through the consolidation of redundant local operations into the more efficient units. Between about 70 and 75 percent of megamergers have some overlap and the average degree of overlap (including the zero overlap cases) covers between 34 and 47 percent of all the deposits of the merging firms. Thus, we have the surprising combination that the acquiring banks appear to choose their merger partners well to create the potential for success (better banks acquiring worse banks with banks with deposit market overlap), and yet there appears to be little ex post success on average.

23. Note that the actual differences in efficiencies between the acquiring and acquired banks is much larger than these figures, since the average size of the weight is only between .27 and .30 (i.e., the acquired bank is only 27 to 30 percent of the combined size of the merging banks).

Panel C of Table 1 shows information on our four control variables. The data on RETAIL suggest that merging banks are typical of large retail banks in that they raise between 60 and 70 percent of their funding through deposits on average. The SCALE variable suggests that there is virtually no potential for scale economy benefits through these megamergers -- the merger partners are almost all above the point of minimum average cost for their product mix and input prices. The market structure variables, HERF and SHARE, do not show that merging banks are particularly in either concentrated or unconcentrated markets on average. The means of these variables are very similar to the national means found in a much more comprehensive sample of U.S. banks [see Berger (1991, Table 1a)].

We next analyze the relationship between the ex post and ex ante conditions. Before examining the results of the full regression equations specified in equations (1) through (4) in Section IV above, we examine the simple bivariate relationships between the ex post and ex ante variables. Figure 1 (a through e) shows the relationships between the five ex post performance improvement variables and the ex ante weighted difference in X-efficiency WDIF_X-EFF for the 57 observations of Data Set 1. Besides the individual observations (dots), we show the simple bivariate regression lines (solid lines) and their 95 percent confidence intervals (dashed lines). The simple regression lines correspond to equations (2) and (3) from Section IV, with OVERLAP and the control variables Z excluded. What is apparent from these observations is that there is no strong relationship between ex post performance improvement and WDIF_X-EFF as would be expected under the arguments given above. The dot patterns show no tight relationships, the simple regression lines are relatively flat, and none of the five slopes are statistically significantly different from zero at the 10 percent level. Perhaps most important, the wide confidence intervals show that at *any* level of ex ante efficiency differences either in or near the sample points, one cannot rule out the expectation that the ex post performance improvement will be either very large positive or very large negative.

Figure 2 (a through e) shows the relationships between the same five ex post performance improvement variables and the degree of deposit market overlap to determine whether within-market mergers tended to produce better merger results than across-market mergers. These

figures correspond to equations (2) and (3) from Section IV above with WDIF_X-EFF and Z excluded. These data do not appear to be very different from Figure 1 except that about 30 percent of the observations are clustered at a zero value for the OVERLAP value. As can be seen the data are quite dispersed, with almost as much variation in the performance results in the zero overlap cluster as elsewhere. The regression lines are all again very flat, and the only statistically significant slope is in Figure (2a), where X-EFF_IMP is significantly negatively related to OVERLAP at the 10 percent level, contrary to the within-market hypothesis. Again, the data suggest that at *any* level of market overlap, one cannot rule out the expectation that the ex post performance improvement will be either substantially positive or substantially negative.

Figure 3 (a through e) shows the relationships between each of the five ex post performance improvement variables and the ex ante weighted difference in the same measure, as in equation (4) above, with OVERLAP and Z excluded. By construction, Figures 1a and 3a are identical. These data again show little relationship between ex post improvements and measures of ex ante potential for improvement. Only the operating cost relationship is statistically significant, but it is negative. This is somewhat surprising, given that most of the claims of great improvement made by many of the consultants and trade press are based on these simple operating cost ratios.

Figures 1, 2, and 3 clearly suggest that the two hypotheses about what pre-merger conditions are likely to result in post-merger improvements in performance do not fit the results of the megamergers of the 1980s very well. Either these conditions do not accurately gauge the potential for performance improvement, contrary to the hypotheses, or merging banks appear not to have performed according to their potential after consolidation. The lack of solid relationships between the ex post and ex ante conditions are also apparent in figures for Data Sets 2 and 3 (not shown).

We next examine the results of more fully specified regressions which test both hypotheses simultaneously and include control variables. Table 2 shows the results of the regressions specified in equations (2) and (3) above, where the ex post performance improvement variables are regressed on the ex ante variables WDIF_X-EFF and OVERLAP, both with

and without the control variables RETAIL, SCALE, HERF, and SHARE. We also show these regressions separately for Data Sets 1, 2, and 3. As in the figures above, the results do not support the two main hypotheses. In the 30 regressions (5 ex post variables by 3 data sets by 2 conditions for the control variables), the coefficients of WDIF_X-EFF are negative 23 times, 4 of which are statistically significant. None of the 7 positive coefficients are significant. Similarly, the coefficients of OVERLAP are negative in 18 of 30 cases, with 1 significant negative coefficient and no significant positives.²⁴ We also note that the R^2 s are quite low when only WDIF_X-EFF and OVERLAP are specified, usually under 10 percent, suggesting that the underlying theories do not provide powerful explanations of the post-merger performance of the large consolidations of the 1980s.

