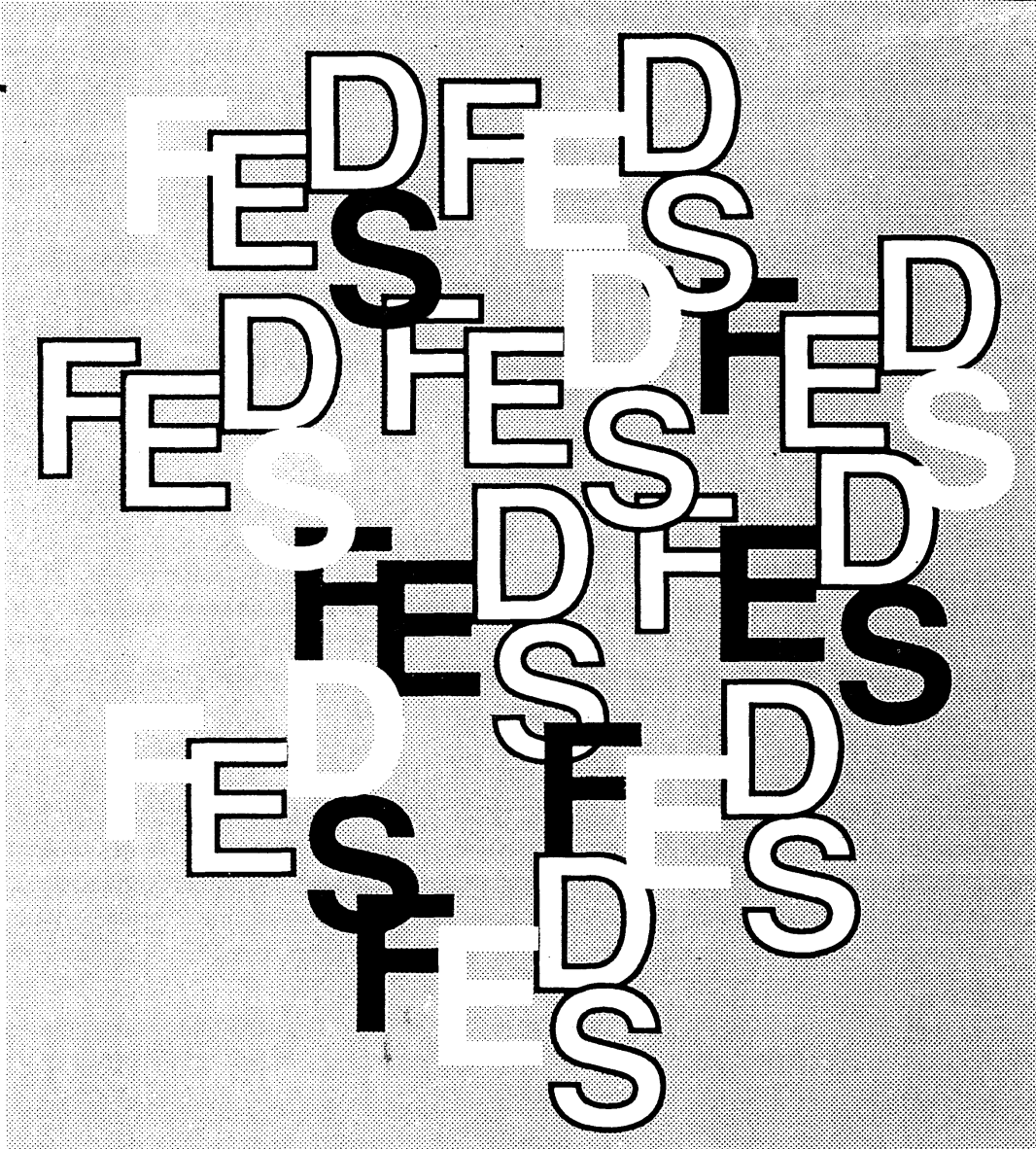
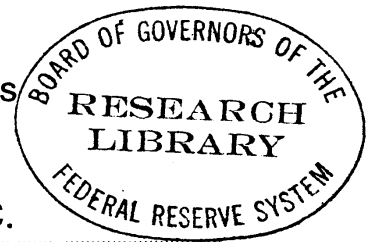


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**BANK SCALE ECONOMIES, MERGERS, CONCENTRATION, AND
EFFICIENCY: THE U.S. EXPERIENCE**

Allen N. Berger and David B. Humphrey

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Abstract

This paper summarizes research on U.S. bank cost and profit functions, and their policy implications. The purpose is to provide a backdrop for the likely implications of European financial integration. Scale and scope economies in banking are not found to be important, except for the smallest banks. X-efficiency, or managerial ability to control costs, is of much greater magnitude -- at least 20% of banking costs. Mergers have no significant predictable effect on efficiency -- some mergers raise efficiency and others lower it. Market concentration results in slightly less favorable prices for customers, but has little effect on profitability.

I. Introduction

Banks in Europe are now poised for a major expansion across international borders. The rise in competition for national and international market shares associated with this expansion is expected to result in a substantial consolidation of the European banking industry. The effects of these developments are likely to parallel the recent experience of the U.S. banking industry, which has recently undergone a similar transformation. Bank expansion across international borders in Europe in the 1990s is likely to be similar in many ways to the expansion across interstate borders in the U.S. in the 1980s. Therefore, it may be expected that the U.S. expansion's effects on banking costs, the potential for and realization of efficiency gains, and its implications for structure-conduct-performance relationships may prove to be a useful model for forecasting the changes that may sweep European banking.

Although legal structure and customs vary between U.S. and European banking, primarily with regard to antitrust regulation and the use of different payments instruments (GIROs versus checks), the production function associated with the primary activities of banks is relatively constant across developed nations. Banks provide safekeeping, liquidity, and payment services for depositors, and perform credit analysis, disburse loanable funds, and monitor outstanding credits for borrowers using very similar technologies. In fact, cost and production studies of banks in individual European countries generally arrive at similar conclusions about the scale and scope economies and efficiencies as studies of U.S. banks. Therefore, the effects on costs, competition, and efficiency from the recent bank consolidation movement in the U.S. should prove to be a useful guide to the likely effects of a similar consolidation of European banking. Toward this end, we provide a relatively comprehensive summary of the academic literature on scale and scope economies and efficiency in the U.S. industry. We also provide analyses of the literatures on bank mergers and the effects of market structure on performance to complete the analysis and frame it in industrial organization terms.

