



Federal Reserve Bank of Chicago

## **Local Market Consolidation and Bank Productive Efficiency**

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WP 2002-25

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## Abstract

The recent banking literature has evaluated the impact of mergers on the efficiency of the merging parties [e.g., Rhoades (1993), Shaffer (1993), Fixler and Zieschang (1993)]. Similarly, there has been analysis of the impact of eliminating bank entry restrictions on the average performance of banks [Jayaratne and Strahan (1998)]. The evidence suggests that acquiring banks are typically more efficient than are acquired banks, resulting in the potential for the new combined organization to be more efficient and, therefore, for the merger to be welfare enhancing. The evidence also suggests, however, that these potential gains are often not realized. This has led some to question the benefits resulting from the recent increase in bank merger activity. We take a somewhat more comprehensive and micro-oriented approach and evaluate the impact of actual and potential competition resulting from market-entry mergers and reductions in entry barriers on bank efficiency. In particular, in addition to the efficiency gains realized by the parties *involved* in a bank merger, economic theory argues that additional efficiency gains should result from the impact of the merger on the degree of local market competition. We therefore examine the impact of increased competition resulting from mergers and acquisitions on the productive efficiency of *incumbent* banks. Our findings are consistent with economic theory: as competition increases as a result of entry or the creation of a more viable local competitor, the incumbent banks respond by increasing their level of cost efficiency. We find this efficiency increase to be in addition to any efficiency gains resulting from increases in potential competition occurring with the initial elimination of certain entry barriers. Thus, consistent with economic theory, new entrants and reductions in entry barriers lead incumbent firms to increase their productive efficiency to enable them to be viable in the more competitive environment. Studies evaluating the impact of bank mergers on the efficiency of the combining parties alone may be overlooking the most significant welfare enhancing aspect of merger activity. We do not find evidence of profit efficiency gains. In fact, the mergers are associated with decreases in profit efficiency; perhaps indicating that revenues may also be competed away from incumbents as a result of mergers.

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<sup>1</sup> The authors are affiliated with the Federal Reserve Bank of Chicago and Southern Illinois University, respectively. They acknowledge helpful comments on earlier drafts from Nicola Cetorelli, Bob DeYoung, Joe Hughes, Frank Skinner and participants in the 2000 International Atlantic Economic Society Meetings in Charleston, the 2001 Financial Management Association Meetings in Toronto and the 2002 American Economic Association meetings in Atlanta. Outstanding data and editorial support by Nancy Andrews, Portia Jackson and Sue Yuska is acknowledged and greatly appreciated. The views expressed are those of the authors and may not be shared by others including the Federal Reserve Bank of Chicago and the Federal Reserve System.

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## **Local Market Consolidation and Bank Productive Efficiency**

### **1. Introduction**

In the U.S., local banking markets have historically been protected from entry through a complex set of state and federal regulations. Significant industry consolidation, mostly in the form of mergers and acquisitions (M&As), has followed the deregulation that took place over the past two decades. Indeed M&A activity has been substantial over this period with some 350 bank mergers per year during the 1980s and expanding to over 550 per year during the 1990s. Although most of these involve smaller banks, interest in the impact of mergers has been significant and has recently been renewed with the combination of larger banks.

There is significant disagreement as to the effect of these mergers. Economic theory suggests that mergers can be an efficient means to restructure the industry allowing inefficient banks to exit the industry and more efficient firms to obtain efficient scale. However, the evidence on the welfare gains from merger activity has been mixed, at best. Indeed, as the result of studies finding relatively minor cost savings and adverse effects on the stock value of the acquiring firm, recent research has often questioned the motives of the management of acquiring banks. For example, evaluating the relationship between large mergers and executive compensation, Bliss and Rosen (2001) found evidence of agency problems and empirical support for the contention that mergers typically increase the wealth of the CEO, often at the expense of shareholders. So there appears to be little evidence of welfare enhancing benefits resulting from the recent increase in bank merger activity.

While previous research has evaluated the productive efficiency gains from merging banks, we take a broader perspective and evaluate potential benefits induced by market structure changes brought on by bank consolidation. Ours is a more comprehensive, micro-oriented approach that examines a group of banks that are expected to be indirectly affected by bank M&As: incumbent

banks that operate in the same market as the acquired bank. We examine changes in incumbent banks' productive efficiency following M&A. Our priors are that external entry into a market via an M&A or within-market consolidation will give a competitive incentive to other incumbent banks to improve the efficiency of their operations. While the bank productive efficiency research, and the bank M&A literature are rather extensive, the effect of entry on the efficiency of incumbent banks has not received as much attention. If one is interested in the potential welfare implications of bank merger activity, however, incumbents' cost reductions and revenue adjustments as a reaction to consolidation may dominate the impact found from concentrating exclusively on the merging parties.

In the next section we discuss the bank merger literature and align our work within that literature. In Section 3 our methodology and data sources are discussed. Our empirical findings are discussed in Section 4 and the final section summarizes.

## **2. Background and Motivation**

As the bank consolidation trend has increased in recent years there have been a number of studies to evaluate the potential impact of bank mergers. The issues considered include the potential impact on market competition [Savage (1993), Thomas (1991), Calem and Nakamura (1995), Prager and Hannan (1998) and Amel and Liang (1997)]; on market entry [Seelig and Crutchfield (1999) and Berger, Bonime, Goldberg and White (2000)]; and on credit availability [Rose (1993), Whalen (1995, 2001), Gunther (1997) and Berger, Demsetz, and Strahan (1999)].