Table 3 tests for the possibility that the relationships exist, but are nonlinear. It might reasonably be expected that ex post efficiency increases occur only when WDIF_X-EFF or OVERLAP are above some critical level. For example, it may be the case that the consolidated bank moves toward the efficiency rank of the acquirer only when the acquirer is more efficient than the acquired, or only when it is in the top quartile. To test this, the regressions in Table 3 replace WDIF_X-EFF with dummy variables that equal 1 when WDIF_X-EFF is positive [WDIF_X-EFF(+)] and when it is in the top quartile [WDIF_X-EFF(Q1)]. OVERLAP is also replaced by OVERLAP(+) and OVERLAP(Q1). The results again run contrary to the theories. The only seemingly positive result is that the coefficient of WDIF_X-EFF(+) is often positive and significant. However, in each such case, the coefficient of WDIF_X-EFF(Q1) is negative and significant and of about the same magnitude. Thus, although there appear to be some merger gains when acquiring banks are slightly more efficient than acquired banks, this does not hold when acquiring banks are much more efficient. Any reasonable form of the relative efficiency hypothesis would require that it also hold for the highest levels of WDIF_X-EFF.

24. Our OVERLAP results are consistent with those of Srinivasin and Wall (1992) and Srinivasin (1992), who found that mergers with greater market overlap had either higher or insignificantly lower costs than other mergers.

Finally, Table 4 shows the results of the regressions specified in equation (4) above, where the ex post performance improvement variables are regressed on the weighted difference in the same performance measure ex ante. By construction, the X-EFF_IMP column of Tables 2 and 4 are identical. Again, most of the key coefficients are negative and the only statistically significant ones are negative.

The data discussed here overwhelmingly suggest that the megamergers of the 1980s did not bring about significant cost efficiency benefits on average, and that neither of the key hypotheses about ex ante efficiency differences or market overlap explain the ex post performance from these megamergers. These results are quite robust against a number of changes in specification, including the use of 5 different measures of ex post and ex ante performance, measuring performance by rank or numerical deviations from the mean, specifying the ex ante conditions as continuous variables or dummies, excluding different numbers of years after mergers for transition costs to subside, estimating the models with the key ex ante variables for either one or both of the hypotheses, estimating the model with and without additional control variables, and subdividing the data into early and late time intervals.

VII. Conclusions

The banking industry appears to be in the process of consolidation, particularly through mergers of large banks, and this trend may accelerate if the remaining prohibitions on interstate banking are removed in the future. While this consolidation may raise antitrust concerns, such concerns would be eased if the likelihood of significant cost efficiency gains could be cited in advance. Our purpose in this study has been to evaluate the use of such an antitrust defense by examining the ex ante potential for efficiency gains and the ex post actual gains using the experience of the megamergers of the 1980s.

The data suggest that there are substantial potential cost efficiency gains from megamergers that dominate the minor anticompetitive effects that appear to be associated with most bank mergers. Prior studies of bank efficiency found average inefficiency to be 20 percent or higher, primarily due to X-inefficiencies, or difficulties in managerial cost control.

This suggests a considerable potential for cost improvements from mergers, provided that relatively efficient banks acquire relatively inefficient banks and restructure them so that the efficiency of the consolidated bank approaches that of the acquiring bank. We find here that most of the megamergers of the 1980s did satisfy this *ex ante* condition -- in 55 to 72 percent of the cases, the efficiency of the acquiring bank exceeded that of the acquired bank.

Moreover, it has been speculated that within-market mergers, or mergers in which there is substantial deposit market overlap, offer additional possibilities for cost savings by consolidating redundant back-office operations or branches into the more efficient units. Again, the *ex ante* conditions were usually right for such gains -- more than 70 percent of the megamergers had some deposit market overlap and the average overlap for all the megamergers was between 33 and 47 percent.

Despite this substantial potential, we found that megamergers were not very successful on average in improving cost efficiency. The average X-efficiency improvement was less than 5 percentage points and was not statistically significant. Moreover, the scale diseconomies created by the megamergers were more than large enough to offset the slight X-efficiency gains, so that total cost efficiency actually declined slightly. Although many mergers were quite successful in improving efficiency, many others resulted in worsened efficiencies, so that there were no significant merger benefits on average. This result was robust across a number of methods of measuring the *ex post* performance of consolidated banks, suggesting the policy conclusion that cost efficiency cannot be used as a credible general antitrust defense each time that two large banks merge.

The finding that there appear to be no cost efficiency benefits on average from megamergers is generally either consistent with the previous academic merger literature or a plausible reason for the inconsistency can be identified. Ours is the first merger study to use direct measures of efficiency derived from a cost frontier model. Previous studies generally used simple financial ratios, such as operating costs divided by assets, that do not separately account for X-efficiency, scale, product mix, and input price effects. It is shown that the use of such ratios is problematic for a number of reasons, including the bias created by leaving out

interest expenses which often represent operating expenses incurred elsewhere. Nevertheless, most of these studies agree with our result of no significant average efficiency benefits from mergers, and we also find no such benefits when we use these simple ratios in place of the efficiency measures. One of the two academic studies that did find net merger benefits also found these benefits to disappear when a measure incorporating interest expenses was used. The other study primarily used small banks, whose merger benefits may not apply to megamergers.

Our findings that suggest no significant average megamerger benefits seem to contrast sharply with the those of banking consultants, who claim that merger benefits are substantial. However, consultants often tend to focus on potential, rather than actual savings; on bank operations where savings are most likely to occur, rather than on all operations; and on the most successful mergers, rather than on mergers overall. In contrast, we focus on actual efficiency changes pursuant to mergers, not potential; on the whole bank, not just parts of it; and on the overall effect of mergers, not just the successful ones. It is this overall effect of mergers which relates most closely to public policy concerns.

