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# Economies of Integration in Banking:
# An Application of the Survivor Principle

**Timothy J. Yeager**
Federal Reserve Bank of St. Louis
Bank Supervision and Regulation

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*The views expressed in this paper are those of the author, not necessarily those of the Federal Reserve Bank of St. Louis or the Federal Reserve System.

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by

Timothy J. Yeager
Timothy.J.Yeager@stls.frb.org
(314)444-8837

Supervisory Policy Analysis
Federal Reserve Bank of St. Louis
P.O. Box 442
St. Louis, Missouri 63166-0442

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## Abstract

Despite the growing concentration of U.S. banking assets in mega-banks, most academic research finds that scale and scope economies are small. I apply the survivor principle to the banking industry between 1984 and 2002 and find that the so-called economies of integration are significant. These results hold after accounting for off-balance-sheet activities and after replicating the results at the holding company level. Regression analysis reveals that deregulation of branching restrictions, especially at the state level, played a significant role in allowing banks to exploit these economies. The results also suggest that, although the absolute number of community banks will decrease over time, community banks of all sizes will remain viable in the future. A likely explanation for the paradox of significant economies of integration and small estimated cost economies is that the size benefits to a bank come from sources other than cost efficiencies.



**JEL Codes:** G2, L1

**Keywords:** survivor principle, economies of scale and scope, economies of integration commercial banks, community banks, deregulation

## I. Only the Large Survive?

A host of regulatory changes have swept through the banking industry over the last two decades, including branching deregulation and financial modernization. An explicit assumption behind many of these changes is that constraints on banks' activities prevented them from fully exploiting economies of scale and scope. The 1994 Riegle-Neal Interstate Branching Act was the culmination of a more than 20-year process of removing geographical constraints. The falling barriers allow banks to exploit economies of scale by freely expanding both within and across state lines. In addition, the Gramm-Leach-Bliley Act of 1999 (Financial Modernization Act) repealed the Glass-Steagall Act and allows bank holding companies to expand more easily into related financial activities. This legislation removes restraints on economies of scope, allowing banking organizations to cross-sell financial products such as credit, insurance, and securities underwriting and brokerage services.

Banking research and ongoing consolidation in the banking industry present a paradox. Conventional research suggests that scale and scope economies in the banking industry are small; yet, bank mergers occurred at a dizzying pace in the 1990s, and large bank holding companies pushed for approval to merge with brokerage and insurance companies, presumably to exploit economies of scope. If scale and scope economies are small, why are so many banking organizations expanding in size and across product lines?

The survivor principle (Stigler, 1958) offers a simple, yet often over-looked approach to measuring so-called *economies of integration* (Keeler, 1989). Economies of integration include all of the benefits from size increases, regardless of their sources. This approach, then, might detect size economies that other approaches miss.

Application of the survivor principle to the banking industry suggests that economies of integration are quite large. Specifically, the market share of banks with more than $10 billion in inflation-adjusted assets surged between 1984 and 2002 while the market share of banks in all other size categories declined. Elimination of branching restrictions, especially at the state level, seemed to play an especially important role in fueling the consolidation of bank assets. The survivor principle also suggests, somewhat unexpectedly, that while the number of community banks will continue to decline, community banks of all sizes are likely to remain viable in the long run.

A likely explanation for the paradoxical findings of significant economies of integration and small cost economies is that the benefits that banks derive from growing in size come from sources other than cost efficiencies. The challenge for researchers is to identify these sources. Likely candidates include revenue efficiencies, diversification benefits, the too-big-to-fail subsidy, and international prestige.

## II. Standard Measures of Scale and Scope Economies in Banking

Economic researchers have studied returns to scale in banking extensively and most conclude that the average cost curve has a relatively flat U-shape. Scale economies exist for banks with assets less than, say, $300 million, but diseconomies set in for banks with between $2 billion and $10 billion in assets (Berger, 1993).

Because theory does not provide a single methodology to measure scale and scope economies, researchers have taken numerous approaches. If the different methodologies provided consistent answers, we could be more confident in the results. Unfortunately, the results vary significantly and they depend critically on the assumptions made.