The most common justification for bank mergers, however, is that they should result in cost reductions and superior operating efficiency. For years, the potential benefits resulting from mergers were evaluated by estimating the potential efficiency gains to be realized from scale

economies. Most of the bank cost literature, however, found that scale advantages were exhausted at relatively low levels of outputs and nearly constant returns to scale were rather common in the industry [for literature reviews see Berger, Demsetz and Strahan (1999), Berger and Humphrey (1997), Berger, Hunter and Timme (1993) and Evanoff and Israilevich (1991)].<sup>2</sup> More recently merger studies have evaluated the impact of bank mergers on the potential improvement in operating efficiency measured with either standard cost accounting ratios or as technical inefficiency representing production away from the cost frontier. Many of these studies find that while there appear to be significant potential efficiency gains from mergers [Rhoades (1993) and Shaffer (1993)] the gains typically are not realized [Berger and Humphrey (1992), Linder and Crane (1993), Rhoades (1993, 1994, 1998), Peristiani (1997), Shaffer (1993), and Srinivasan and Wall (1992)].<sup>3</sup>

One possible response to this literature, however, is to be critical of it and to argue that there may indeed be efficiency gains with mergers although they cannot be captured using this methodology. An alternative ‘catch-all’ methodology would be to evaluate how the stock market appraises the value of bank mergers. It may be that gains from either cost savings or from other merger benefits such as diversification are realized and viewed favorably by shareholders. This literature, however, is no more suggestive of merger benefits than is the cost efficiency literature. Hannan and Wolken (1989) and Houston and Ryngaert (1994) found that the merger announcements actually lead to a decrease in the value of the acquiring firm’s stock price. While increases in the acquired firm’s stock price may partially offset this loss, studies of the net benefits typically suggest either net losses are realized or, at best, the findings are inconclusive [see Rhoades (1994)].

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<sup>2</sup> An exception to this finding is the work of Hughes and Mester (1998).

<sup>3</sup> Again, there are exceptions: see Fixler and Zieschang (1993), Berger and Humphrey (1997), and Hughes, Lang, Mester and Moon (1999).

We take a different approach to evaluating potential welfare gains resulting from bank mergers. Our basic contention is, similar to the arguments of DeYoung, Hasan and Kirchhoff (1998) and Jayaratne and Strahan (1998), that the elimination of entry barriers should result in efficiency gains as institutions realize that their local market will no longer be protected by regulation. Similarly, and most importantly, actual entry by a firm into a local market should place competitive pressure on banks to improve operations to remain a viable competitor. In competitive markets, banks are also likely to face increased competitive pressure to reduce costs and adjust revenues as competitors in the local market merge. The potential for these latter effects may be particularly strong in the banking industry as past research has found acquiring banks to be relatively efficient, and thus, potentially, relatively aggressive competitors. Therefore, increases in both potential and actual competition should place pressure on incumbent banks to improve their operational efficiency. The first effect occurs when entry barriers are eliminated and the latter when consolidation actually occurs. We differ from previous research in that we are not assessing the efficiency of the bank actually involved in the merger. Rather we evaluate the parties that will be affected by the bank that is buying his way into a more viable role in the local market. Since we evaluate the impact on a larger number of banks the welfare implications could be quite large. Even small efficiency improvements by a large number of incumbents can lead to substantial industry-wide cost savings and revenue effects.

Our work most closely aligns with previous research by DeYoung, Hasan, and Kirchhoff (1998) who find that following the deregulation of laws that restricted interstate and intrastate banking, local banks' productive efficiency initially deteriorated, but then improved over time. However, it is not clear from this evidence how the incumbent banks in local markets reacted to

actual competitive entry.<sup>4</sup> It could be that the local banks, following deregulation, increased efficiency anticipating market entry. It could also be the case that banks waited for the actual consolidation before investing managerial time and effort to improve their efficiency. We separate out these potential effects.

### 3. Methodology and Data Sources

We examine the impact of entry on incumbent banks in both urban (as defined by MSA and CMSA) and in rural banking markets (as defined by counties). We use X-efficiency measures generated from the estimation of annual cost frontiers and alternative profit frontiers to conduct the analysis.<sup>5</sup>

Below we define the following cost relationship and resulting cost efficiency measures:

$$C_i = f^C(\mathbf{w}_i, \mathbf{y}_i, \mathbf{z}_i) (1 + Ineff_i^C) e^{v_i^C}$$

$$C_i = f^C(\mathbf{w}_i, \mathbf{y}_i, \mathbf{z}_i) \left( \frac{1}{Eff_i^C} \right) e^{v_i^C}$$

$$C_i = f^C(\mathbf{w}_i, \mathbf{y}_i, \mathbf{z}_i) e^{u_i^C} e^{v_i^C}$$

$$\ln C_i = F^C(\mathbf{w}_i, \mathbf{y}_i, \mathbf{z}_i) + u_i^C + v_i^C$$

$$\frac{1}{Eff_i^C} = e^{\hat{u}_i^C} \quad \Leftrightarrow \quad Eff_i^C = e^{-\hat{u}_i^C}$$

$$\text{where } \hat{u}_i^C = E(u_i^C | \varepsilon_i^C) \quad \text{and} \quad \varepsilon_i^C = u_i^C + v_i^C$$

where  $\mathbf{w}$ ,  $\mathbf{y}$ ,  $\mathbf{z}$  are vectors of factor prices, output levels, and fixed-netput levels, respectively.

Similarly, we define the following ‘standard’ profit relationship and resulting profit X-efficiency measures:

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<sup>4</sup> Although DeYoung, Hasan and Kirchhoff do evaluate the change in efficiency as the market share controlled by non-local firms changes.

<sup>5</sup> We also evaluated a standard profit frontier and found results similar to those using the alternative profit approach. Additionally, we utilize financial ratios in place of the technical efficiency measures to check the robustness of the results.

$$\begin{aligned}
P_i &= f^{StdP}(\mathbf{w}_i, \mathbf{p}_i, \mathbf{z}_i) (Eff_i^{StdP}) e^{v_i^{StdP}} \\
P_i &= f^{StdP}(\mathbf{w}_i, \mathbf{p}_i, \mathbf{z}_i) \left( \frac{1}{1 + Ineff_i^{StdP}} \right) e^{v_i^{StdP}} \\
P_i &= f^{StdP}(\mathbf{w}_i, \mathbf{p}_i, \mathbf{z}_i) e^{-u_i^{StdP}} e^{v_i^{StdP}} \\
\ln P_i &= F^{StdP}(\mathbf{w}_i, \mathbf{p}_i, \mathbf{z}_i) - u_i^{StdP} + v_i^{StdP} \\
Eff_i^{StdP} &= e^{-\hat{u}_i^{StdP}} \\
\text{where } \hat{u}_i^{AltP} &= E(u_i^{StdP} | \mathcal{E}_i^{StdP}) \quad \text{and} \quad \mathcal{E}_i^{StdP} = -u_i^{StdP} + v_i^{StdP}
\end{aligned}$$

where  $\mathbf{w}$ ,  $\mathbf{p}$ ,  $\mathbf{z}$  are vectors of factor prices, output prices, and fixed-netput levels, respectively. We also define (and report results based on) an ‘alternative’ profit relationship which consists of the dependent variable and composite error term of the ‘standard’ profit relationship and the explanatory variables of the cost relationship (where,  $\mathbf{w}$ ,  $\mathbf{y}$ ,  $\mathbf{z}$  are vectors of factor prices, output levels and fixed-netput levels, respectively).