Moreover, it also is quite possible that our results are *not* substantially different from the consultant claims -- the biggest difference between our results and theirs may lie in how the results are presented. As demonstrated in Section III.B above, when the often-claimed benefit of about 30 percent savings of the acquired bank's operating costs is dissected, it does not necessarily give a dissonant result from ours. This 30 percent amounts to only roughly 3 percent of the consolidated bank's total (operating plus interest) expenses. This may even translate into an *increase* in costs per dollar of assets if the consolidated bank shrinks sufficiently after the merger. Thus, the conflict between our results and those of consultants is considerably smaller than it at first appears.

Our final result concerns the linking of ex post performance benefits to the two ex ante conditions identified as being likely to result in merger benefits -- a large difference in efficiency between the acquiring and acquired banks and a large degree of deposit market overlap prior to the merger. We find that ex post cost efficiency gains are not significantly

positively associated with these conditions, contrary to the two main hypotheses tested. These results suggest the policy conclusion that cost efficiency cannot be used as a credible antitrust defense based upon simple rules related to the relative *ex ante* efficiencies of the merging banks and/or their degree of market overlap. Note that this does not entirely exclude the cost efficiency defense, given that many mergers were successful in reducing costs. Rather, it suggests that some other basis for the defense would need to be found. That is, it would have to be based on some other *ex ante* conditions which can be *logically* linked to *ex post* performance, and which are also *empirically* linked to that performance in past mergers.

We conclude the paper with one final caveat. It is possible and perhaps even likely that the megamergers of the 1990s may be more successful in reducing costs than those of the 1980s. This is because the business climate and attitudes toward cost-cutting appear to have changed over time. In the past, merger participants may well have placed more emphasis on asset growth and geographic market extension than cost efficiency. It was sometimes believed that scale economies would result in savings without significant effort. Recently, however, attitudes appear to have changed because of profitability pressures in the banking industry. Merger participants in the 1990s appear to be more focused on cutting costs through mergers -- for example, they often announce goals for employee layoffs, branch closings, and total cost savings in advance of the mergers. An additional change in the 1990s is that more of the mergers are between very large banks of relatively equal size. It is difficult to determine the effect of this change, given that there are so few examples of this from which to generalize. Thus, it is possible that some of our results, particularly the finding of no significant cost efficiency benefits on average from megamergers in the 1980s, may change in the 1990s.

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Table 1

DESCRIPTIONS, MEANS, AND RANGES OF VARIABLES

		<u>Data Set 1</u> Excludes 1 year	<u>Data Set 2</u> Excludes 2 years	<u>Data Set 3</u> Excludes 3 years
		Sample Mean (Range)	Sample Mean (Range)	Sample Mean (Range)
A. EX POST PERFORMANCE IMPROVEMENT VARIABLES				
X-EFF_IMP	Improvement in the X-efficiency rank of the consolidated bank over the weighted sum of the merging banks.	.0466 (-.4885, .7995)	.0431 (-.7139, .8288)	.0192 (-.6021, .8408)
T-EFF_IMP	Improvement in the total efficiency rank of the consolidated bank over the weighted sum of the merging banks. Includes scale effects.	-.0248 (-.5959, .4840)	-.0820* (-.6053, .5229)	-.1133* (-.6149, .5934)
ROA_IMP	Improvement in the return-on-assets rank of the consolidated bank over the weighted sum of the merging banks. Includes revenue effects.	-.0323 (-.7114, .5880)	-.0288 (-.5907, .7873)	-.0016 (-.5207, .8216)
ATC_IMP	Improvement in the (operating plus interest expense)/assets rank of the consolidated bank over the weighted sum of the merging banks.	-.0470 (-.6611, .6543)	-.0615 (-.5481, .5710)	-.0485 (-.3471, .4696)
AOC_IMP	Improvement in the operating expense/assets rank of the consolidated bank over the weighted sum of the merging banks.	-.0748** (-.6663, .6162)	-.0950** (-.6639, .2066)	-.1434** (-.6708, .2575)
NUMBER OF OBSERVATIONS		57	34	20

* (**) Mean is significantly different from zero at the 10 (5) percent significance level, two-sided.

Table 1 (continued)