One crucial assumption in measuring economies of scale is the functional form of the cost function. The most common approach, a translog function, estimates the flat U-shaped curves commonly reported in the literature. However, this specification performs poorly when applied to banks of all sizes, especially when sample banks have significantly different product mixes. McAllister and McManus (1993) show that specification bias accounts for the decreasing returns to scale typically found in studies utilizing the translog function. Rather than using the translog, they use nonparametric techniques to fit an average cost curve and find that minimum average scale is achieved at banks with $500 million in assets; diseconomies of scale do not set in over their entire bank sample, which includes banks with up to $10 billion in assets. Mitchell and Onvural (1996) find similar results for large banks using a Fourier Flexible function.

Another critical assumption is the definition of output. As with many other service industries, defining the level of bank output is not a trivial exercise. Fortunately, Humphrey (1990) finds scale economy results are not particularly sensitive to traditional output measures such as deposits and loans. Jagtiani et. al. (1995) include off-balance-sheet products in the output specification. In particular, they account for guarantees, foreign currency transactions and interest rate transactions. The authors find that inclusion of such products does not change their finding of small scale economies.

Risk reduction is another dimension that often goes unmeasured in the scale economies literature. Larger banks may benefit significantly from product and geographic diversification, which reduces their risks, holding expected profits constant.

Such banks can reduce their capital levels (subject to regulatory requirements), reducing the cost of capital. McAllister and McManus (1993) find that so-called financial returns to scale are significant; inclusion of this risk benefit increases returns to scale estimates for small banks and eliminates significant diseconomies of scale among large banks. Other researchers have also found that size is a significant risk-reducing factor at banks. (Emmons, Gilbert and Yeager, 2004)

Even more serious difficulties arise in measuring economies of scope. Because most banks produce similar products, few observations exist on differing output arrays to statistically discern the costs of joint production from the costs of producing a single product. In addition, the results are even more sensitive than scale economy measures to the cost function chosen. Because the translog cost function is multiplicative in outputs, it predicts costs of zero for firms that do not produce the entire array of products (Berger, 1993). Thus far, researchers have not been satisfied with alternative cost functions. Measurements of economies of scope are also highly sensitive to the use of data not on the efficient frontier.

An additional complexity is employing a methodology that comprehensively captures all the scope-efficiency gains. Studies of cost functions focus solely on average costs; however, scope economies may be more important on the revenue side of the income statement. Larger banks may be able to generate additional revenues by offering joint products rather than specializing in one output. For example, a bank that produces both lending and brokerage services may generate more revenue than two firms which produce each of these products separately. Akhavein et. al. (1997) estimate efficiencies using a profit function (which accounts for revenue and cost efficiencies) and find that merged "mega-banks" significantly increase efficiency. Most of the improvement is from increasing revenues, not from cost changes.

An alternative approach to measuring scale and scope economies is to examine efficiency gains from bank mergers. If economies exist, then, given the appropriate time to reorganize, a post-merger bank should be more efficient than the pre-merger banks. Once again, most studies find that efficiency gains are small, suggesting that economies of scale and scope are not significant.

The most common approach to measuring efficiency gains from mergers is to compare pre- and post-merger financial ratios. Rhoades (1993) analyzes the efficiency of horizontal bank mergers—those that *a priori* would be the most likely candidates for efficiency gains—between 1981 and 1986 by examining various expense ratios. He finds no evidence of efficiency gains. Studies that do find significant economies find most of the benefits on the revenue side. Cornett and Tehranian (1992), for example, find that merged banks produce superior cash flow returns due to their improved ability to attract loans and deposits.

Several authors have criticized comparison of pre- and post-merger financial ratios. Calomiris (1999) argues that post-merger performance evaluations must specify counterfactual benchmarks of what the bank's performance would have been if no merger had taken place. This procedure introduces selectivity bias in that only the merged banks are observed. In addition, the researcher must choose a time horizon over which gains are realized. If the horizon is too short, then potential benefits are missed. Peristiani (1997) argues that ratio comparison fails to account for X-efficiency gains. Using the standard translog cost function, he finds that post-merger performance depends on the ability of banks to strengthen asset quality; no evidence is found to support efficiency gains.

In sum, researchers have tried different approaches to measuring scale and scope economies at banks. The results generally fail to find evidence of significant economies, despite the growing asset concentration of commercial banks. In addition, the results depend critically on the technical assumptions, a problem that the survivor principle avoids.