To empirically relate bank performance to actual and potential market entry, in our first stage procedure we generate bank cost and profit frontiers for each year. We utilize the intermediation approach, accounting for both interest and noninterest expenses and estimate two-output, three-input, and two-fixed-netput translog cost and profit frontiers. Outputs are defined as loans and leases, and securities and are produced using labor, transaction deposits, and purchased funds. Physical capital and financial (equity) capital are included as fixed netputs as these are difficult to change in the short-term. The frontiers are estimated using semi-parametric translog functional forms. Previous research has shown that the standard translog function often does not provide an adequate representation of the frontier for all banks in the sample. Fourier transformations have been found to significantly improve the fit and, therefore, is the approach



taken in our analysis [see for example, Mitchell and Onvural (1996), McAllister and McManus (1993)]. Our resulting cost relationship is: <sup>6</sup>

$$\begin{aligned}
\ln\left(\frac{C}{w_3 z_2}\right) &= \alpha + \sum_{i=1}^2 \beta_i \ln\left(\frac{w_i}{w_3}\right) + \frac{1}{2} \sum_{i=1}^2 \sum_{j=1}^2 \beta_{ij} \ln\left(\frac{w_i}{w_3}\right) \ln\left(\frac{w_j}{w_3}\right) + \sum_{m=1}^2 \chi_m \ln\left(\frac{y_m}{z_2}\right) \\
&+ \frac{1}{2} \sum_{m=1}^2 \sum_{n=1}^2 \chi_{mn} \ln\left(\frac{y_m}{z_2}\right) \ln\left(\frac{y_n}{z_2}\right) + \delta_1 \ln\left(\frac{z_1}{z_2}\right) + \frac{1}{2} \delta_{11} \ln\left(\frac{z_1}{z_2}\right)^2 \\
&+ \sum_{i=1}^2 \sum_{j=1}^2 \gamma_{ij} \ln\left(\frac{w_i}{w_3}\right) \ln\left(\frac{y_j}{z_2}\right) + \sum_{i=1}^2 \mu_i \ln\left(\frac{w_i}{w_3}\right) \ln\left(\frac{z_1}{z_2}\right) + \sum_{m=1}^2 \theta_m \ln\left(\frac{y_m}{z_2}\right) \ln\left(\frac{z_1}{z_2}\right) \\
&+ \sum_{q=1}^5 [\theta_q \cos(\Psi_q) + \rho_q \sin(\Psi_q)] \\
&+ \sum_{q=1}^5 \sum_{r=1}^5 [\theta_{qr} \cos(\Psi_q + \Psi_r) + \rho_{qr} \sin(\Psi_q + \Psi_r)] + u^C + v^C
\end{aligned}$$

where<sup>7</sup>:

C: is the cost of production (including interest and noninterest expenses)

w<sub>1</sub>: price of labor – salaries and employee benefits divided by the number of full-time equivalent employees

w<sub>2</sub>: price of small deposits (core deposits) – interest expense on all deposits except wholesale CDs divided by the book value of all deposits except wholesale CDs

w<sub>3</sub>: price of purchased funds – interest expense on wholesale CDs, fed funds, repos, demand notes issued to the Treasury, other borrowed money, and subordinated notes and debentures divided by the book value of these liabilities

z<sub>1</sub>: physical capital – book value of premises and fixed assets

z<sub>2</sub>: financial (equity) capital – book value of equity

y<sub>1</sub>: securities – book value of interest bearing balances due from depository institutions, held-to-maturity and available-for-sale securities, fed funds sold, reverse repos, trading assets

y<sub>2</sub>: loans and leases – book value of total loans and leases

p<sub>1</sub>: price of securities

<sup>6</sup> See Berger and Mester (1997) for a discussion of our cost specification. We scale total costs by one of the input prices to insure factor price homogeneity, and by one of the fixed-netputs to avoid heteroskedastic joint-error terms.

<sup>7</sup> Bank and time subscripts are omitted here for clarity.

$p_2$ : price of loans and leases

$\cos(\Psi_q)$  and  $\sin(\Psi_q)$  are orthogonal trigonometric Fourier terms that are created based on rescaled cost function explanatory terms spanning the  $[0, 2\pi]$  interval.<sup>8</sup>

$u_i + v_i$  is a composite error term with  $u_i$  representing the efficiency term and  $v_i$  the random error term.

Assuming a half-normal distribution for the X-efficiency term,  $u_i$ , and a normal distribution for the symmetric error term,  $v_i$ , around the frontier, the X-efficiency estimate can be obtained as:

$$E[u_i | \varepsilon_i] = \frac{\sigma_u \sigma_v}{\sigma} \left[ \frac{\phi\left(\frac{\varepsilon_i \lambda}{\sigma}\right)}{\Phi\left(\frac{\varepsilon_i \lambda}{\sigma}\right)} + \frac{\varepsilon_i \lambda}{\sigma} \right]$$

where

$$\sigma = \sqrt{\sigma_u^2 + \sigma_v^2} \quad \text{and} \quad \lambda = \frac{\sigma_u}{\sigma_v}.$$

We define the ‘standard’ profit frontier by substituting (1) adjusted-variable profits instead of variable costs, (2) output prices instead of output levels, and (3) a composite error term that incorporates one-sided profit inefficiencies ( $-u_i$ ) and symmetric random error ( $v_i$ ). We also derive the ‘alternative’ profit frontier which is defined in terms of adjusted variable profits, output levels, fixed netputs, and a composite error structure ( $-u_i + v_i$ ).