		Data Set 1	Data Set 2	Data Set 3
		Sample Mean (Range)	Sample Mean (Range)	Sample Mean (Range)
B. KEY EX ANTE CONDITION VARIABLES				
WDIF_X-EFF	Weighted difference in the X-efficiency rank of the acquiring bank and the acquired bank. Weight is the relative size of the acquired bank.	.1903 (-.3373, .7220)	.1347 (-.5960, .6150)	.0925 (-.4250, .6147)
WDIF_X-EFF(+)	Dummy, equals 1 if WDIF_X-EFF > 0.	.7193	.6471	.5500
WDIF_X-EFF(Q1)	Dummy, equals 1 if WDIF_X-EFF is in top quartile.	.2456 ^a	.2353 ^a	.2500
OVERLAP	Proportion of the deposits of the merging banks that are in the same local markets (MSAs or non-MSA counties).	.3392 (0, .9889)	.4055 (0, .9889)	.4650 (0, .9889)
OVERLAP(+)	Dummy, equals 1 if OVERLAP > 0.	.7018	.7059	.7500
OVERLAP(Q1)	Dummy, equals 1 if OVERLAP is in top quartile.	.2456 ^a	.2353 ^a	.2500
WDIF_T-EFF	Weighted difference in the T-EFF rank of the acquiring and acquired banks (as in WDIF_X-EFF).	.1880 (-.2580, .7272)	.1631 (-.5197, .6590)	.1409 (-.3765, .6590)
WDIF_ROA	Weighted difference in the ROA rank of the acquiring and acquired banks (as in WDIF_X-EFF).	.2318 (-.4729, .9034)	.1942 (-.4481, .7259)	.2156 (-.4481, .7259)
WDIF_ATC	Weighted difference in the ATC rank of the acquiring and acquired banks (as in WDIF_X-EFF).	.2307 (-.3752, .8043)	.1719 (-.4616, .7395)	.1406 (-.4616, .7395)
WDIF_AOC	Weighted difference in the AOC rank of the acquiring and acquired banks (as in WDIF_X-EFF).	.2372 (-.2375, .7250)	.2128 (-.1435, .7250)	.2483 (-.0597, .7250)

^aThe quartiles do not have exactly 25 percent of the observations when the sample size is not divisible by 4.

Table 1 (continued)

		<u>Data Set 1</u>	<u>Data Set 2</u>	<u>Data Set 3</u>
		Sample Mean (Range)	Sample Mean (Range)	Sample Mean (Range)
C. OTHER EX ANTE CONTROL VARIABLES				
RETAIL	Proportion of the assets of the merging banks that are funded by deposits.	.6894 (.3600, .9331)	.6686 (.3600, .8902)	.6429 (.3600, .8332)
SCALE	Scale of merging banks, expressed in terms of scale efficiency. Equals the scale efficiency ratio S-EFF for banks below efficient scale and (2 - S-EFF) otherwise.	1.1394 (.9863, 1.4348)	1.1551 (1.0333, 1.4127)	1.1539 (1.0333, 1.4127)
HERF	Weighted average of the Herfindahl index of concentration in the affected local markets.	.1850 (.0800, .3628)	.1832 (.0800, .2727)	.1807 (.0800, .2727)
SHARE	Weighted average of the local market shares of the merging banks.	.2068 (.0587, .4474)	.2112 (.0587, .4017)	.2151 (.1311, .4017)

Table 2

REGRESSIONS OF EX POST PERFORMANCE IMPROVEMENTS ON EX ANTE CONDITIONS FOR MEGAMERGERS

	X-EFF_IMP		T-EFF_IMP		ROA_IMP		ATC_IMP		AOC_IMP	
Variable	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat
<u>Data Set 1 -- Excluding Year of Merger (57 Observations)</u>										
CONSTANT	.148**	2.75	.009	0.16	-.037	-0.65	-.013	-0.21	-.108**	-2.18
WDIF X-EFF	-.212	-1.66	.024	0.18	-.005	-0.04	-.107	-0.72	-.051	0.41
OVERLAP	-.180*	-1.86	-.114	-1.11	.017	0.16	-.039	-0.35	.069	0.78
R-squared	.098		.023		.001		.011		.014	
CONSTANT	.408	0.77	-1.229**	-2.14	.064	0.11	.657	1.02	-.280	-0.66
WDIF X-EFF	-.133	-1.03	.043	0.31	-.032	-0.22	-.115	-0.74	-.018	-0.17
OVERLAP	-.056	-0.50	-.019	-0.16	-.032	-0.25	-.088	-0.65	-.039	-0.43
RETAIL	.041	0.15	.534*	1.76	-.081	-0.25	.208	0.61	.898**	4.00
SCALE	-.503	-1.34	.543	1.34	.068	0.16	-.619	-1.36	-.200	-0.67
HERF	-.196	-0.20	-.319	-0.30	-.063	-0.06	.281	0.24	-.017	-0.02
SHARE	1.274*	1.85	1.328*	1.80	-.430	-0.55	-.684	-0.82	-.804	-1.47
R-squared	.227		.150		.015		.083		.373	
<u>Data Set 2 -- Excluding Year of and Year Following Merger (34 Observations)</u>										
CONSTANT	.176**	2.18	-.015	-0.21	-.072	-0.92	-.008	-0.12	-.122**	-2.21
WDIF X-EFF	-.386**	-2.09	-.231	-1.40	-.040	-0.23	-.307*	-1.94	-.017	-0.14
OVERLAP	-.199	-1.33	-.088	-0.65	.120	0.83	-.030	-0.23	.073	0.71
R-squared	.186		.080		.022		.115		.016	
CONSTANT	1.838**	2.12	-.131	-0.16	.715	0.82	1.004	1.33	-.280	-0.60
WDIF X-EFF	-.416**	-2.27	-.256	-1.46	-.032	-0.18	-.317*	-1.98	-.077	-0.77
OVERLAP	-.135	-0.72	-.118	-0.65	.183	0.97	-.047	-0.28	-.107	-1.04
RETAIL	-.328	-0.68	.536	1.15	-.559	-1.15	-.542	-1.28	.778**	2.95
SCALE	-1.384**	-2.14	-.030	-0.05	-.619	-0.95	-.645	-1.14	.026	0.08
HERF	.759	0.37	-2.622	-1.34	3.211	1.57	2.545	1.43	-.434	-0.39
SHARE	-.020	-0.02	1.363	1.23	-1.481	-1.28	-1.720	-1.70	-1.101*	-1.75
R-squared	.341		.147		.158		.256		.500	
<u>Data Set 3 -- Excluding Year of and Two Years Following Merger (20 Observations)</u>										
CONSTANT	.057	0.44	-.039	-0.36	-.050	-0.40	-.111	-1.33	-.185	-1.80
WDIF X-EFF	-.030	-0.11	-.315	-1.38	.199	0.76	.043	0.24	-.067	-0.31
OVERLAP	-.075	-0.35	-.097	-0.54	.064	0.31	.127	0.92	.103	0.61
R-squared	.007		.107		.035		.048		.030	
CONSTANT	-.870	-0.61	-2.306*	-2.15	-.364	-0.26	-.245	-0.24	.143	0.18
WDIF X-EFF	.130	0.42	-.120	-0.52	.260	0.87	.065	0.30	-.219	-1.26
OVERLAP	.315	1.04	.079	0.35	.293	0.99	.181	0.84	-.198	-1.15
RETAIL	-.486	-0.55	.858	1.29	-.820	-0.95	-.575	-0.91	1.289**	2.56
SCALE	.204	0.18	1.262	1.52	.100	0.09	.266	0.33	-.420	-0.67
HERF	3.482	1.01	-2.201	-0.85	5.719	1.71	2.728	1.12	-1.847	-0.95
SHARE	.832	0.45	2.588*	1.85	-1.949	-1.07	-1.506	-1.14	-.859	-0.81
R-squared	.260		.463		.263		.148		.631	