## III. The Survivor Principle

The survivor principle is derived from microeconomic principles: the most efficient firms survive in the long run. The advantages of the survivor principle are simplicity and comprehensiveness. To apply the survivor principle, one must segment the industry by size and then observe what happens to market share through time in each size category. Those categories in which market share is growing over time presumably are more efficient than categories in which market share is shrinking.

The seminal article on the survivor principle was published by Stigler (1958), who argued that traditional accounting methodology failed to capture important scale and scope economies. Subsequent authors have applied this technique in manufacturing (Saving, 1961; Weiss, 1964), health care (Frech and Ginsberg, 1974), trucking (Keeler, 1989), and insurance (Blair and Vogel, 1978; Blair and Herndon, 1994).

The survivor principle is comprehensive; it captures the economies of integration, or all ways in which a large bank can be more efficient than a smaller bank. Economies of integration include scale and scope economies, but they also include revenue efficiencies and any other environmental or regulatory factors that have changed during the sample period. Therefore, this technique is not subject to the criticism of other methodologies that important economies are missed.

Besides being comprehensive, the survivor principle is specification-free; that is, the results do not depend on a particular cost or profit function. An important assumption, however, is the definition of output. For the banking industry, I choose bank assets because asset size is highly correlated with traditional output measures such as loans and deposits. In addition, the literature specifies bank scale and scope economies by asset size. The results, therefore, can be compared more easily to results from other methodologies. Because assets do not account for off-balance-sheet activities, I devise a methodology to include such services.

The survivor principle has at least four limitations when applied to banking. First, it cannot precisely determine quantitative output levels where economies or diseconomies of scale set in. Indeed, an industry's efficiency frontier may be lumpy, encompassing small and large firms alike. Many researchers, for example, argue that the banking industry can and will accommodate community banks and mega-banks because their product mix, technologies, and markets are so different. Because there are an infinite number of possible output ranges and size categories to test, at best, one can estimate scale and scope economies for reasonable ranges based on prior research. The results, however, may point to one local maxima, missing other equilibrium outcomes.

Second, this approach is not necessarily accurate for short-run analysis. We can reasonably assume that market share adjusts slowly to industry changes as firms fail, merge or expand; therefore, we observe movements to a new equilibrium, not necessarily new equilibrium outcomes. Consequently, economies of scale may be underestimated if market share would continue to shift to the larger firms after the researcher's sample period ends. On the other hand, we may overestimate scale economies if market share shifts to the larger firms after deregulation, for example, but banks find that they have over-expanded and subsequently begin to downsize. Over the long run, we can be more confident in the results.

A third limitation is that the survival principle assumes that firms are free to grow and contract as market conditions dictate; however, past regulation imposed severe geographic restrictions on banks. Intrastate branching laws were common until the early 1980s when many states relaxed their restrictions, and interstate branching was primarily restricted to holding company activity until passage of the Riegle-Neal Interstate Branching Efficiency Act in 1994. The Financial Modernization Act of 1999 only recently allowed banking organizations to venture into new activities. Consequently, measured economies of scale and scope are likely to be underestimated until the full impact of deregulation on the banking industry is complete.

A final limitation of the survivor principle is that it considers only private costs and benefits with no concern for social efficiency (Frech and Ginsburg, 1974). For example, a bank that gains market share over time may simultaneously attain considerable monopoly power. The survivor principle argues that such firms are always more efficient precisely because they have survived and weeded out their competitors. As a practical matter, the U.S. banking system is believed to be highly competitive; inefficiencies from monopoly behavior are likely to be small.

## IV. Application of the Survivor Principle to Banking

I apply the survivor principle to the banking industry between 1984 and 2002, examining market trends over six-year intervals. This 18-year period is long enough to observe meaningful changes in market share, although banking organizations certainly are still responding to branching and product deregulation.

Based on prior scale economies research, I group banks into five size categories based on assets. The smallest category includes banks with fewer than $100 million in assets. Other size categories range from $100 million to $300 million in assets, $300 million to $1 billion, and $1 billion to $10 billion. The largest category includes banks with more than $10 billion in assets. Assets are deflated by an index constructed from nominal GDP growth, using 1993 (the mid-point of the sample) as the base year. Such an index accounts both for inflation and real growth in the banking sector so that a bank will remain in a certain size class if it grows at the same rate as nominal GDP.