The frontier relationships are estimated using a three-step procedure [see Kim and White (1998)]. First we estimate a cost (profit) function using Ordinary Least Squares (OLS). The function’s coefficient estimates together with the variance of the predicted error terms are used as starting values in the Maximum Likelihood Estimation where  $\lambda$  is assumed to be equal to 1. The coefficient estimates obtained from this second stage are then used as the starting values for the final Maximum Likelihood Estimation of the

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<sup>8</sup> Where the cost frontier terms are scaled into the  $[0.1 \times 2\pi, 0.9 \times 2\pi]$  range using the following transformation:  $\Psi_q = 0.2\pi - \mu \times \text{Min}(\varphi) + \mu \times \varphi$  and  $\mu = (0.9 \times 2\pi - 0.1 \times 2\pi) / [\text{Max}(\varphi) - \text{Min}(\varphi)]$ . For additional details, see Berger and Mester (1998).

complete model where the initial value of  $\lambda$  is set equal to 1. Two efficiency measures are generated from this process. An increase in either one is consistent with efficiency improvements. The first is an efficiency ranking relative to the sample for each year. Using the relative ranking decreases potential problems with having the efficiency frontier shift through time. However, we also generate X-efficiency measures and pool them across time and assume if there is a any shift in the frontier it has been a parallel shift across all banks, i.e., we allow for annual shift binaries in our performance estimation procedure.

We use a two-step procedure to evaluate changes in cost efficiency resulting from actual or potential mergers. We generate the performance measures from the annual frontier estimates. We then develop an unbalanced panel data set with over 140,000 bank observations over the 1984-1999 period and analyze the relationship between the performance measures and the increased competition resulting from potential entry (via the elimination of barriers) and actual consolidation. That is, the performance measures can then be regressed on alternative measures of merger activity or entry barrier reductions to capture their impact on performance.

$$Performance_{i,t} = a + \sum_{j=-2}^4 b_j MA_{i,t+j} + c InterBHC_{i,t} + d IntraBranch_{i,t} + e IntraBHC_{i,t} \\ + f AGE_{i,t} + g BVTA_{i,t} + h MSA_{i,t} + k HHI_{i,t} + l BHC_{i,t} + m PIG_{i,t} + D_i + D_t + \varepsilon_{i,t}$$

where

$Perf_{i,t}$  : the performance measure (either the X-efficiency index or accounting ratios. If the inefficiency index is used it is equal to 0 for the least efficient firm, 100 for the most efficient.)

$MA_{i,t+j} = 1$  if entry occurs in bank  $i$ 's market in year  $t+j$  ( $j \in \{-2, -1, \dots, +4\}$ ), and 0 otherwise.

$InterBHC_{i,t} = 1$  for all years following the year in which interstate BHC deregulation took place in bank  $i$ 's state, 0 otherwise.

$IntraBranch_{i,t} = 1$  for all years following the year in which intrastate branching deregulation took place, 0 otherwise.

$IntraBHC_{i,t} = 1$  for all years following intrastate BHC expansion deregulation in bank  $i$ 's state, 0 otherwise.

$AGE_{i,t}$  = Bank i's age in year t.

$BVTA_{i,t}$  = Book value of total assets (in 1999-dollars).

$MSA_{i,t}$  = 1 if bank i is located in a MSA or CMSA, 0 otherwise.

$BHC_{i,t}$  = 1 if bank i is the affiliate of a BHC, 0 otherwise.

$HHI_{i,t}$  is the Herfindahl Index for the local market.

$IG_{i,t}$  is percentage annual personal income growth in bank i's market.

$D_i$  is the bank fixed-effect for bank i.

$D_t$  is the year fixed-effect for year t (excluded when the X-efficiency rankings are used as the performance measure).

### 3.1 Data

Bank level financial data are obtained from the Report of Condition and Report of Income Statements (Call Reports) for the 1984-1999 period. Merger and acquisition information is from the Board of Governors Merger and Acquisition database. Summary statistics of the merger data are presented in Tables 1 and 2. In our analysis we also control for additional factors that may explain changes in bank performance such as banking market concentration, regional economic conditions, and the timing of deregulation. Regional personal income growth is used to control for local economic conditions at the county or MSA level. Personal income data are obtained from the BEA.

Concerning our deregulation information, we define intrastate branching deregulation as occurring when a state moves from unit or some form of limited statewide branching to unlimited statewide branching. Our intrastate branching indicator variable is set equal to one starting with the year in which unrestricted statewide branching legislation became effective, zero otherwise. In 1986 (the starting year of our sample) all states except Illinois, Kansas, North Dakota, and Texas allowed some form of statewide branching. We define intrastate multi-bank holding company (MBHC) deregulation as passage from limited to unrestricted operations for MBHCs within the state. Our indicator variable is set equal to one for the year the restriction is liberalized and

thereafter. Interstate MBHC deregulation occurs when legislation allows out-of-state BHC entry based on regional reciprocal, national reciprocal, or national non-reciprocal (whichever comes first). The indicator variable is set equal to one starting with the year the deregulation took place and thereafter, and zero otherwise. The sources of information for deregulation include Amel (2000) and Berger, Kashyap, and Scalise (1995, Table B6).

#### **4. Empirical Results**

Our estimates of the performance equation using the cost X-efficiency ratings for the entire sample are presented in the first column of Table 3. Over 140,000 observations are used in the estimation. We are interested in determining whether cost efficiency improves (i.e.,  $b > 0$ ) following mergers in the local market. However, it is possible that banks in markets where mergers occur are simply more efficient banks and would have been improving whether entry had occurred or not. To allow for this we also include measures, MA-, to capture changes in performance in the two years prior to the mergers. The results presented in column 1 of Table 3 do not indicate any efficiency improvement prior to entry. However, we do see improvements after entry, MA+, and the findings are consistent with our earlier discussion of banks attempting to improve their efficiency when they are confronted with actual competition via a merger in the local market. For the first three years following a merger in the market the cost efficiency (X-efficiency) of incumbent banks improves relative to banks in markets without entry. The coefficients for the merger variable in the year of the merger and four years afterwards are also positive, but are insignificant. The results are somewhat mixed for the influence of eliminating potential entry barrier, i.e., statewide branching barriers and intra- and inter-state restrictions on BHC expansion. Elimination of barriers to intra-state BHC expansion results in banks responding by improving cost X-efficiency (i.e.,  $e > 0$ ). We do not get this type of response for the other two entry barriers. The

deterioration in efficiency following inter-state BHC expansion is somewhat consistent with DeYoung, Hasan and Kirchoff (1988) who found efficiency deteriorated immediately following the elimination of entry barriers, but eventually (after 6 years) delivered gains in efficiency. The deterioration can be characterized as an adjustment period. It may be that a substantial portion of our bank observations do not have sufficient time for recovery during our sample period and a more complex binary structure may be needed to capture delayed improvements. Efficiency gains were not found to be realized by banks when statewide branching laws were relaxed; in fact the regulatory change was associated with deterioration in cost X-efficiency. Banks may have rapidly expanded their branch network and increased their costs during the transition period to the new environment. The results in column 1 also suggest that improvements in cost X-efficiency were also greater, *ceterus paribus*, for banks that were members of a holding company and were located in non-metropolitan areas. To summarize the findings, they are generally consistent with welfare enhancing effects from mergers, and less so with potential entry from new competitors.