* (**) Significantly different from zero at the 10 (5) percent significance level, two-sided.

Table 3

REGRESSIONS USING DUMMY VARIABLES FOR EX ANTE EFFICIENCY AND MARKET OVERLAP

	X-EFF_IMP		T-EFF_IMP		ROA_IMP		ATC_IMP		AOC_IMP	
Variable	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat
<u>Data Set 1 -- Excluding Year of Merger (57 Observations)</u>										
CONSTANT	.117	1.49	-.041	-0.51	-.057	-0.66	-.045	-0.50	-.233**	-3.48
WDIF_X-EFF (+)	.125	1.52	.196**	2.33	.089	1.00	.181*	1.95	.129*	1.85
WDIF_X-EFF (Q1)	-.174**	-2.10	-.196**	-2.29	-.063	-0.69	-.164*	-1.73	-.150**	-2.11
OVERLAP (+)	-.142*	-1.77	-.103	-1.25	-.039	-0.45	-.157*	-1.72	-.157**	-2.40
OVERLAP (Q1)	-.072	-0.85	-.018	-0.20	.011	0.11	.073	0.75	.164	0.69
R-squared	.161		.151		.023		.115		.215	
CONSTANT	.344	0.65	-1.374**	-2.53	.074	0.12	.719	1.16	-.474	-1.14
WDIF_X-EFF (+)	.139*	1.75	.218**	2.67	.087	0.93	.148	1.58	.094	1.50
WDIF_X-EFF (Q1)	-.136	-1.61	-.198**	-2.30	-.091	-0.92	-.127	-1.28	-.127*	-1.93
OVERLAP (+)	-.094	-1.09	-.074	-0.85	-.056	-0.56	-.241**	-2.40	.053	0.79
OVERLAP (Q1)	.007	0.08	.036	0.39	-.038	-0.36	.084	0.79	-.044	-0.62
RETAIL	.020	0.07	.514*	1.75	-.096	-0.29	.336	0.99	.776**	3.44
SCALE	-.467	-1.24	.660*	1.71	.099	0.23	-.697	-1.58	-.045	-0.15
HERF	-.315	-0.33	-.729	-0.75	-.275	-0.25	.080	0.07	-.092	-0.12
SHARE	1.337*	1.94	1.514**	2.15	-.455	-0.57	-.698	-0.86	-.632	-1.17
R-squared	.283		.287		.048		.200		.437	
<u>Data Set 2 -- Excluding Year of and Year Following Merger (34 Observations)</u>										
CONSTANT	.222*	1.96	-.019	-0.18	-.161*	-1.81	.088	0.91	-.203**	-3.17
WDIF_X-EFF (+)	.056	0.44	.021	0.19	.307**	3.14	-.116	-1.08	-.032	-0.46
WDIF_X-EFF (Q1)	-.195	-1.41	-.152	-1.24	-.374**	-3.48	-.069	-0.59	-.048	-0.62
OVERLAP (+)	-.247*	-1.92	-.035	-0.30	-.004	-0.04	-.081	-0.74	.256**	3.53
OVERLAP (Q1)	.020	0.15	-.072	-0.60	.101	0.95	-.004	-0.04	-.172**	-2.26
R-squared	.175		.076		.366		.112		.328	
CONSTANT	1.666*	1.82	-.219	-0.26	.914	1.28	1.020	1.33	-.318	-0.71
WDIF_X-EFF (+)	.029	0.23	.043	0.36	.289**	2.90	-.147	-1.37	-.037	-0.59
WDIF_X-EFF (Q1)	-.196	-1.39	-.179	-1.37	-.367**	-3.33	-.049	-0.41	-.053	-0.77
OVERLAP (+)	-.194	-1.19	-.055	-0.36	.020	0.16	-.100	-0.72	.088	1.09
OVERLAP (Q1)	.024	0.16	-.065	-0.46	.070	0.59	-.016	-0.13	-.140*	-1.90
RETAIL	-.186	-0.33	.497	0.94	-.488	-1.10	-.460	-0.96	.565*	2.02
SCALE	-1.279*	-1.86	.038	0.06	-.716	-1.33	-.610	-1.05	.068	0.20
HERF	.798	0.37	-2.608	-1.29	1.743	1.02	2.862	1.56	-.073	-0.07
SHARE	-.038	-0.03	1.454	1.25	-1.137	-1.16	-1.958*	-1.86	-1.006*	-1.63
R-squared	.299		.145		.456		.268		.563	
<u>Data Set 3 -- Excluding Year of and Two Years Following Merger (20 Observations)</u>										
CONSTANT	-.041	-0.31	-.016	-0.11	-.201	-1.50	-.174	-1.74	-.335**	-2.76
WDIF_X-EFF (+)	.430**	3.18	.081	0.53	.465**	3.40	.241**	2.37	.018	0.14
WDIF_X-EFF (Q1)	-.422**	-2.74	-.271	-1.55	-.359**	-2.31	-.241*	-2.08	-.109	-0.77
OVERLAP (+)	-.178	-1.28	-.114	-0.72	-.027	-0.19	.020	0.19	.348**	2.75
OVERLAP (Q1)	.251*	1.79	.046	0.29	.215	1.52	.153	1.44	-.211	-1.65
R-squared	.505		.182		.469		.355		.361	
CONSTANT	-.523	-0.44	-2.368**	-2.41	.459	0.40	.222	0.26	-.020	-0.24
WDIF_X-EFF (+)	.394**	2.29	.188	1.31	.391**	2.32	.263*	2.13	.030	0.24
WDIF_X-EFF (Q1)	-.353*	-1.85	-.282	-1.77	-.338*	-1.80	-.297*	-2.16	-.165	-1.21
OVERLAP (+)	-.063	-0.27	-.037	-0.19	-.182	-0.81	-.097	-0.58	.033	0.20
OVERLAP (Q1)	.275	1.54	.124	0.83	.261	1.49	.142	1.11	-.122	-0.96
RETAIL	.075	0.09	1.047	1.57	-.065	-0.08	-.146	-0.25	1.035	1.81
SCALE	.041	0.04	1.378*	1.81	-.405	-0.45	.030	0.05	-.122	-0.19
HERF	.293	0.10	-3.369	-1.39	2.038	0.71	.322	0.15	-1.378	-0.66
SHARE	1.138	0.70	2.625	1.93	-1.765	-1.10	-1.407	-1.20	-.860	-0.74
R-squared	.555		.601		.549		.474		.647	