The results show that economies of integration are significant for banks with more than $10 billion in assets. Table 1 lists commercial bank assets by market share and number of firms. Between 1984 and 2002, banks with assets greater than $10 billion in assets increased their market share from 35.6 percent to 64.3 percent. Market share at every other size category declined during the period. The same pattern is observed in the number of banks. While banks of all sizes declined 45.6 percent during the period, banks with assets greater than $10 billion increased 70.4 percent. Banks with less than $100 million in assets performed the worst—market share declined more than 50 percent and the number of banks declined 47.2 percent.

| *Table 1* | *% of Total Commercial Bank Assets* | | | | *Number of Banks* | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ***Total Assets*** | **1984** | **1990** | **1996** | **2002** | **1984** | **1990** | **1996** | **2002** | **% chg** |
| ***less than $100 million*** | 10.4 | 9.3 | 7.3 | 5.1 | 10,097 | 8669 | 6681 | 5327 | -47.2 |
| ***$100-$300 million*** | 11.7 | 10.0 | 7.9 | 6.2 | 3020 | 2408 | 1873 | 1677 | -44.5 |
| ***$300 M – $1 bil*** | 10.4 | 9.3 | 7.5 | 6.2 | 863 | 724 | 561 | 550 | -36.3 |
| ***$1 bil - $10 bil*** | 31.9 | 37.3 | 31.3 | 18.2 | 383 | 383 | 314 | 233 | -39.2 |
| ***greater than $10 bil*** | 35.6 | 34.1 | 46.0 | 64.3 | 27 | 33 | 36 | 46 | 70.4 |
| ***Total*** | 100 | 100 | 100 | 100 | 14,390 | 12,217 | 9465 | 7833 | -45.6 |

Another interesting trend revealed in Table 1 is that banks with assets between $1 billion and $10 billion roughly held their market share until the 1996-2002 interval. A large portion of the decline between those years certainly was due to full enactment of interstate branching deregulation. The implication is—with the caveat that we are still in the short run in the deregulated environment—that interstate branching deregulation is allowing banks with assets greater than $10 billion to exploit significant economies of integration.

### IV.1. Accounting for Off-Balance-Sheet Assets

Because bank output is proxied with assets, the analysis thus far has excluded off-balance-sheet activity, which often appears on financial statements as noninterest income. As Boyd and Gertler (1993) document, off-balance-sheet activity has grown tremendously since the late 1980s. Banks provide significant quantities of loan commitments and letters of credit to their customers. In addition, many banks—especially the larger ones—engage in derivatives activity such as interest rate swaps. Beginning in 2001, derivatives are commonly marked to market and placed on banks' balance sheets; however, this change is not reflected in most of the 1984 to 2002 sample period. These off-balance-sheet activities must be included to measure the economies of integration more accurately.

I use the approach outlined by Boyd and Gertler (1994) to convert off-balance sheet activity into bank assets. This approach essentially capitalizes noninterest income flows by estimating the quantity of on-balance sheet assets required to generate the observed level of noninterest income. Following Boyd and Gertler (1994) I estimate off-balance sheet asset equivalents by the equation $A_o = A_b[Y/(I\text{-}E\text{-}P)]$, where $A_o$ is off-balance sheet assets, $A_b$ represents on-balance sheet assets, Y is noninterest income, I is interest income, E is interest expense, and P represents loan loss provision. The intuition behind the equation is that it should take the same amount of off-balance sheet assets to generate noninterest income as it takes of on-balance sheet assets to generate interest income (less loss provisions). The output measure used for the survivor principle is the sum of on- and off-balance sheet asset equivalents. Because the variance of the computed off-balance sheet assets was high, I constrained $A_o$ to lie in the $[0,A_b]$ interval. Results for all commercial banks are reported in Table 2.