For robustness checks we also conducted analyses using subsamples of the data. These results are also presented in columns 2-4 of Table 3. Using the efficiency rankings we analyze the largest quartile of banks, the highest quartile of banks ranked by the Market's HHI, and the subsample of mature banks, defined as those in existence over nine years. The latter subsample is included because previous work has shown newly chartered banks to have substantially different efficiency ratings [see DeYoung and Hasan (1998)].

The results are similar to those found using the overall sample. Efficiency was not improving prior to merger activity but did following the merger. In fact, the efficiency gains following mergers were greater in the subsamples. This is generally consistent with our priors:

larger banks may be more responsive to new or larger competitors and banks in highly concentrated markets potentially have the most room for efficiency gains from perceived increased competition.<sup>9</sup>

We get rather similar results using the efficiency measures instead of the rankings. Across the four samples, (columns 4-7 of Table 3) the banks did not appear to be increasing their efficiency prior to the merger activity, but did see advances following mergers (although the impact appears weaker in the large bank and mature bank subsamples). Again, however, using this efficiency measure across time requires some rather strong assumptions about changes in bank efficiency estimates across annual samples. Concerning influences from potential competition resulting from the elimination of entry barriers, our results are similar to those found with the efficiency rankings. The only barrier reduction that tends to be followed by efficiency gains is the elimination of the restriction to intra-state BHC expansion.

We also evaluate profit efficiency changes in markets following merger activity. We again use efficiency rankings to evaluate changes in the relative position of banks. Results for the full sample and alternative subsamples are presented in columns 9-12 in Table 3. Profit efficiency was either deteriorating or remaining relatively unchanged following market merger activity. This could result from increased (price) competition having significant effects on ‘revenue’ efficiency as banks may suddenly be required to charge more competitive loan rates or transaction fees than were previously charged. Combined with the cost efficiency finding, these results suggest that the adverse revenue effects were quite significant.

Finally, we also analyzed the impact of potential and actual entry on bank performance measured with accounting ratios. There are a number of potential reservations to keep in mind with this analysis. First, past studies have shown that simple accounting ratios may significantly misrepresent cost efficiency [DeYoung (1997, 1998)]. Second, while in the current analysis we are

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<sup>9</sup> However most of the potential apparently lies in the tails of the distribution as the HHI entered with a negative

accounting for time effects, we are not controlling for an array of additional influences, which may affect the ratios. Therefore the results using the accounting ratios should be viewed and interpreted cautiously. However the trends in these ratios following mergers may help explain the sources of efficiency gains or losses.

With the preceding caveat in mind, using various cost ratios as performance measures we relate these to the same measures of entry barrier reduction and entry via mergers as before. These results are presented in Table 4.<sup>10</sup> First we find that non-interest expenses relative to total assets decreases following market merger activity (column 1) although the change is not statistically significant. We also find that as merger entry occurs banks respond by controlling both labor costs and the cost of premises-and-fixed-assets (columns 2 and 4). The ratio of each of these expenses relative to total non-interest expense decreases with mergers. Again, this most likely occurs because these are items over which management has control in an attempt to become efficient in response to additional competition. However, these results should be interpreted with caution for the reasons discussed above.

## **5. Summary and Conclusions**

Much of the recent banking literature has evaluated the impact of mergers on the efficiency of the merging parties. The evidence suggests that while acquiring banks are typically more efficient than acquired banks, creating the potential for the new combined organization to be more efficient, these potential gains appear to often not be realized. This has led some to question the benefits resulting from the recent bank merger activity. We take a somewhat more comprehensive approach and evaluate the impact of actual and potential competition resulting from market-entry mergers and reductions in entry barriers on bank cost and profit efficiency. We consider both the

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coefficient in the full sample.



efficiency gains realized by *incumbent* banks in the affected banking market. Our findings are consistent with economic theory: as mergers occur, the incumbent banks respond to the increased competition by decreasing their costs and increasing their level of efficiency. We find this efficiency increase to be in addition to efficiency changes resulting from increases in potential competition occurring with the initial elimination of entry barriers. However, there are inconsistencies in our findings concerning efficiency gains around decreases in competitive barriers. While there are generally cost efficiency gains following the liberalization of restrictions on intra-state BHC expansion, these are insignificant or perverse when intrastate branching or inter-state BHC restrictions are eliminated. However, consistent with economic theory, new entrants via mergers lead incumbent firms to increase their productive efficiency to enable them to be viable in the more competitive environment. Thus, studies evaluating the impact of bank mergers on the efficiency of the combining parties alone may be overlooking the most significant welfare enhancing aspect of merger activity.

There are a number of potential extensions of the analysis. For example, the analysis could be integrated into the literature on strategic responses to takeovers [see Hughes, et al. (2001)]. This literature argues that as the threat of takeovers increase, the potential target firms will respond by increasing leverage to reduce the potential gains from acquisition. This should make them less attractive targets. Thus there may be a relationship between attempts to improve efficiency and incumbent bank capital ratios. The sample could be bifurcated into subsamples based on capital levels to see if the efficiency response differs.

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<sup>10</sup> Coefficients for the time dummies are again excluded from the table to save space.

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Table 1: Mergers & Acquisition Sample Statistics

Sample information covers the 1984-1999. The Merger & Acquisition (M&A) information comes from the Board of Governors of the Federal Reserve System’s M&A dataset. The sample excludes Government assisted M&As (i.e., excluding observation for which code=5 and/or merge\_cd=50).