* (**) Significantly different from zero at the 10 (5) percent significance level, two-sided.

Table 4

REGRESSIONS OF EX POST PERFORMANCE IMPROVEMENTS ON OWN EX ANTE CONDITIONS

	X-EFF_IMP		T-EFF_IMP		ROA_IMP		ATC_IMP		AOC_IMP	
Variable	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat
<u>Data Set 1 -- Excluding Year of Merger (57 Observations)</u>										
CONSTANT	.148**	2.75	.044	0.75	-.027	-0.42	.022	0.38	.007	0.13
WDIF_PERF	-.212	-1.66	-.148	-0.95	-.041	-0.29	-.220	-1.51	-.377**	-3.01
OVERLAP	-.180*	-1.86	-.122	-1.19	.012	0.12	-.053	-0.48	.023	0.27
R-squared	.098		.039		.002		.042		.153	
CONSTANT	.408	0.77	-1.111*	-1.88	.070	0.11	.730	1.15	-.156	-0.37
WDIF_PERF	-.133	-1.03	-.103	-0.65	-.038	-0.25	-.231	-1.55	-.188	-1.55
OVERLAP	-.056	-0.50	-.042	-0.35	-.032	-0.25	-.095	-0.72	-.041	-0.48
RETAIL	.041	0.15	.562*	1.86	-.081	-0.25	.255	0.76	.821**	3.67
SCALE	-.503	-1.34	.489	1.19	.058	0.14	-.688	-1.54	-.250	-0.85
HERF	-.196	-0.20	-.539	-0.50	-.022	-0.02	.039	0.03	-.130	-0.17
SHARE	1.274*	1.85	1.328*	1.80	-.428	-0.55	-.433	-0.52	-.567	-1.02
R-squared	.227		.155		.015		.115		.402	
<u>Data Set 2 -- Excluding Year of and Year Following Merger (34 Observations)</u>										
CONSTANT	.176**	2.18	-.010	-0.13	-.086	-1.02	-.011	-0.15	-.009	-0.19
WDIF_PERF	-.386**	-2.09	-.209	-1.14	.064	0.30	-.167	-0.97	-.544**	-4.49
OVERLAP	-.199	-1.33	-.094	-0.70	.111	0.77	-.053	-0.40	.073	0.93
R-squared	.186		.062		.023		.037		.403	
CONSTANT	1.838**	2.12	-.073	-0.09	.695	0.76	.895	1.09	-.071	-0.16
WDIF_PERF	-.416**	-2.27	-.239	-1.21	-.008	-0.03	-.151	-0.77	-.331**	-2.38
OVERLAP	-.135	-0.72	-.124	-0.68	.184	0.97	-.035	-0.20	-.046	-0.47
RETAIL	-.328	-0.68	.498	1.06	-.567	-1.16	-.556	-1.20	.641**	2.62
SCALE	-1.384**	-2.14	-.051	-0.08	-.608	-0.87	-.618	-0.98	-.128	-0.39
HERF	.759	0.37	-2.636	-1.33	3.260	1.61	2.637	1.35	-.639	-0.63
SHARE	-.020	-0.02	1.369	1.22	-1.481	-1.27	-1.486	-1.33	-.465	-0.73
R-squared	.341		.127		.157		.168		.577	
<u>Data Set 3 -- Excluding Year of and Two Years Following Merger (20 Observations)</u>										
CONSTANT	.057	0.44	-.027	-0.23	-.007	-0.05	-.112	-1.34	.012	0.17
WDIF_PERF	-.030	-0.11	-.278	-1.21	-.069	-0.23	.050	0.28	-.827**	-5.23
OVERLAP	-.075	-0.35	-.102	-0.56	.044	0.22	.122	0.89	.107	1.02
R-squared	.007		.086		.006		.049		.626	
CONSTANT	-.870	-0.61	-2.321**	-2.16	1.313	0.75	-.507	-0.52	.161	0.25
WDIF_PERF	.130	0.42	-.111	-0.49	-.404	-0.88	.212	0.89	-.661**	-2.61
OVERLAP	.315	1.04	.079	0.34	.116	0.40	.188	0.95	.001	0.01
RETAIL	-.486	-0.55	.851	1.28	-.269	-0.28	-.827	-1.21	.931*	2.15
SCALE	.204	0.18	1.283	1.56	-1.273	-0.86	.581	0.70	-.458	-0.90
HERF	3.482	1.01	-2.249	-0.86	3.617	1.01	3.636	1.39	-2.075	-1.26
SHARE	.832	0.45	2.627*	1.87	-1.366	-0.71	-2.109	-1.44	.761	0.69
R-squared	.260		.462		.264		.191		.728	