There have been numerous econometric studies of bank scale and scope economies, efficiency, mergers, and market structure and performance in U.S. banking. In as few words as possible, the academic studies have come to the following conclusions:

- **Scale Economies:** For the very smallest banks, there are scale economies that allow average costs to fall with increases in bank size. These scale effects generally account for less than 5% of costs. For the largest banks, constant average costs or slight diseconomies of scale prevail. Average revenues increase slightly with bank size (1% to 4%), but these scale benefits are also confined to smaller banks.
- **Scope Economies:** There are at most relatively minor scope economies that reduce costs by 5% or less when multiple products are produced jointly. Revenues appear to be unaffected by product mix.
- **X-Efficiency:** Managerial ability to control costs is much more important than scale and scope economies. The consensus is that on average, banks may have costs about 20% higher than the industry minimum for the same scale and product mix.
- **Mergers:** On average, mergers have had no significant, predictable effect on costs and efficiency. Some mergers have reduced costs, but others have raised costs. The efficiency benefits from mergers are not strongly related to the degree of deposit market overlap or the difference in efficiency between the acquiring and acquired banks.
- **Market Structure and Bank Performance:** Greater local market concentration results in slightly lower deposit rates for small borrowers and slightly higher loan rates for small borrowers. Thus, within-market mergers may reduce competition and create social costs, but cross-market mergers may create social benefits by increasing competition. Differences in local market concentration, however, have virtually no effect on bank profitability.

On the surface, these academic results appear to conflict substantially with the analyses of U.S. banking consultants, who claim large efficiency gains from mergers and increases in bank scale. However, as shown below, both sets of results are quite similar once they are placed in a comparable framework. Consequently, the summary of the U.S. experience given above is essentially supported by both numerous academic econometric studies using large samples of U.S. banks at various points in time and by the more detailed, practical, and focused consultant studies of many individual U.S. banks and mergers.

The implications of the U.S. experience for Europe are that cross-border mergers and acquisitions by banks in Europe are not likely to lower costs by any significant amount. What cost improvements there are will most likely be generated by improvements in X-efficiency, or better management of resources, rather than through improved scale or scope economies. To

the degree that cross-border expansions increase local market competition, they may also yield the social benefit of slightly more favorable prices for the consumers of financial services. More detailed implications are given in the concluding section.

II. The Changing Distribution of Banking Institution Sizes in the U.S.

In contrast with most other countries, the U.S. has retained a highly disaggregated banking system. There are 11,416 commercial banks in the U.S. as of December 31, 1992, the vast majority of which are quite small, with less than \$100 million in assets. Even the largest U.S. banks are often smaller than their global competitors -- typically no U.S. bank makes the list of the top 20 banks in the world.

The reason for this disaggregated structure has been Federal and state laws that limited the ability of banks to branch or acquire other banks, both within and across state lines. Banks have gotten around these restrictions somewhat by expanding through the multi-bank holding company (MBHC) form, which is sometimes permitted where branching is prohibited.¹ Importantly, all interstate expansions must take place through the MBHC form. Even after aggregating the legally separate banks within an MBHC, the U.S. industry is still very unconsolidated by world standards. After pooling together all the banks in each highest tier holding company (some holding companies are owned by other holding companies), there were still 8,899 'banking entities' in the U.S. as of December 1992, where a 'banking entity' is defined here as a bank that is not owned by an MBHC, or the highest tier MBHC that owns banks.

As noted above, there has been a considerable trend toward consolidation in the U.S. banking industry in recent years. During the 1980s, many states loosened their restrictions on branching within state lines, so that currently all states allow some form of within-state branching. More important for the analogy to cross-border expansions in Europe, as of October 1993, all but one small state (Hawaii) allow for some form of interstate banking through MBHCs, and this has brought about a considerable merger wave among medium and large U.S. banks. The 11,416 banks and 8,899 banking entities of 1992 stand in sharp contrast to the 14,422 banks and 12,363 banking entities of 1980, reflecting consolidations of 21% and 28%, respectively.

Historically, there are three ways that individual banking entities in the U.S. have expanded. First, they have grown because their local markets have grown, increasing the demand for deposit and loan services. Second, they have grown by *de novo* expansion, establishing branch offices in new market areas. Third, and most important, banking entities have grown by merging with or acquiring other banking entities, either in the same or new market areas. While all three methods of growth have occurred, the most important source of growth in the U.S. has been through mergers and acquisitions. Rhoades (1985a) estimated that as of 1980, 72% of the growth of the top 20 U.S. banking entities was due to mergers. Since that time, the role of mergers in large bank expansion has undoubtedly grown because of the number of interstate holding company acquisitions [e.g., Nation's Bank], and because of the trend toward large within-market mergers [e.g., Chemical/Manufacturers Hanover].

The change in the distribution of bank entity sizes is shown in Table 1. In 1980 (Panel A), the 12,363 entities had a total of just over \$2 trillion in assets measured in constant 1982 dollars, while in 1990 (Panel B), 8,899 entities held over \$2.4 trillion in assets (1982 dollars). Thus, the number of banking entities fell by 28% over the 12 years, while handling about 17% more total assets in real terms. Combining the increase in aggregate assets with the smaller number of entities yields an increase in average banking entity size of 63% [i.e., $1.17/(1-.28) = 1.63$], from \$166 million in average assets in 1980 to \$270 million in 1992 (1982 dollars).

Because of the skewness of the distribution of U.S. banks -- where a relatively small number of large banking entities have much of the total industry assets -- it is more appropriate to compare by size classes. Comparing Panel B for 1992 with Panel A for 1980, it may be seen where the gains and losses occurred. In the two largest size classes (over \$10 billion and \$5 billion to \$10 billion), there are considerable increases in the numbers of entities and the percent of total industry assets. In 1980, there were only 49 entities with over \$5 billion, which accounted for 50.7% of industry assets, while in 1992, there were 75 such entities with 65% of all assets. In the size classes below \$5 billion, there is a reduction in the numbers of banks for almost every size class and a reduction of the percent of total industry assets held by every size class. The biggest reduction occurred in the smallest size class (under \$50 million), which lost

over 3500 members, more than the entire reduction for the industry. Thus, large banks have increased in prominence, while many of the very smallest banks have been lost to mergers, growth into larger size classes, failures, and regulatory closures.