**A: Breakdown of Mergers & Acquisitions by Organizational Structure Type**

	Number of M&As
<b>Within-BHC M&amp;As</b>	3,570
<b>Across-BHC M&amp;As</b>	3,378
<b>Independent Bank M&amp;As</b>	78
<b>BHC acquiring Independent Bank</b>	68
<b>Independent Bank Acquiring a BHC unit</b>	837
<b>Total</b>	<b>7,931</b>

**B: Breakdown of Mergers & Acquisitions by Entry Type**

The market is defined as a CMSA, MSA, or county. An institution’s market is defined as the largest-holder’s market (CMSA, MSA, or county for the highest-BHC if any exists, for the institution itself otherwise). Note that some of the largest markets, i.e. MSAs and CMSAs, span multiple states. The number of observations in this table may not necessarily add up to 7,931, as we could not match some of the market definitions across (i) Board’s M&A dataset which spans the whole calendar year, (ii) the Federal Deposit Insurance Corporation’s Summary of Deposits dataset which are collected each June, and (iii) the Call Reports which are end-of-year reports.

	Number of M&As
<b>Within-Market M&amp;As</b>	4,411
<b>Out-of-Market M&amp;As</b>	2,438
<b>Within-State M&amp;As</b>	5,622
<b>Out-of-State M&amp;As</b>	2,309

**Table 2: M&A-Affected Market and Bank Statistics**

Information on the number of M&As (row 2) is from the Fed's M&A database and includes some M&As involving non-banks. Information on the number of affected banks and markets is from the Call Reports and excludes non-commercial banks (non-commercial banks are not analyzed in the study). Banks with negative book value of total assets (BVT/A) or book value of equity are also deleted from the sample.

Number of	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Total
<b>Bank Observations (excludes the banks involved in the M&amp;As)</b>	11,222	11,349	11,065	10,579	10,175	9,918	9,776	9,537	9,288	8,964	8,585	8,142	7,529	7,330	6,908	6,552	146,919
<b>M&amp;As</b>	350	353	323	533	599	410	381	422	458	594	593	659	588	646	589	463	7,931
<b>Affected Counties</b>	95	84	99	98	154	158	134	114	138	134	187	210	169	184	173	142	2,273
<b>Affected MSAs</b>	70	79	77	103	95	81	84	92	85	112	113	129	107	131	129	86	1,573
<b>Affected Markets, Total</b>	165	163	176	201	249	239	218	206	223	246	300	339	276	315	302	228	3,846
<b>Incumbent Banks in Affected Counties</b>	305	262	349	326	627	586	487	401	500	468	592	634	526	500	471	411	7,445
<b>Incumbent Banks in Affected MSAs</b>	2,166	2,428	2,673	2,816	2,607	2,250	2,257	2,437	2,443	2,657	2,520	2,455	2,024	2,132	2,009	1,545	37,419
<b>Incumbent Banks, Total</b>	2,471	2,690	3,022	3,142	3,234	2,836	2,744	2,838	2,943	3,125	3,112	3,089	2,550	2,632	2,480	1,956	44,864

Table 3: Descriptive Statistics

X-efficiency estimates are obtained from cross-sectional translog-Fourier semi-parametric cost, standard profit, and alternative profit frontier estimates assuming half-normal - normal composite error term. Financial ratios are truncated at the 1% and 99% of their distributions to dampen the influence of outliers.

	Mean	Std. Dev.	Median	Max.	Min.	Obs.
Cost X-Efficiency	85.55%	8.34%	87.56%	99.05%	12.07%	146,919
Standard-Profit X-Efficiency	46.99%	16.50%	48.17%	90.37%	0.01%	146,919
Alternative-Profit X-Efficiency	47.74%	16.06%	49.03%	90.94%	0.01%	146,919
Total Costs / TA	7.50%	1.50%	7.43%	12.17%	4.51%	143,979
Non-Interest Expenses / TA	3.17%	0.96%	3.00%	7.22%	1.44%	143,979
Labor Expenses / Non-Interest Expenses	50.75%	7.28%	50.96	70.30%	28.91%	143,979
Fixed Asset Expenses / Non-Interest Exp.	13.67%	4.25%	13.40%	26.81%	3.88%	143,979
Fixed Assets / TA	1.62%	1.03%	1.41%	5.57%	0.11%	143,979
Interest Expenses / TA	4.31%	1.29%	4.34%	7.44%	1.71%	143,979
Interest Revenue / TA	8.35%	1.29%	8.32%	11.64%	5.47%	143,979
Non-Interest Revenue / TA	0.73%	0.44%	0.62%	2.99%	0.12%	143,979
Transaction Deposits / TA	25.43%	7.31%	24.53%	49.29%	10.55%	143,979
Non-Transaction. Deposits / TA	62.79%	7.82%	63.57%	78.86%	37.78%	143,979
Total Loans / TA	52.71%	13.42%	54.00%	80.42%	16.81%	143,979
ROA	0.93%	0.70%	1.02%	2.41%	-3.25%	143,979
ROE	9.94%	9.72%	11.31%	27.95%	-73.46%	143,979
Equity / TA	8.95%	2.63%	8.47%	19.09%	0.01%	145,449
InterBHC	0.77	0.42	1	1	0	146,919
IntraBHC	0.47	0.50	0	1	0	146,919
IntraBranch	0.41	0.49	0	1	0	146,919
Age	64.34	33.91	72	197	6	146,919
BVTA (millions of 1999 \$)	122.19	318.65	60.31	18,939.00	2.00	146,919
MSA	0.62	0.49	1	1	0	146,919
BHC	0.72	0.45	1	1	0	146,919
HHI	0.2588	0.1706	0.2193	1.0000	0.0273	146,919
IG	5.31%	4.94%	5.12%	112.38	-49.93%	138,774



**Table 4: Fixed Bank-Effect Models Using X-Efficiency Estimates**

$$Performance_{i,t} = a + \sum_{j=2}^4 b_j MA_{i,t+j} + c InterBHC_{i,t} + d IntraBranch_{i,t} + e IntraBHC_{i,t} + f MSA_{i,t} + g HHI_{i,t} + h BHC_{i,t} + D_i + \varepsilon_{i,t}$$