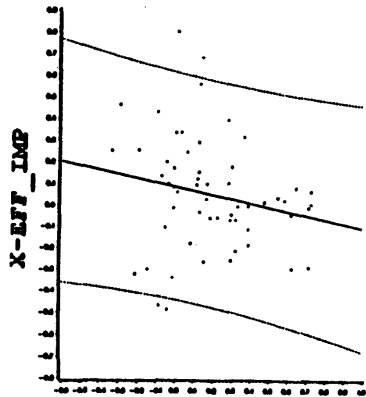
* (**) Significantly different from zero at the 10 (5) percent significance level, two-sided.

Figure 3

EX POST PERFORMANCE IMPROVEMENTS VS. EX ANTE WEIGHTED DIFFERENCE IN OWN PERFORMANCE

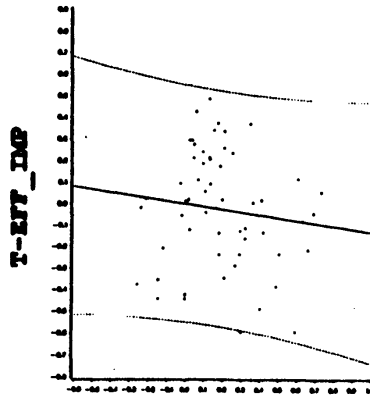
Data Set 1 -- Excluding Year of Merger (57 Observations)

(a)



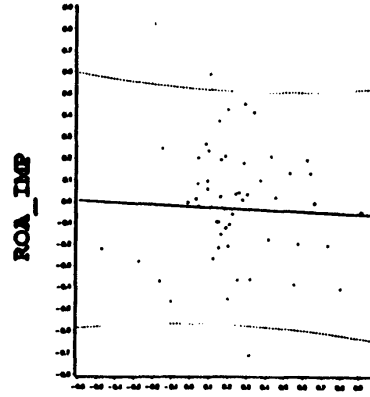
WDIF_X-EFF

(b)



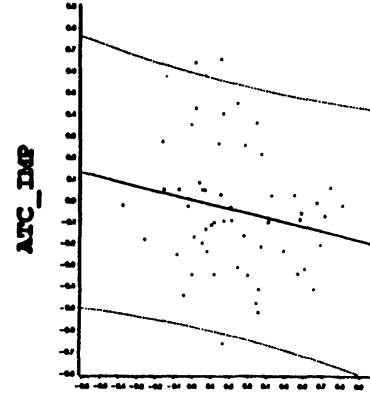
WDIF_T-EFF

(c)



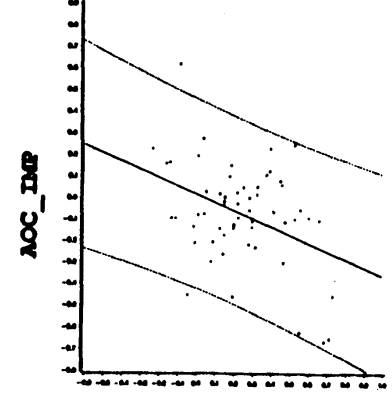
WDIF_ROA

(d)



WDIF_ATC

(e)