Perhaps a better way to examine the industry consolidation is to control for the effects of the growth of the industry as a whole. After all, a shift from smaller towards larger classes would be observed even if all banks grew uniformly and there was no change in the relative distribution across banks. To control for the effects of growth pushing banks into larger size classes, Panel C shows what the distribution of entities would be if the 17% industry growth were subtracted proportionately from all banks. That is, we remove the tendency for banks to be in larger size classes simply because the industry grew. Statistically, this is the same as increasing the size class bounds by 17%.

Comparing Panel C to Panel A, we see that the industry growth was **not** very important in explaining the size class movements observed in the movement from Panel A to Panel B. The top two size classes gained slightly fewer members once average growth is removed, but they still account for 62.6% of all industry assets. The biggest difference is that the small banks are not decimated when average growth is taken out. They lose about 3,100 members, rather than over 3,500. Nevertheless, the conclusion is clear from Table 1 that the very small banks are disappearing and the very largest banks are increasing in number and average size. With this background, we next examine how bank costs have changed as a result of the industry consolidation.

III. Scale Economies at U.S. Banks

Scale economies for large banks are often claimed by the banking industry, particularly as a justification for bank mergers. In contrast to these claims, large banks generally do not have lower average costs or higher average profits than most other banks. The academic profession has researched this question vigorously and has made substantial progress over the last 30 years.

Early Studies of Bank Scale Economies. The first analyses of how bank costs varied with bank size found slight, but statistically significant scale economies for all banks, regardless of size [e.g., see Benston (1965, 1972), Bell and Murphy (1968)]. The results of these studies suggested that banks that doubled their size, all else held constant, would experience a

reduction in average costs on the order of about 5% to 8%. This result would occur for all banks, regardless of size. Unfortunately, these conclusions were later seen to overstate the true scale economies. This problem had three parts.

First, the Cobb-Douglas cost or production function specified in these early studies is restrictive. It can only show one of three possible outcomes -- decreasing, constant, or increasing average costs for all banks. It cannot show, for example, a U-shaped average cost curve in which small banks have decreasing average costs, medium banks have approximately constant average costs, and large banks have increasing average costs.

Second, the samples used in these early studies were primarily composed of small banks since, as shown in Table 1, the vast majority of U.S. banks are small. Often, the largest banks were excluded because of the data set employed.² Since the top 49 banks had more than half of all industry assets by 1980, the focus on small banks underrepresented the industry. Importantly, because most sample banks were small, the process of fitting a Cobb-Douglas functional form to the data essentially forced the scale economy results of smaller banks to be extended to all institutions. That is, because small banks experience scale economies and all banks were assumed to have the same result, banks of all sizes were found to have scale economies.

Third, early studies often failed to distinguish between scale economies at the level of the average branch office, and scale economies at the level of the banking firm. Holding the number of branch offices constant in a cost equation or production function 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 result was often found in later studies [e.g., Benston, et al. (1982), Berger, et al. (1987), Berger and Humphrey (1991)]. However, the early studies often simply found scale economies at the branch office level and did not compute economies at the level of the bank as a whole, giving misleading results.

Recent Scale Economy Studies. More recent scale economy studies have corrected the three problems with the earlier studies by: 1) using a more flexible functional form (e.g.

translog) that can show a U-shaped average cost curve if one exists in the data; 2) expanding the data samples to include large banks (over \$1 billion in assets), or focusing exclusively on large banks; and 3) determining scale economies at the level of the banking firm, rather than at the level of the average branch office.

The consensus view of the recent scale economies literature 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 the potential for scale efficiency gains and the measured economies are usually relatively small, on the order of 5% or less [see the surveys by Mester (1987), Clark (1988), Humphrey (1990), Berger, Hunter, and Timme (1993)]. 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 in assets usually found that average cost was minimized somewhere between about \$75 million and \$300 million in assets [see Berger, et al. (1987), Ferrier and Lovell (1990), Berger and Humphrey (1991), Bauer, et al. (1993)]. Studies that used only banks with over \$1 billion in assets usually found the minimum average cost point to be between \$2 billion and \$10 billion in assets [see Hunter and Timme (1986), Noulas et al. (1990), Hunter, et al. (1990)]. The difference between the two groups of estimates suggests that something may be fundamentally different about the cost function for the largest banks. The critical difference may be that the largest banks produce a distinct variety of products (e.g., off-balance sheet activities), that they have different technologies, or that they have a different degree of cost dispersion than smaller banks that confounds the measurement of scale economies.³ Despite the differences on the location of the scale-efficient point, the fact that almost all estimates place this point well below the size of the largest U.S. banks clearly suggests that there are no significant overall scale economies to be gained through increases in bank size beyond the currently largest values. In fact, the data suggest that such increases may create slight scale *diseconomies*, which presumably owe to the difficulty of managing a larger, and usually more geographically dispersed, enterprise. However, it is difficult to draw strong conclusions about the exact nature and existence of these measured diseconomies because the data are so sparse on the largest U.S. banks.⁴

Several types of criticisms may be leveled against most of the recent scale economy literature. First, scale economies are usually measured using data on all of the banks in the sample, rather than just using the data on the most efficient banks. Scale economies theoretically apply only to the production possibilities frontier -- where firms are fully X-efficient and minimize costs for every scale of output. The use of data from banks other than those on the frontier could confound scale effects with differences in X-efficiency.

Second, most studies measure only the scale economy effects of marginal changes in output near the point of evaluation. The commonly used definition of scale *economies* is the ratio of marginal cost to average cost, taken along a ray that holds output mix constant. Scale *efficiencies*, in contrast, take into account the full difference in ray 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.

Third, the finding that large and small banks do not appear to fit on the same parametric cost function as each other suggests that nonparametric methods might be more appropriate for examining scale economies. The commonly-specified translog functional form forces large and small banks to lie on a U-shaped (or possibly flat) ray average cost curve and disallows other possibilities, such as an average cost curve that falls up to some output point and remains flat thereafter. Thus, if there are strong scale economies for the smallest banks and flat average costs for larger banks, the translog form would likely incorrectly find measured scale diseconomies for the largest banks.. In addition, the translog approximation may behave poorly away from the mean product mix, which can create problems in measuring scale efficiencies because large banks tend to have very different product mixes from the average. Nonparametric estimation methods, such as kernel regressions and Fourier Flexible forms allow the data more freedom to choose shapes for the average cost curve.