| ***Table 2*** | ***% of Total Commercial Bank Assets adjusted for off-balance- sheet activity*** | | | | ***Number of Banks*** | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ***Total Assets*** | **1984** | **1990** | **1996** | **2002** | **1984** | **1990** | **1996** | **2002** | **% chg** |
| ***less than $100 million*** | 7.2 | 5.9 | 4.6 | 3.0 | 9221 | 7968 | 6119 | 4828 | -47.6 |
| ***$100-$300 million*** | 9.9 | 7.5 | 6.1 | 4.4 | 3573 | 2812 | 2225 | 1949 | -45.5 |
| ***$300 M - $1 bil*** | 9.3 | 7.5 | 6.0 | 4.7 | 1088 | 913 | 697 | 699 | -35.8 |
| ***$1 bil - $10 bil*** | 21.2 | 20.4 | 16.6 | 11.0 | 429 | 413 | 330 | 279 | -35.0 |
| ***greater than $10 bil*** | 52.4 | 58.8 | 66.7 | 77.0 | 79 | 106 | 94 | 77 | -2.5 |
| ***Total*** | 100 | 100 | 100 | 100 | 14390 | 12212 | 9465 | 7832 | -45.6 |

Inclusion of off-balance sheet activity has essentially no effect on measured economies of integration. Banks with assets greater than $10 billion gained market share rapidly, while the market shares of banks in all other size categories declined precipitously. This result should not be surprising because large banks have been at least as active in off-balance sheet activities as smaller banks. In sum, inclusion of off-balance-sheet activities only exaggerates the asset concentration in larger banks relative to the concentration shown in Table 1.

### IV.2. Application of the Survivor Principle to Holding Companies

Thus far, I have applied the survivor principle to bank-level data. However, bank holding companies (BHCs) exist in part to capture gains from economies of integration that were elusive to a particular bank prior to deregulation. Previous to the 1994 Reigle-Neal Interstate Branching Act, bank holding companies were the only entities legally able to operate across state lines by owning bank subsidiaries. Consequently, focus on bank-level data may miss some of the scale and scope economies from which holding companies previously benefited. In addition, the survivor principle identified massive growth in banks with more than $10 billion in assets between 1996 and 2002. Much of this activity could have resulted from holding companies simply merging subsidiaries into a single bank charter.

I consolidated bank assets by top-tier holding company, excluding non-bank holding company assets to focus more narrowly on scale economies in the banking industry, and because data on certain holding company non-bank assets are unavailable. I also excluded banks not affiliated with holding companies. This exclusion has little effect on aggregate banking assets. As of December 2002, 6,371 of the 7,764 banks were affiliated with holding companies, accounting for 97 percent of all banking assets. The first time period of the holding company analysis begins in 1986 rather than 1984 due to data limitations. Results of the survivor principle applied to holding companies appear in Table 3.

| ***Table 3*** | ***% of Total Holding Company Bank Assets by Holding Company*** | | | | ***Number of BHCs*** | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ***Total Assets*** | **1986** | **1990** | **1996** | **2002** | **1986** | **1990** | **1996** | **2002** | **% chg** |
| ***less than $100 million*** | 4.4 | 4.8 | 4.3 | 3.3 | 3842 | 3845 | 3439 | 3103 | -19.2 |
| ***$100-$300 million*** | 5.7 | 5.9 | 5.2 | 4.8 | 1376 | 1283 | 1149 | 1245 | -9.5 |
| ***$300 M - $1 bil*** | 4.9 | 5.3 | 5.1 | 5.2 | 395 | 375 | 358 | 448 | 13.4 |
| ***$1 bil - $10 bil*** | 19.2 | 17.6 | 11.7 | 10.9 | 232 | 197 | 144 | 164 | -29.3 |
| ***greater than $10 bil*** | 65.7 | 66.5 | 73.7 | 75.8 | 75 | 66 | 54 | 51 | -32.0 |
| ***Total*** | 100 | 100 | 100 | 100 | 5920 | 5766 | 5144 | 5011 | -15.4 |

Once again, the largest BHCs—those with assets greater than $10 billion—exhibit significant economies of integration. Their market share grew from 65.7 percent in 1986 to 75.8 percent in 2002. BHC market share for this size category, however, is significantly higher than *bank* market share listed in Table 1. In 1984, for example, banks with more than $10 billion in assets accounted for 35.6 percent of all assets. Clearly, the removal of geographic restrictions led BHCs to consolidate banks after 1994. A more surprising result is that holding companies with less than $1 billion in assets exhibit essentially constant returns to scale. The clear loser in market share is the $1 billion to $10 billion asset range. Although bank-level economies of scale and scope are overstated for the later years in Table 1 due to holding company affiliations, the Table 3 results confirm the existence of economies of integration between 1986 and 2002.