X-efficiency estimates are in percentages: a coefficient estimate of 1.0 corresponds to a 1.0% increase in the dependent variable given a unit change in the explanatory variable. X-efficiency rankings range between 0 for the least X-efficient bank and 100 for the most efficient bank in each year. Models are estimated over the 1984-1998 period.  $MA_{i,t+j}$  dummy variable is equal to 1 in year  $t+j$  if a M&A takes place in bank  $i$ 's market ( $j \in \{-2, \dots, +4\}$ ), and 0 otherwise. InterBHC is an indicator variable that is equal to 1 following the deregulation of out-of-state Bank Holding Company entry into bank  $i$ 's host state, and 0 otherwise. IntraBHC is an indicator variable that is equal to 1 following the deregulation of within state BHC expansion in bank  $i$ 's host state, and 0 otherwise. And IntraBranch is an indicator variable that is equal to 1 following the deregulation of within-state branching restrictions and 0 otherwise. MSA is an indicator variable that is equal to 1 if the bank is located in a Metropolitan Statistical Area and 0 otherwise. BHC is an indicator variable that is equal to 1 if bank  $i$  is a member of a BHC, 0 otherwise. HHI is the Herfindahl-Hirschman Index for banking market (county or MSA) concentration calculated using deposits. Year-effects (D<sub>*i*</sub>) are added when the dependent variable is the X-efficiency estimates. Standard errors are presented below the coefficient estimates.

	Cost X-Efficiency Rankings:	Non Local Entry	Cost X-Efficiency Estimates:	Full Sample	Cost X-Efficiency Estimates:	Non-Local Entry	Cost X-Efficiency Estimates:	High Concentration Markets	Cost X-Efficiency Estimates:	Largest Bank Quartile	Alt.-Profit X-Eff. Rankings:	Full Sample	Alt.-Profit X-Eff. Rankings:	Non-Local entry	Alt.-Profit X-Eff. Rankings:	High Concentration Markets	Alt.-Profit X-Eff. Rankings:	Largest Bank Quartile	
Constant	51.13801 .3955224	49.90154 .9852559	52.02252 .4194639	56.65084 1.001804	87.37568 .1152727	87.58877 (.2815677)	87.69419 (.1211758)	88.25834 (.2744501)	53.01796 (.2515815)	54.78098 (.6252778)	52.92981 (.2691415)	54.78098 (.6252778)	53.01796 (.2515815)	54.78098 (.6252778)	52.92981 (.2691415)	54.78098 (.6252778)	52.92981 (.2691415)	54.78098 (.6252778)	17.94136 (.5491401)
MA <sub>2</sub>	-.0067454 .139509	.9679921 .5003731	-.077857 .1588268	.3827389 .2526015	-.0098481 .0401914	.3011207 .1371728	-.0463717 .0441815	.0438597 .0701403	.525928 .089189	.224537 .3175542	.4579369 (.0999835)	.224537 .3175542	.525928 .089189	.224537 .3175542	.4579369 (.0999835)	.224537 .3175542	.4579369 (.0999835)	.224537 .3175542	.6035185 (.1384639)
MA <sub>-1</sub>	-.0841756 .1397598	.1093367 .5106717	-.0279923 .157244	.0092469 .2522746	-.0542833 .0399384	-.0049126 .1400408	-.0421096 .0442977	-.0239355 .0692204	.3739468 .0893494	.0428771 .3240901	.3546815 (.1008928)	.0428771 .3240901	.3739468 .0893494	.0428771 .3240901	.3546815 (.1008928)	.0428771 .3240901	.3546815 (.1008928)	.0428771 .3240901	.7102183 (.1382847)
MA <sub>0</sub>	-.0074875 .1465984	1.322327 .5054066	.4243353 .2003557	-.1659537 .2760745	-.0241953 .041341	.3065684 .138562	.1053931 .0556919	-.0715322 .0741018	.1535411 .0937213	.3139432 .3207487	-.2164146 (.1285547)	.3139432 .3207487	.1535411 .0937213	.3139432 .3207487	-.2164146 (.1285547)	.3139432 .3207487	-.2164146 (.1285547)	.3139432 .3207487	.2367202 (.1513306)
MA <sub>-1</sub>	.3732874 .1437712	1.061158 .5186515	.3271655 .1650187	.44255 .2629468	.0703613 .040799	.3943617 .1421023	.0796475 .0459193	.0022055 .0717633	-.2984393 .0919139	.2698775 .3291544	.0774095 (.1058813)	-.2984393 .0919139	.2698775 .3291544	.0774095 .3291544	.0774095 (.1058813)	.2698775 .3291544	.0774095 (.1058813)	.2698775 .3291544	.1351032 (.1441347)