Fourth, recent scale economy analyses generally do not take into account financial scale economies associated with risk reduction. As banks grow larger, their loan portfolios generally become more diversified, lowering the amount of equity capital which must be held to keep the risk exposure of the bank's creditors (including the deposit insurer) at a given level. Because

equity is the most expensive marginal source of funding, this creates a financial scale economy by which banks can lower their average costs of funds as scale increases by holding a smaller proportion of capital (to the extent that this is allowed by regulators).

Fortunately, none of these four potential problems appears to change the fundamental findings of the scale economies literature. With regard to the first problem, comparisons of scale effects on and off the efficient frontier are generally quite close [see Berger and Humphrey (1991), Bauer et al. (1993), McAllister and McManus (1993), Mester (1993)]. Second, comparisons of scale economies with scale efficiencies show that they tend to be within a few percent of each other in most instances [see Berger (1993,1994), Evanoff and Israilevich (1991)]. Third, use of nonparametric methods generally give the same basic result that scale economies are important only for the smallest banks, although it does seem to suggest that the scale diseconomies for the largest banks may be the result of the rigidity of the translog functional form and the dominating effect of large number of small banks [see Mitchell and Onvural (1992), McAllister and McManus (1993)]. Finally, the incorporation of financial scale economies from risk reduction increases estimated scale economies only slightly for small banks, and these effects level off below \$1 billion in assets [see McAllister and McManus (1993)]. Thus, the literature is essentially unshaken in its conclusion that scale economies are available only to smaller U.S. banks and that further expansion by the largest banks does not promise any important reduction in average costs.

The raw data on bank costs are also consistent with this literature. When average cost per dollar of assets (including both operating and interest expense) is plotted by size class, the result is 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, the raw data suggest that the merger process has not generally produced cost savings for large banks.

As a final note on bank scale economies, it is possible that such economies may also exist on the revenue side, as opposed to the cost side, and that these economies extend through the largest banks. That is, larger banks may be able to provide services or combinations of services

that consumers value more highly and are willing to pay higher prices to obtain. To our knowledge, only one study has estimated revenue scale economies for banks by employing a revenue function in place of a cost function. This study found minor revenue scale economies of about 1% to 4%, but these were generally exhausted before reaching the size of the largest U.S. banks [see Pulley, et al. (1993)]. Cost and revenue scale economies can also be evaluated jointly using the profit function. The results of a recent study suggest that profitability is increasing, even for large banks, possibly from revenue scale economies [see Berger, Hancock, and Humphrey (1993)]. However, more research using the revenue and profit functions will be needed before definitive conclusions can be drawn regarding revenue scale economies.

IV. Scope Economies at U.S. Banks

Scope economies or changes in product mix are another potential way in which mergers might help improve bank performance. Economies of scope occur when it is more economical to produce two or more products jointly in a single production unit than to produce the products in separate specializing firms. Scope economies can arise from two sources: 1) the spreading of fixed costs over an expanded product mix; and 2) cost complementarities in producing the different products. Spreading fixed costs occurs, for example, when the fixed capital of a bank branch is more fully utilized by issuing many types of deposits to local residents than building separate offices to fulfill the separate demands for transactions accounts, savings accounts, consumer loans, business loans, and trust services. Such economical spreading of costs occurs to the extent that the production of different types of services require much the same type of computer, accounting system and other fixed inputs of a branch **and** there is insufficient local demand to justify a full specialized branch for each of the services. In contrast, cost complementarities between deposits and loans occur, for example, when the payment flow information developed in providing deposit services is used to reduce the costs of acquiring credit information about and monitoring loans to the same customers.

The literature on scope economies for financial institutions is much more problematic than the scale literature. Three major problems have been recognized in measuring scope

economies. First, there is a problem in applying the translog cost function or other multiplicative specifications to evaluate scope economies. Computation of scope economies compares the predicted costs of producing a given bundle of products by two or more specializing firms with the costs of joint production by a single firm. In the two-product case, this amounts to comparing $C(y_1, 0) + C(0, y_2)$ with $C(y_1, y_2)$, where $C(\cdot)$ is the cost function and y is the output vector. Because the translog is multiplicative in outputs, it has the unfortunate property of having predicted costs of zero for each of the specialized firms, i.e., $C(y_1, 0) = C(0, y_2) = 0$. Therefore, the translog specification imposes extreme scope diseconomies on any data set.

One common solution to this problem is to define a minimum level of each product, ε_i , below which y_i is not evaluated. The comparison in the two-product case is then of $C(y_1 - \varepsilon_1, \varepsilon_2) + C(\varepsilon_1, y_2 - \varepsilon_2)$ with $C(y_1, y_2)$. The minimum value ε_i must be subtracted from y_i so that the sum of the outputs of the two specializing firms equals the total output of the joint production firm.⁵ Unfortunately, this strategy does not really solve the problem of using the translog, since any finding of scope economies can be summarily eliminated by setting the ε 's sufficiently close to zero. This is because setting any output sufficiently close to zero will yield predicted costs arbitrarily close to zero for the specializing firms.

A better solution is to specify an alternate functional form that is not so poorly behaved at or near zero output. Some studies have applied the Box-Cox transformation to the outputs, replacing y with $(y^\lambda - 1)/\lambda$. Unfortunately, λ is usually estimated to be close to zero, which again yields properties similar to the translog [see Pulley and Humphrey (1993)]. Some studies have avoided this problem by specifying $\lambda=1$, which amounts to replacing the log of output with the level [Berger et al. (1987), Buono and Eakin (1990)]. However, the composite function, which specifies the fixed-costs component of scope economies separately from the cost-complementarities component, appears to be a better choice [Pulley and Humphrey (1993)].

The second recognized problem in estimating scope economies is that there are often little or no data on firms that specialize. In banking, virtually all firms produce the entire array of products specified in the cost function. In fact, the dense part of the data set is usually well away from zero outputs, creating potentially significant problems of extrapolation. The effects

of extrapolation, often combined with the problems of the translog specification, can be quite dramatic. Measured scope economies and diseconomies using the translog form are often erratic and far exceed credible levels, at times over 1,000% in absolute value [Berger and Humphrey (1991), Pulley and Humphrey (1993), Mester (1993)].