WDIF_AOC

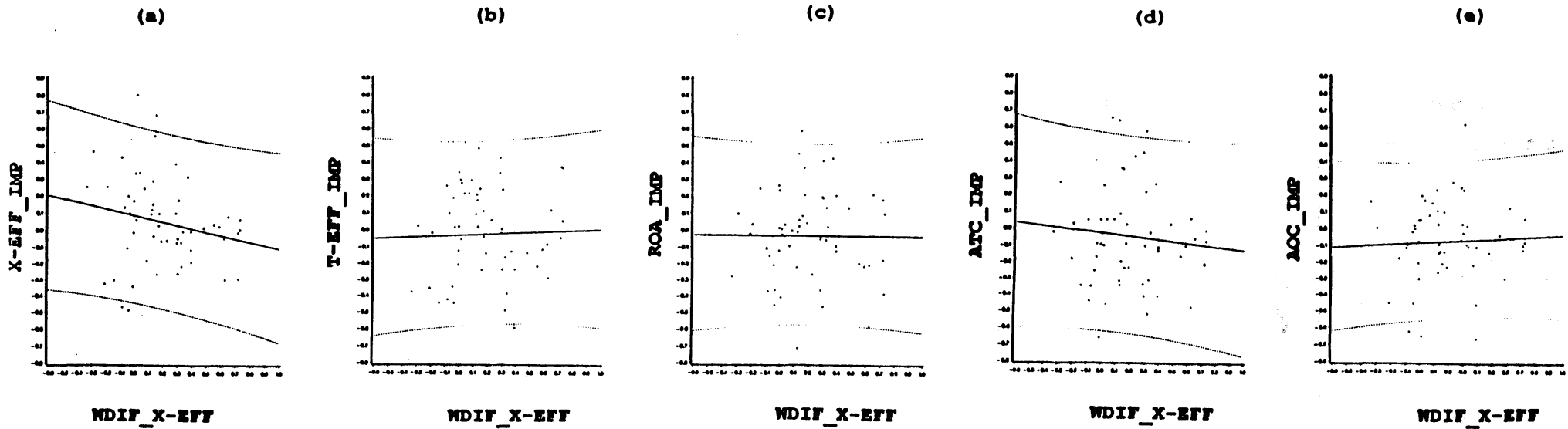
— bivariate regression line

— 95 percent confidence interval boundaries

Figure 1

EX POST PERFORMANCE IMPROVEMENTS VS. EX ANTE WEIGHTED DIFFERENCE IN X-EFFICIENCIES

Data Set 1 -- Excluding Year of Merger (57 Observations)



— bivariate regression line

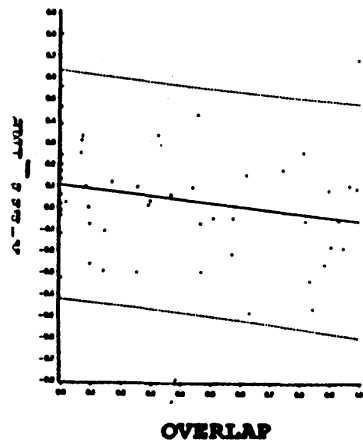
— 95 percent confidence interval boundaries

Figure 2

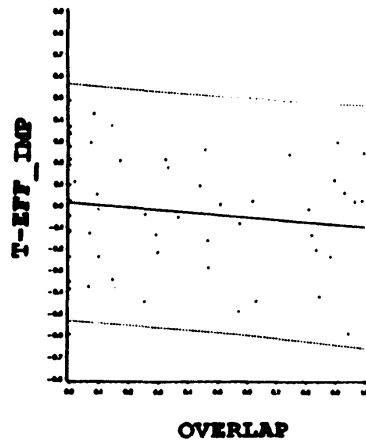
EX POST PERFORMANCE IMPROVEMENTS VS. MARKET OVERLAP

Data Set 1 -- Excluding Year of Merger (57 Observations)

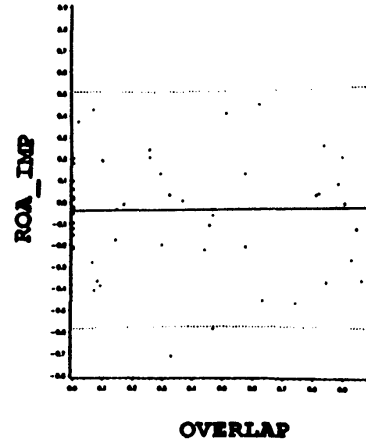
(a)



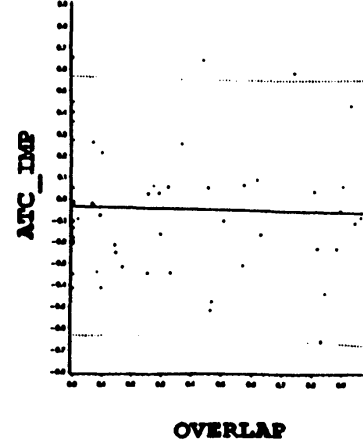
(b)



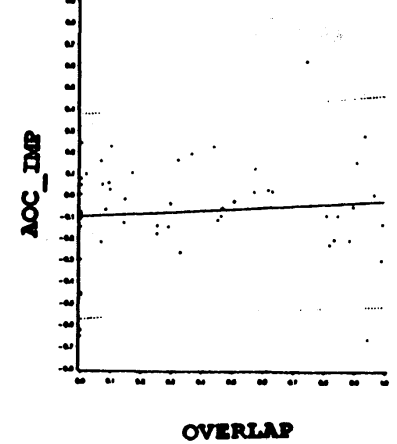
(c)



(d)



(e)



— bivariate regression line

— 95 percent confidence interval boundaries