MA <sub>2</sub>	.5157765	1.636647	.4386099	.4094847	.1084121	.4837166	.1058959	-.0250129	-.6159159	-.6358517	-.5119965	-.0067016
	.1488913	.5585496	.169045	.2712531	.0421315	.1530295	.0470991	.0736721	.0951872	.3544751	.1084647	.1486878
MA <sub>3</sub>	.6597956	1.616009	.7284296	.8744246	.1865341	.4345818	.2454697	.1351903	-.6426959	-.0854656	-.6300672	-.1838778
	.1560323	.5946723	.1769672	.2826693	.044348	.1628157	.0494382	.0776946	.0997525	.3773998	.1135478	.1549456
MA <sub>4</sub>	.5980584	.8750122	.6537067	.626805	.1356205	.3580932	.229892	.1149502	-.6754814	.5457083	-.6778373	-.6969612
	.1609307	.6238533	.1830717	.2900931	.0461913	.170869	.0516426	.0813332	.1028841	.3959191	.1174647	.159015
InterBHC	-1.093454	-1.556757	-1.264052	-.4353412	-.0308641	-.0273276	.0092239	-.5122992	1.171524	1.633844	1.340455	.1256522
	.1440754	.280353	.1529561	.3272047	.054105	.1001712	.0573515	.1152567	.0921084	.1779218	.0981415	.1793578
IntraBHC	1.502678	-.7423617	-.1565492	1.131526	.6583583	.1308328	.3278571	.5407665	-.2.2786	-.2.596324	-.1.094729	-.1.540121
	.3485717	1.382474	.4250944	.5781077	.0988413	.3791694	.1186372	.1553946	.2228442	.8773662	.2727542	.3168906
IntraBranch	-3.404531	-4.451171	-3.320927	-5.000174	-.5810094	-.9178507	-.575424	-.5884603	-.3350524	.6570461	-.4087215	1.334655
	.1523199	.3348396	.1628224	.3143132	.0493874	.102367	.0519609	.0986203	.0973791	.2125009	.1044721	.1722913
MSA	-2.241786	-1.762583	-2.089626	-1.478665	-.4881411	-.6556636	-.4697526	.1143778	-1.94914	-2.232926	-1.848085	.6582419
	.5205306	1.793461	.5765987	1.117105	.1463586	.492626	.1598916	.298323	.3327788	1.138193	.3699642	.6123427
BHC	1.354095	1.084239	1.25033	-.6982564	.7348785	.6573614	.7087707	.1966594	-.6152419	.2592253	-.4625105	.3910114
	.2038919	.4258997	.2192393	.4706249	.0587141	.1201226	.062264	.1277872	.1303495	.2702909	.140671	.2579737
HHI	1.766578	5.481053	2.69891	8.292748	-.4246577	.6954644	-.2985291	.8001882	-.7712375	-4.654366	-1.202534	.1091123
	.9124996	1.572402	.9732049	2.005306	.2664852	.4429454	.2806909	.555106	.5833671	.9979011	.6244395	1.099211
Bank-years	146,919	32,458	126,702	36,729	146,919	32,458	126,702	36,729	146,919	32,458	126,702	36,729
Num.of Banks	14,607	4,148	14,357	5,380	14,607	4,148	14,357	5,380	14,607	4,148	14,357	5,380
Ave. Obs. per Bank	10.1	7.8	8.8	6.8	10.1	7.8	8.8	6.8	10.1	7.8	8.8	6.8
F Statistic	59.81	26.08	55.63	26.07	414.20	118.54	377.87	121.33	50.11	14.69	30.66	13.21
R <sup>2</sup>	.58%	1.20%	.64%	1.1%	8.10%	10.5%	8.6%	9.8%	.50%	.67%	.35%	.55%

**Table 5: Fixed Bank- & Year-Effect Models Using Accounting Ratios**

$$Performance_{i,t} = a + \sum_{j=2}^4 b_j MA_{i,t+j} + c InterBHC_{i,t} + d IntraBranch_{i,t} + e IntraBHC_{i,t} + f MSA_{i,t} + g HHI_{i,t} + h BHC_{i,t} + D_i + D_t + \varepsilon_{i,t}$$

All performance variables are in percentages: a coefficient estimate of 1.0 corresponds to a 1.0% increase in the dependent variable given a unit change in the explanatory variable. To avoid the effects of the outliers for financial ratios, we truncate financial ratios at 1<sup>st</sup> and 99<sup>th</sup> percentiles of their distributions. BVTA represents the Book Value of Total Assets. Non-interest expenses include salaries and employee benefits (labor expenses) and expenses of premises and fixed assets (fixed asset expenses), and other non-interest expenses. To generate levels of capitalization the sample is divided into highly capitalized (highest 2/3 of the sample) and lowly capitalized banks (lowest 1/3 of the sample). Capital ratios are based on book values. MA<sub>t+j</sub> dummy variable is equal to 1 in year t if a M&A takes place in year t+j in bank i's market (j ∈ {-2, ..., +4}), and 0 otherwise. InterBHC is an indicator variable that is equal to 1 following the deregulation of out-of-state BHC entry into bank i's host state, and 0 otherwise. IntraBHC is an indicator variable that is equal to 1 following the deregulation of within state BHC expansion in bank i's host state, and 0 otherwise. And IntraBranch is an indicator variable that is equal to 1 following the deregulation of within-state branching restrictions, and 0 otherwise. BVTA is the book value of bank's total assets in millions of 1999 dollars at year-end t. MSA is an indicator variable that is equal to 1 if bank i is a member of a BHC, 0 otherwise. HHI is the Herfindahl-Hirschman Index for banking market (county or MSA) concentration calculated using deposits. Year-effect (D<sub>t</sub>) coefficient estimates are not reported to conserve space. Models are estimated over the 1984-1998 period. Standard errors are presented below the coefficient estimates.

	1	2	3	4
Constant	3.030366 .0115072	6.41782 .0092079	9.869467 .0379735	6.31795 .0449873
MA <sub>-2</sub>	.0065675 .0040296	-.016624 .003179	-.0248952 .0136712	.1292664 .0125909
MA <sub>-1</sub>	-.0036836 .0040053	-.0227674 .0031554	-.0473147 .013557	.1580999 .012478
MA <sub>0</sub>	-.0002204 .0041379	-.015463 .00326	-.043416 .0138548	-.0150372 .0133259
MA <sub>+1</sub>	-.0121681 .0040883	-.0029161 .0032222	-.0681516 .013828	-.0185935 .012847
	Non-Interest Expenses BVTA	Total Assets Interest Expenses	Expenses of Premises & Fixed Assets BVTA	Interest Expenses Total Assets

MA <sub>t-2</sub>		-.0190556	.0198853	-.0659936	.0220927
		.0042232	.0033255	.014214	.0133101
MA <sub>t-3</sub>		-.0219864	.0396052	-.0522017	.0296648
		.0044443	.0034984	.0147695	.0143289
MA <sub>t-4</sub>		-.0245283	.0404194	-.0707842	-.0156985
		.004634	.0036478	.015375	.0152206
InterBHC		.0012547	-.0157051	.0276459	-.1161628
		.0054074	.0042602	.0185631	.017534
IntraBHC		-.0046115	.0692137	.2008434	.1768953
		.0098804	.0078593	.0352343	.030895
IntraBranch		.0574765	-.041574	.0100766	-.1993408
		.0049382	.003903	.0169854	.016812
MSA		.0824664	-.042802	.0228014	-.1205616
		.0146203	.011578	.0486701	.0571255
BHC		-.014992	.0403241	-.4563021	.184335
		.0058935	.0046688	.0193679	.022492
HHI		.016144	-.0829465	-.1907816	.0349888
		.0266902	.0211444	.0886222	.0973863
Total Bank-years		138,009	143,979	96,966	48,483
Number of Banks		14,520	14,465	11,973	10,028
Average Bank-years		9.9	10.0	8.10	4.81
F Statistic		164.1	41,635	388.93	85.53
R <sup>2</sup>		3.44%	90%	11.36%	5.9%

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