A way around this problem is to examine alternative measures that use product mixes that remain within the dense part of the data set, where more confident conclusions can be drawn. Expansion path subadditivity (EPSUB) combines the scale and product mix effects of moving from one size class mean to the mean of the next largest size class, and provides what appears to be a more reasonable representation of the opportunity of existing banking firms to change their outputs than scope economies [Berger et al. (1987), Hunter et al. (1990), Berger and Humphrey (1991), Hunter and Timme (1991)]. A special case of EPSUB -- economies of diversification -- combines pure scope economies for some outputs with pure scale economies for others [Ferrier et al. (1993)]. These methods essentially sidestep the question of pure scope economies per se in favor of the potentially more interesting question of whether efficiency can be improved by changing scale and product mix simultaneously.

The third recognized problem in evaluating scope economies is that of using data that are not on the efficient frontier. As in the case of scale economies, scope economies are defined only on the efficient frontier, so that evaluation using data off of the frontier could confound scope economies with X-efficiency differences across banks. The empirical evidence suggests that, unlike the case of scale economies, this is a problem for estimating scope economies in banking. Berger and Humphrey (1991) found scope diseconomies of about 10% to 20% on the frontier and economies in the 1,000's of percent when the entire data set was used. Mester (1993) also finds a large difference between scope economies on and off the frontier, although both sets of estimates are in the 1,000's of percent.

Because of the estimation problems in most of the papers, it is difficult to draw a consensus conclusion as to whether scope economies exist in banking and what their exact level is. However, it is safe to say that there probably are not substantial measurable cost scope economies when the estimation problems are solved. The most consistent, reliable scope

economies are those derived from the composite function by Pulley and Humphrey (1993). They found that large banks did **not** experience significant cost complementarities between deposit and loan products, but did enjoy benefits of sharing fixed costs between these products on the order of 4% to 5%.

As described above for scale economies, there is also the possibility of scope economies on the revenue side in banking. This may occur, for example, if consumers are willing to pay higher prices to have multiple products delivered in one location to save their own transportation and time costs. The one study that measured revenue scope economies between deposits and loans found no evidence of these economies [Pulley, et al. (1993)].

Also as described for scale economies, cost and revenue scope economies may be evaluated jointly using the profit function. 'Optimal scope economies' are defined to exist if for all the given prices and fixed inputs, it is the most profitable to produce all products, taking into account both costs and revenues. The one study to use the profit function to evaluate optimal scope economies found that joint production is optimal for most banks, but that specialization is optimal for others [Berger, Hancock, and Humphrey (1993)].

Combining the results from the cost function, revenue function, and profit function together suggests that the synergies in producing joint products in banking are rather small. While these results technically apply only to existing banking services, they may be indicative of the types of gains (or non-gains) that may occur with an expansion of banking powers. Presumably, banks already combine the types of deposit and loan services that have the most scope economy benefits, so it is unlikely that joint provision of traditional banking and non-banking services will produce large economies.

V. The X-Efficiency of the U.S. Banking Industry

The cost or input X-efficiency of a bank refers to how close it is to the efficient cost frontier -- where the bank's output bundle is produced at the minimum cost for the input prices it faces. X-efficiency differs from scale and scope economies because it takes the output bundle as given, while scale and scope economies try to determine least-cost scale and mix of the output bundle, taking as given that the firms are on the efficient frontier. There is virtual

consensus in the literature that X-efficiency differences across banks are relatively large and dominate both scale and scope efficiency differences. The X-inefficiencies are usually found to be primarily technical in nature, meaning that inputs are simply overused, rather than allocative, meaning that the choice of inputs was a poor reaction to the prices faced. However, there is no consensus on the best method for estimating X-efficiency or on the average level of X-efficiency of the banking industry.

The major econometric problem lies in distinguishing X-efficiency differences from random error that may temporarily give certain institutions relatively high or low costs. Four different approaches have been employed, each of which maintains a different set of assumptions about the probability distributions of the X-efficiency differences and random error. Such assumptions are necessary in order to distinguish between these two explanations of the observed dispersion in bank costs. The econometric frontier approach (EFA) generally assumes that inefficiencies follow an asymmetric half-normal distribution, that random errors follow a symmetric normal distribution, and that both are orthogonal to the cost function exogenous variables [Ferrier and Lovell (1990), Timme and Yang (1991), Bauer et al. (1993)]. The thick frontier approach (TFA) assumes that deviations from predicted costs within the lowest average-cost quartile of banks in a size class represent random error, while deviations in predicted costs between the highest and lowest quartiles represent X-inefficiencies [Berger and Humphrey (1991, 1992b), Bauer et al. (1993), Berger (1993)]. The data envelopment analysis (DEA) approach generally assumes that there are *no* random fluctuations, so that *all* deviations from the estimated frontier represent inefficiency [Rangan et al. (1988), Aly et al. (1990), Ferrier and Lovell (1990), Elyasiani and Mehdi (1990), Fixler and Zieschang (1991), Ferrier et al. (1993)]. Finally, the 'distribution-free' approach (DFA) assumes that efficiency differences are stable over time, while random error averages out over time [Berger (1993, 1994), Bauer et al. (1993), Berger and Humphrey (1992a), Berger and Hannan (1993)].

There is no simple rule for determining which of these methods best describes the true nature of the banking data. This would not be a problem if all of the methods arrived at essentially the same conclusion. Unfortunately, this is not the case -- the choice of measurement

method does appear to affect the level of measured inefficiency. Authors applying the EFA, TFA, and DFA methods to banking usually find average inefficiency to be about 20% to 25% of costs, while authors using DEA find results ranging anywhere from less than 10% to over 50% of costs. Perhaps a more important problem is that when these methods are compared with one another using the same data set, the rankings of individual banks often do not correspond well across methods, even when the methods find similar average efficiency levels [Ferrier and Lovell (1990), Bauer et al. (1993), Berger (1993)].

As was the case for scale and scope efficiencies, X-efficiencies may also be important on the revenue or output side, even though most studies have only examined the cost or input side. A bank may be revenue X-inefficient if it produces less of an output than it would like (technical inefficiency) or reacts poorly to output prices in choosing its output bundle (allocative inefficiency). The one study of banks that directly examines output X-inefficiency [English et al. (1993)] and the one profit function study that examines both input and output X-inefficiency [Berger, Hancock, and Humphrey (1993)] both find that output inefficiencies are at least as large as input inefficiencies. Once again, these new results should be viewed with caution until there are more studies using revenue and profit functions.