### IV.3. Economies of Integration at Community Banks

A difficulty in applying the survivor principle to the entire banking industry is that we may be identifying local maxima instead of global maxima. It could be the case, for example, that large banks have such different product mixes and technologies compared with smaller banks that the two groups of banks should be separated. The biggest banks service the large publicly traded firms that need access to significant funding; smaller banks cannot serve this market because they can only lend a certain percentage of capital to any one customer. Large banks primarily use objective, quantifiable measures to approve loan projects; community bank rely heavily on soft information. (DeYoung, Hunter, and Udell, 2004) The production technology and, hence, the economies of integration for large banks may be very different from that of community banks.

To apply the survivor principle to community banks, I eliminate all banks with assets greater than $1 billion (adjusted for nominal GDP growth) in each year.[1] The sample is split into four size categories, with the largest size ranging from $500 million to $1 billion. Although this analysis ignores the decline in market share from banks moving from less than $1 billion in assets to more than $1 billion in assets, it highlights market share trends within the community bank sector. If economies of integration at community banks are significant, we should observe smaller community banks losing market share to larger community banks.

| ***Table 4*** | ***% of Total Commercial Bank Assets for banks under $1 billion*** | | | | ***Number of Banks under $1 billion*** | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ***Total Assets*** | **1984** | **1990** | **1996** | **2002** | **1984** | **1990** | **1996** | **2002** | **% chg** |
| ***less than $100 million*** | 32.1 | 32.4 | 32.4 | 29.4 | 10,097 | 8,669 | 6681 | 5327 | -47.5 |
| ***$100-$300 million*** | 36.0 | 35.0 | 34.8 | 35.4 | 3020 | 2408 | 1873 | 1677 | -45.2 |
| ***$300 M - $500 M*** | 14.6 | 14.5 | 14.8 | 16.8 | 523 | 424 | 336 | 344 | -34.6 |
| ***$500 million-$1 billion*** | 17.3 | 18.2 | 18.0 | 18.4 | 340 | 300 | 225 | 206 | -40.6 |
| ***Total*** | 100 | 100 | 100 | 100 | 13980 | 11801 | 9115 | 7554 | -46.0 |

[1] An asset cutoff of $1 billion is a crude but commonly used definition of community banks.

The results reveal only slight economies of integration at community banks. Table 4 shows that market share for banks with less than $300 million in assets declined from 68.1 percent in 1984 to 64.8 percent in 2002. In contrast, market share for banks with assets greater than $300 million climbed from 31.9 percent in 1984 to 35.2 percent in 2002. The percentage change in the number of banks also indicates that scale economies are slight for community banks. The 47.5 percent decline in the smallest of the community bank size categories was nearly equal to the 46.0 percent decline in the number of community banks overall. These results suggest that, although the market share and number of community banks will continue to decline over time, community banks of all sizes will remain viable in the banking industry of the future.

## V. What Accounts for Growth in Market Share, Deregulation or Firm Size?

A weakness of the survivor principle is that the sources of the economies of integration are unknown. Intrastate and interstate branching deregulation, for example, certainly influenced survival patterns between 1984 and 2002. It is desirable to analyze scale economies and deregulation effects simultaneously to get a sense of each factor's relative importance. Using a methodology modified from Keeler (1989), we can attribute survivor patterns to multiple factors such as firm size and deregulation.

One can view the survival principle as modeling the probability of survival as a function of size. The survivor principle implicitly assumes that for each size class, $\Pr(MS_t > MS_{t-1}) = F(Size_{t-1})$, where $MS_t$ is the market share of the class at time $t$. By converting the probability function into a discrete variable with a value of 0 if market share does not increase and a value of 1 otherwise, we can derive a limited dependent regression model with size as the explanatory variable. In addition, we can easily incorporate other explanatory variables into the model. Defining $F$ as the cumulative logistic probability function, I estimate the following equation:

$$F^{-1}(P_i) = \alpha + \beta_0 Size_i + \beta_1 Intra_i + \beta_2 Inter_i + \beta_3 BHC_i + \varepsilon_i \qquad (1)$$