Despite the lack of congruity across all the methods, it seems clear that X-efficiency differences are much more important than scale and scope efficiencies in banking. Most of the studies find that the average cost X-inefficiencies are on the order of 20% or higher for virtually all size classes of banks, as opposed to scale inefficiencies, which are on the order of 5% or less and are restricted to the smaller size classes of banks. Scope inefficiencies are difficult to measure, but also appear to account for 5% or less of costs.

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 and average cost quartile, 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.

VI. Studies of Recent U.S. Bank Mergers

We next discuss studies of recent U.S. mergers to determine whether the scale and scope economy results hold, and, more importantly, whether mergers can improve X-efficiency or managerial cost control. Most analyses of bank mergers 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. That is, costs declined, but the size of the consolidated firm fell by about the same amount, so that average cost and average profit ratios remained approximately constant.

Srinivasin and Wall (1992) and Srinivasin (1992) performed similar analyses, 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 mergers from across the entire U.S. The larger, more general sample gave the same basic finding -- that the typical merger did not produce average cost savings. 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 significant performance differences relative to nonacquired banks three years prior to the acquisition or three years after the acquisition. Rhoades (1986) also obtained similar results for 413 acquired banks over 1968-78. These studies suggest no significant efficiency benefits from bank mergers.

In contrast to these findings, two studies found overall benefits from mergers using simple ratio comparisons. Cornett and Tehranian (1992) used a sample of 30 large U.S. 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 that interest expenses should be included in efficiency comparisons because they constitute about 70% of bank costs, and are included in the profit maximization plans of any efficient firm. Moreover, interest expenses are substitutes for directly incurred operating expenses and often represent operating expenses incurred at other banks from which the funds were borrowed.

Spindt and Tarhan (1992) also found net merger benefits when examining the median differences in performance between merging banks and nonmerging peers for a sample of 394 mergers that took place in 1986. They found that the median difference in return on equity (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. One reason for their measured merger benefits may be scale economies rather than any X-efficiency 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, giving results consistent with the scale efficiency literature described above.

There are several problems with these studies that examine simple financial ratios. First and foremost, financial ratios may be misleading indicators of efficiency because they do not control for product mix or input prices. Implicitly, studies using a cost-to-asset ratio assume that all assets are equally costly to produce and all locations have equal costs of doing business. In addition, the use of a simple ratio cannot distinguish between X-efficiency gains and scale

and scope efficiency gains. This greatly reduces the predictive power of the ratios in determining which types of mergers are likely to be successful in improving efficiency, since scale and scope efficiencies automatically change when a merger is consummated, but X-efficiencies may or may not change. In addition, many of these simple ratio comparisons exclude interest expenses, which comprise about 70% of total U.S. banking costs and often represent operating expenses incurred elsewhere in the banking system.

Some recent studies have begun using frontier X-efficiency methods to determine the efficiency effects of bank mergers. Using the distribution-free approach (DFA), Berger and Humphrey (1992a) analyzed 57 large-bank mergers of the 1980s in which both parties had at least \$1 billion in assets. They found small, statistically insignificant average X-efficiency benefits from these mergers. However, these X-efficiency benefits were more than offset by scale efficiency losses. The scale diseconomies created by merging banks that were generally larger than efficient scale resulted in a small total efficiency loss that was sometimes statistically significant. They also found that there were no efficiency gains associated with mergers in which the acquirer was more efficient than the acquired or in which both banks were represented in the same local market, two conditions often thought to be conducive to and predictive of merger efficiency gains.

Rhoades (1993) analyzed 898 horizontal mergers -- mergers in which there was some local market overlap prior to the merger. In most cases, the acquiring bank was more efficient than the acquired bank, so his data satisfied the conditions identified by consultants as most likely to result in efficiency gains. Despite these supposedly favorable conditions for merger efficiency gains, Rhoades found no such gains using the thick frontier approach (TFA) to measuring efficiency.

One merger paper that used frontier efficiency techniques did find efficiency benefits from mergers. Fixler and Zieschang (1993) analyzed 160 mergers that took place in 1986 by constructing Tornqvist productivity indices for the merging banks and their nonmerging peers and used these as measures of relative efficiency. For each bank, productivity was measured by

a value-weighted output index divided by a value-weighted input index. This method is equivalent to assuming that each bank has its own technology and measuring efficiency by assessing "quality" differences among these technologies. They found that the acquiring banks were about 40% to 50% more efficient than other banks in the sample prior to merging, and that this same advantage was maintained after mergers.

One reason why Fixler and Zieschang's results may differ somewhat from the cost studies of mergers is that they included revenue effects through their output index as well as cost effects through their input index. As discussed above, Berger, Hancock, and Humphrey (1993) and English et al. (1993) found measured revenue efficiency differences to be as large or larger than cost efficiency differences. Thus, Fixler and Zieschang may have found merger benefits because of revenue effects in their output index which were not included in other merger studies. It is also notable that the two merger studies using simple ratios that found efficiency benefits found them primarily in ratios that included revenues [Cornett and Tehranian (1992), Spindt and Tarhan (1992)].⁶

In sum, the literature shows that there is considerable **potential** for cost efficiency benefits from bank mergers, but the data show that on average, such benefits were **not realized** by the U.S. mergers of the 1980s. As discussed above, cost X-inefficiencies average about 20% to 25% of costs, so that it is seemingly possible that the best-practice firms could acquire the least efficient, restructure them, and raise industry efficiency. Some offset to this gain might be forthcoming from scale diseconomies associated with mergers of the largest banks.

Unfortunately, even when a more efficient bank acquired a less efficient one, and when both banks were in the same local markets -- creating the potential for consolidating inefficient bank branches and back-office operations into more efficient units -- significant efficiency benefits did not accrue on average. Although some mergers were quite successful in improving cost efficiency, others were equally unsuccessful and had cost efficiency losses, so that there were no efficiency gains on average.

This literature leaves two avenues for discovering the secrets, if there are any, of mergers that improve efficiency. First, further research on the mergers that were found to be successful

in terms of cost efficiency gains may be useful in discovering what conditions might be used to predict a successful merger. Second, further research may find efficiency benefits of mergers on the revenue side, even though they do not appear to exist strongly on the cost side. As discussed above, Berger, Hancock, and Humphrey (1993) and English, et al. (1993) found substantial efficiency differences among banks in their revenue efficiency, and Fixler and Zieschang (1993) found efficiency gains from mergers when revenues as well as costs were included.

VII. Academic Versus Consultant Analyses of U.S. Bank Mergers

The academic findings of little or no improvements in average costs and efficiency 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 banking press, savings as high as 30% of the operating expenses of the acquired institution have been projected for some recently consummated large bank mergers. 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., back-office check processing 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), 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.⁷

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 measures 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' problems in which consultants tend to focus on the benefits and not the detriments associated with bank 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% of the acquired bank's operating costs are correct. The typical acquired bank is about one-third of the size of the consolidated assets of the merging banks, or half as large as the bank that acquires it [see Berger and Humphrey (1992a)]. The 30% of the acquired bank's operating costs then amount to 10% of the consolidated bank's operating costs. Further, since operating costs constitute only about 30% of total bank costs, the savings of 10% of consolidated operating costs amounts to only 3% of consolidated total costs. Thus, the 30% cost savings in consultants' terms is only 3% in academics' terms. Moreover, it is not always clear that consultants' estimates take full account of the shrinkage in size of the consolidated bank relative to the pre-merger sum of the two partners. Branch closings and sales pursuant to a merger, as well as changes in lending policies, often result in runoffs of deposits and assets that reduces the size of the consolidated bank.⁸ If the size of the consolidated firm decreases sufficiently, it could offset the 3% 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 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, et al. (1992), Hawawini and Swary (1989), Hannan and Wolken (1989)]. The finding of no significant gain in combined value suggests that the market believes, 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 merger benefits that are not likely to be realized.

In sum, the difference between the consultants' and academics' analyses is much more a matter of emphasis than it is a true conflict. Both come to the conclusion that potential benefits often exceed actual benefits, and the large numerical gap in cost savings is primarily a matter of the metrics in which they are expressed.

VIII. Mergers, Concentration, and Performance of U.S. Banks

An important consideration when assessing the overall social benefits and costs of bank mergers concerns whether the increase in market shares and concentration created by within-market mergers may create excessive local market power and whether cross-market mergers may reduce local market power. That is, if there is substantial market power among banks in concentrated local markets, then a within-market merger may increase this power and result in anticompetitive behavior -- the setting of prices that are unfavorable to consumers (lower deposit rates, higher loan rates), and restrictions on the quantity or quality of banking services that are made available to the public. By the same token, this market power argument may work in favor of cross-market mergers, which may reduce local market power in the markets that are invaded by a new competitor.

Many studies in the banking literature and in the more general industrial organization literature have addressed the question of whether market power is quantitatively important in the U.S. These studies often find a positive statistical relationship between profitability and measures of market structure -- either concentration or market share. On first blush, this may

suggest that the wave of within-market merger activity in the U.S. banking industry is motivated by the prospective benefits from greater market power created by increasing the concentration or market shares of the merging firms. The traditional structure-conduct-performance hypothesis (SCP) asserts that this finding reflects the setting of prices that are less favorable to consumers in more concentrated markets as a result of the exercise of market power. A related theory is the relative-market-power hypothesis (RMP), which asserts that only firms with large market shares and well-differentiated products are able to exercise market power in pricing these products and earn supernormal profits [see Shepherd (1982)].

In contrast to these two market-power theories, there is also an efficiency-related explanation of the positive relationship between profits and either concentration or market share. Under the efficient-structure hypothesis, firms with superior management or production technologies (i.e., greater X-efficiency) have lower costs and therefore higher profits. These firms are also assumed to gain large market shares that may result in high levels of concentration [see Demsetz (1973, 1974), Peltzman (1977)]. Here, the positive profit-structure relationship is spurious, rather than of direct origin, with efficiency determining both profits and market structure. Similar arguments are sometimes used to justify scale efficiencies as the underlying advantage of firms in concentrated markets [e.g., Lambson (1987)]. Thus, under the efficient-structure hypothesis, 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 within-market 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, et al. (1984,1986), Smirlock (1985), 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), 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), analyses of two cross-sections of 1985 data by Berger and Hannan (1993), and well as analyses of 30 cross-sections that cover every year of the 1980s by Berger (1994), 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 the profits of the other firms in the affected markets. Despite these coefficient results, the explanatory power of these profit equations were quite low, with R^2 's less than 10% 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.

Other studies have tested the market power hypotheses by examining the price-concentration relationship, usually without the benefit of efficiency variables. Prices are regressed against concentration and/or market share, and a finding of less favorable prices for consumers of firms in more concentrated markets or with larger market shares is taken as support for the market power hypotheses [e.g., Berger and Hannan (1989), Hannan (1991)]. However, such tests are also problematic because the excluded efficiency variables may be correlated with both prices and market structure. Recently, one study has included measures of efficiency in the price

equations [Berger and Hannan (1993)]. The results are identical across these studies whether or not efficiency is controlled for -- banks in more concentrated markets offer prices that are slightly less favorable to both small retail depositors and small business loan customers. In addition, studies of price rigidity in banking find that banks in more concentrated markets change their deposit prices less often in response to fluctuations in open-market interest rates -- another indication of market power [see Hannan and Berger (1991), Neumark and Sharpe (1992)].

Thus, some market power associated with concentration is apparent from the price-concentration studies, but this does not have an observable effect on profits. One reason for this seeming discrepancy may be that profits are 'noisy' -- determined by many factors other than the market power on a few small retail deposit and loan categories. It is also possible that through Hicks' (1935) quiet-life hypothesis, banks that have market power in pricing enjoy most of the benefits in the form of a more relaxed environment in which efficiency falls and costs rise. As a result, these firms do not earn observably higher profits, although the managers enjoy a reduced work effort. Some evidence favoring this interpretation was found in Berger and Hannan (1993).

The sum total of the structure-performance literature suggests that within-market mergers that increase local market concentration significantly may create some social costs in terms of prices that misallocate resources and lead to some minor reduction in efficiency, but these effects are generally expected to be relatively small. On the other hand, cross-market mergers and acquisitions that bring new competition into markets in which market power was being exercised may have social benefits in terms of slight improvements in prices for consumers and slight increases in efficiency for the other local competitors. Such benefits may be expected to accrue as new interstate and nationwide mergers are allowed in the U.S., and as international and continent-wide mergers take place in Europe over the next several years.