where $P_i$ is the probability of market share increasing between two pre-defined time periods for class $i$; *Size* is the average assets of the aggregated observation; *Intra* and *Inter* are dummy variables equal to 1 if, respectively, intrastate and interstate deregulation have occurred for banks in class $i$ at the beginning of the period; and *BHC* is a dummy variable equal to 1 if banks in class $i$ are part of a holding company during the sample period.[2] A positive sign for $\beta_0$ is an indication of economies of scale, while positive signs on the coefficients $\beta_1$ and $\beta_2$ would indicate that banks in states with the ability to branch within and across state lines, respectively, grew more quickly than those without such freedoms. The expected sign of $\beta_3$ is not clear. Being part of a holding company may make market share growth more likely as the holding company structure lends itself to more acquisitions; on the other hand, banks in holding companies may be more attractive candidates for takeovers than unaffiliated banks because several banks can be bought at one time by the purchasing entity.

Use of bank-level data in equation (1) leads to inefficient estimation because the survivor principle can only be usefully applied to broad classes of firms based on size. The technique is not precise enough to predict, for example, that a $300 million bank should survive relative to a $290 million bank.[3] However, to have enough degrees of

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[2] Data on the years in which states deregulated are available from Jayaratne and Strahan (1998).
[3] If we used bank-level data and a $290 million bank merged with a $300 million bank, the dependent variable of the smaller bank would receive a value of ‘1’ (showing that the bank grew) while the dependent

freedom to separate asset size from deregulation, we need to have a larger number of size classes than five—the number of classes we used in the standard technique above. I divide the sample into 11 size classes, with up to eight observations per class. The details for stratifying the sample into classes and observations are in the Appendix.

I run regression equation (1) during three time periods, 1986-1990, 1990-1994 and 1986-1994 because federal regulation largely eliminated branching restrictions after 1994. The results, shown in Table 5, suggest that branching deregulation was the primary force driving market share growth between 1986 and 1990 (Panel A). The coefficients on intrastate and interstate deregulation have the expected positive signs and are statistically significant at the one and five percent levels, respectively. In contrast, the coefficient on beginning-of-period firm size is statistically insignificant. The BHC coeffient is negative and statistically significant at the five percent level, suggesting that banks affiliated with BHCs were less likely to increase market share. For the 1990 to 1994 sample period (Panel B), none of the variables (except the intercept) are statistically significant. Finally, in the 1986 to 1994 period (Panel C), the intrastate deregulation indicator is significant at the five percent level, suggesting that banks in states that allowed within-state branching were able to increase market share. Interestingly, the firm size coefficient is essentially zero and statistically insignificant in all three regressions, suggesting that economies of scale were overshadowed by deregulation in fueling bank growth. These results are consistent with Jayaratne and Strahan (1998) who find that banks' efficiency improved sharply after intrastate branching restrictions were lifted

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value of the larger bank would receive a '0.' This methodology would misapply the survivor principle and introduce large standard errors into the regression results.

because better-managed banks expanded at the expense of the less efficient ones. Removal of interstate banking restrictions also produced a positive, but smaller, benefit.

**Table 5**

**Panel A**
**Analysis of Maximum Likelihood Estimates**
**(1986-1990)**

| **Parameter** | **Estimate** | **Chi-Square** | **P-value** |
|---|---|---|---|
| Intercept | 0.009 | 0.000 | 0.988 |
| Size | 0.000 | 2.052 | 0.152 |
| BHC Indicator | -1.531 ** | 4.277 | 0.039 |
| Intrastate Deregulation | 3.005 *** | 14.948 | 0.000 |
| Interstate Deregulation | 1.759 ** | 6.165 | 0.013 |

N = 77

**Panel B**
**Analysis of Maximum Likelihood Estimates**
**(1990-1994)**

| **Parameter** | **Estimate** | **Chi-Square** | **P-value** |
|---|---|---|---|
| Intercept | -1.394 ** | 4.075 | 0.044 |
| Size | 0.000 | 1.466 | 0.226 |
| BHC Indicator | 0.248 | 0.177 | 0.674 |
| Intrastate Deregulation | -0.661 | 1.268 | 0.260 |
| Interstate Deregulation | 0.882 | 2.011 | 0.156 |

N = 65

**Panel C**
**Analysis of Maximum Likelihood Estimates**
**(1986-1994)**

| **Parameter** | **Estimate** | **Chi-Square** | **P-value** |
|---|---|---|---|
| Intercept | -0.326 | 0.392 | 0.531 |
| Size | 0.000 | 0.358 | 0.550 |
| BHC Indicator | -0.824 | 2.607 | 0.106 |
| Intrastate Deregulation | 1.241 ** | 6.222 | 0.013 |
| Interstate Deregulation | 0.416 | 0.711 | 0.399 |

N = 77

Note: ***,**,* significant at the one, five, and ten percent levels, respectively.