IX. Conclusions

The implications of the U.S. experience for the consolidation of European banking are clear. First, significant cost efficiency gains should **not** be expected from the cross-border mergers and acquisitions that take place over the next several years in Europe. The data on U.S. banks and their consolidation over the past decade suggests 1) that larger banks do not have

lower average costs than middle size banks; 2) that larger banks do not experience scale economies as they grow larger; 3) that there is only limited potential for scope and product mix economies as banking firms merge; 4) that while mergers have the **potential** to improve cost X-efficiency significantly, this potential is generally **not realized**, resulting in no significant merger cost efficiency gains on average; 5) that consultants' claims of large cost efficiency improvements from mergers often refer to potential, rather than realized merger gains, and do **not** amount to substantial efficiency gains **nor** do they differ substantially from the findings of academic studies once they are expressed in terms of total cost ratios of the consolidated firm.

Second, there may be more potential for efficiency gains from mergers on the revenue side than on the cost side, but these have not yet been thoroughly explored. A few studies have found substantial X-efficiency differences on the revenue side that equal or exceed X-efficiency differences on the cost side. As well, there is limited evidence that mergers may improve revenues. However, more research on revenue and profit functions is needed before drawing definitive conclusions about the revenue effects of mergers.

Third, there is likely little to fear from cross-border European mergers and acquisitions in terms of the creation of excessive market power from concentration. The structure-performance literature on U.S. banks suggests that increased local market concentration associated with **within-market** mergers may lead to slightly less favorable prices for consumers on some deposit and loan accounts, and also may result in slightly less efficiency as bank managers enjoy some of the fruits of market power as reduced effort levels. However, this is not likely to occur for the type of **cross-market** mergers expected in Europe. If anything, these mergers are more likely to intensify local market competition, resulting in slightly more favorable prices for consumers and slightly greater efficiency for the local rivals whose markets have been invaded.

FOOTNOTES

1. An MBHC owns and coordinates the operations of a number of legally separate banks, but is a reasonably close substitute for a branching bank in terms of costs and services provided.

2. The Federal Reserve's Functional Cost Analysis data was commonly used because of its rich detail of accounting data, but it contains very few banks with over \$1 billion in assets.

3. 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), and did not fit the observations on large banks very well. See Berger and Humphrey (1991).

4. Most of the deviations from the consensus findings in the recent academic literature have involved model specification problems. Examples of these problems are: (a) using only operating costs rather than total operating plus interest costs [e.g., Langer (1980), Nelson (1985)]; (b) specifying a Cobb-Douglas or other nonquadratic functional form [e.g., Clark (1984), Shaffer (1991)]; or (c) holding the number of branch offices constant when computing scale economies [e.g., Gropper (1991)]. 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. As noted above, the specification of a non-quadratic form does not allow for a U-shaped average cost curve, and holding the number of branch offices constant gives the scale economies at the branch office level, not at the bank level as would be more accurate to gauge the effects of size on bank costs.

5. In some cases, authors have not properly subtracted the ϵ 's, biasing the scope economies. See Berger, et al. (1987, p. 517) for a discussion of this and other scope estimation problems.

6. Similarly, a study that related a profit ratio to state regulations regarding takeovers found that banks in more liberal takeover states were more profitable [Schantz (1993)]. However, the study did not distinguish between whether the mergers and acquisitions resulted in higher profits or whether the threat of takeovers spurred improved performance.

7. For example, Keefe, Bruyette, and Woods and Ernst and Young surveyed selected consolidated banks and found an average savings of 35 percent of the acquired bank's data processing and back-office operations expense within 6 to 9 months after the mergers. Bryan (1991, pp.12-13), also predicted savings of as much as 20 percent of the noninterest expenses of large banks through the merger process if branching across state lines were permitted.

8. For example, after the 1986 Wells Fargo-Crocker merger, total consolidated assets were 10.75% lower in real terms and deposits were 6.24% lower in real terms in 1987 than were the combined assets and deposits in 1985.

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Table 1
Change in the Distribution of U.S. Banking Entity¹ Sizes
between 1980 and 1992
(in constant 1982 dollars)

Panel A
Distribution of Banking Entity Sizes in 1980

Size	Number	Total Assets ²	%num	%ta
Less than \$50 M	9,217	192.4	74.6	9.4
\$50 M - \$100 M	1,699	116.3	13.7	5.7
\$100 M - \$500 M	1,069	207.6	8.6	10.1
\$500 M - \$1 B	156	108.3	1.3	5.3
\$1 B - \$5 B	173	387.4	1.4	18.9
\$5 B - \$10 B	23	146.7	0.2	7.1
Greater than \$10 B	26	895.0	0.2	43.6
Total	12,363	2,053.6	100.0	100.0

Panel B
Distribution of Banking Entity Sizes in 1992

Size	Number	Total Assets ²	%num	%ta
Less than \$50 M	5,650	132.8	63.5	5.5
\$50 M - \$100 M	1,726	120.6	19.4	5.0
\$100 M - \$500 M	1,207	232.7	13.6	9.7
\$500 M - \$1 B	112	77.7	1.3	3.2
\$1 B - \$5 B	129	276.9	1.4	11.5
\$5 B - \$10 B	33	227.0	0.4	9.4
Greater than \$10 B	42	1,335.5	0.5	55.6
Total	8,899	2,403.3	100.0	100.0

Panel C
Distribution of Banking Entity Sizes in 1992
Adjusted to 1980 Total Industry Assets

Size	Number	Total Assets ²	%Num	%ta
Less than \$50 M	6,124	135.4	68.8	6.6
\$50 M - \$100 M	1,498	103.9	16.8	5.1
\$100 M - \$500 M	999	193.8	11.2	9.4
\$500 M - \$1 B	93	66.4	1.0	3.2
\$1 B - \$5 B	121	269.5	1.4	13.1
\$5 B - \$10 B	27	190.5	0.3	9.3
Greater than \$10 B	37	1,094.2	0.4	53.3
Total	8,899	2,053.6	100.0	100.0

¹ A Bank Entity is defined as a bank that is not owned by a Multi-bank holding company (MBHC), or the highest tier MBHC that owns banks.

² Total assets are measured in billions of dollars.