## VI. Conclusion

A paradox within the banking literature is that the mega-banks continue to increase market share even as research shows that scale and scope economies in banking are small. Application of the survivor principle to the banking industry shows that large banks—those with more than $10 billion in assets—have exploited significant economies of integration between 1984 and 2002. The market share of these banks has grown rapidly over the sample period, while the market shares of banks in other size categories declined sharply. These results hold after accounting for off-balance-sheet activities and holding company affiliation.

The sample period in this study covers a period of unprecedented deregulation. Although the survivor principle cannot, by itself, separate scale economies from deregulation, a technique modified from Keeler (1989) finds that deregulation over the 1984 to 1994 period, especially intrastate branching deregulation, seemed to play an important role in fueling large bank growth. Banks in states that deregulated more quickly gained market share relative to banks in states that deregulated more slowly.

The dominance of large banks, however, does not necessarily imply that community banks are on the verge of extinction. Although the number of community banks has declined sharply since 1984, the market shares of small and large community banks within the community banking sector have remained relatively constant. In other words, the smallest community banks appear to be as viable as the largest community banks, suggesting that banks of all sizes will continue to play a role in the banking system of the future.

Although the application of the survivor principle to banking cannot resolve the scale economies paradox in banking, it does suggest that conventional estimates of scale and scope economies are missing key elements. One possible explanation is that the benefits to bank size accrue from revenue economies rather than cost economies. Or perhaps large firms derive meaningful political benefits and/or international prestige that allow them to conduct significant international activities. Finally, size may allow banks to benefit from an implicit too-big-to-fail subsidy or to reduce risk by achieving greater diversification. Of course, it may also be the case that recently merged banks will begin to shrink once they realize that the expected scale and scope economies are not forthcoming. Whatever the reason, researchers must find an explanation for the growth in bank size that is consistent with both the cost literature and the survivor principle.

## Appendix 1

The methodology for stratifying the bank sample into observations for use in regression analysis proceeded as follows. I selected a time period long enough to capture a reasonable degree of change in the industry—beginning with the 1986 to 1990 period—and split the sample into eight groups based on the intrastate and interstate deregulation environment that the bank operated in and whether the bank was part of a BHC. Because I chose these three characteristics to separate the sample, the number of different possible combinations was $2^3$.

For each of the eight groups, I divided the banks into 11 size classes based on assets, and aggregated the assets within those classes. The size classes were (in millions of dollars) 0-25, 25-50, 50-100, 100-200, 200-400, 400-700, 700-1000, 1000-2000, 2000-5000, 5000-10,000, and over 10,000. This process left a maximum of 88 (8 x 11) observations, with each observation consisting of an aggregated bank with similar size, deregulation, and holding company characteristics. To assign the value of the dependent variable, I computed the market share of each aggregated observation at both the beginning and end of the time period.[4] If market share increased over the time period, I assigned a value of one, zero otherwise.

It is important to understand how mergers influence the construction of the sample. Suppose that a large bank merged with another large bank in the same observation, a within-observation merger. Instead of assigning a value of one to the takeover bank and a value of zero to the now-defunct bank (which we would have done

[4] The end-of-period market share takes into account assets of *de novo* banks that were created after the beginning of the period. By including *de novo* banks in the market share calculation, we are reducing the market share calculations of the end-of-period observations, biasing the results against finding economies of scale. The bias is likely to be small, however, because *de novo* banks are typically small.

using bank-level data) our approach treats the merger as if it never happened. But if the merged firm grows for reasons other than the merger, then market share does increase. On the other hand, suppose that a bank merges with an out-of-observation bank. The market share of the observation that includes the acquiring bank increases while the market share of the observation with the purchased bank decreases. By observing the size and branching environments of the observations, we can attribute the probability of increased market share to each of these characterisics.

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