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Scale Economies and Geographic Diversification as Forces Driving Community Bank Mergers

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The Importance of Scale Economies and Geographic Diversification in Community Bank Mergers

Abstract

Mergers of community banks across economic market areas potentially reduce both idiosyncratic and local market risk. Idiosyncratic risk may be reduced because the larger post-merger bank has a larger customer base. Negative credit and liquidity shocks from individual customers would have smaller effects on the portfolio of the merged entity than on the individual community banks involved in the merger. Geographic dispersion of banking activities across economic market areas may reduce local market risk because an adverse economic development that is unique to one market area will not affect a bank's loans to customers in different market areas.

This paper simulates the mergers of community banks both within and across economic market areas by combining their call report data. We find that the potential for idiosyncratic risk reduction dominates the marginal contribution to risk reduction by diversifying across local markets. In other words, a typical community bank can reduce its insolvency risk about as much by merging with a bank across the street as it can by merging with one located across the country. The bulk of the pure portfolio diversification effects for community banks, therefore, appears to be unrelated to diversification across market areas and instead is related to bank size. These findings may help explain why many community banks have not pursued geographic diversification more aggressively, but they beg the question as to why more small community banks do not pursue in-market mergers.

The Importance of Scale Economies and Geographic Diversification in Community Bank Mergers

1. Introduction

Largely as a result of previous branching restrictions, most U.S. banks are small community banks. As of March 2001, 58 percent of banks (4,732 of 8,174) had less than $100 million in assets, and 95 percent of banks had fewer than $1 billion in assets. In addition, most U.S. banks have geographically concentrated operations. As of June 2000, 62 percent of U.S. banks derived all of their deposits from offices in a single county.

Small community banks pose special challenges to bank supervisors because such banks are more likely to fail than larger banks. Shibut (2001) shows that failure rates and FDIC loss rates decrease as bank size increases. These observations raise several questions. Should supervisors require small or geographically undiversified banks to maintain higher capital ratios than other banks? Should supervisors encourage banks to undertake in-market or out-of-market mergers to reduce risk? Which type of merger would yield the largest reduction in risk? These questions are relevant for bank supervisors' risk-focused supervision of community banks (Board of Governors, 1997), as that approach to supervision involves identifying factors that influence the risk assumed by banks rather than just focusing on their problem loans.

In an analysis of the risk assumed by community banks, it is relevant to distinguish between idiosyncratic risk and local market risk. Idiosyncratic risk is unique to each bank. The factors that influence idiosyncratic risk include the quality of a bank's management and the ability of its borrowers to repay their loans. Banks can reduce their idiosyncratic risk by merging with other banks. The larger the number of loan customers served by a bank, the smaller the effect that one borrower's default will have on the bank's profits. In theory a bank could reduce its idiosyncratic risk by merging either with a bank located across the street or one located across the nation.

A bank with all of its offices in one community is vulnerable to local market risk: the probability that the bank's customers will repay their loans is affected by the same events. Clearly, then, two banks with all of their offices in the same community cannot diversify their local market risk by merging with each other. Because a bank reduces its market risk by providing services to customers located in more than one community, a bank that operates all of its offices in one community could diversify its market risk by merging with banks that operate offices in other communities.

A particular concern regarding geographically concentrated community banks is their vulnerability to business cycle downturns. Many economists and regulators alike have suggested that out-of-market mergers may reduce the risk of insolvency through geographic diversification, allowing more banks to remain viable through business cycle troughs. If geographic diversification benefits are important, the elimination of interstate branching restrictions through the Riegle-Neal Act of 1994 should have encouraged community banks to insulate themselves better from deteriorating local economic conditions through out-of-state merger activity.

In fact, however, 92 percent of community bank mergers during the 1998-2000 period occurred between banks in the same state, and 32 percent of community bank mergers took place between banks located in the same local market.[1] This presents something of a puzzle that our study addresses. We use a simulation technique that permits us to distinguish the way in which the scale of a bank's assets affects risk (idiosyncratic risk) compared with the way in which the geographic dispersion of its offices affects risk (local market risk). Each bank in our sample is relatively small and has all of its offices in one county. We create a large number of hypothetical banks by merging the accounting statements of the sample banks. We identify local markets as "labor market areas" (LMAs). The Bureau of Labor Statistics defines an LMA as an economically integrated geographic area in which individuals can reside and find employment within a reasonable distance or can readily change employment without changing their place of residence (Bureau of Labor Statistics, 2001). Some LMAs are metropolitan statistical areas (MSAs), whereas other LMAs are single counties or groups of counties not defined as MSAs. We assume that different banks located in the same LMA are affected by similar economic forces. Some of the hypothetical banks we create have all of their offices in the same LMA and others have offices dispersed over wide geographic areas. We calculate several risk measures for each of the merged banks and compare them with the risk measures of the unmerged sample banks.

We examine the effects of mergers on risk in two dimensions. Holding constant the degree of geographic diversification, we examine the effects of scale on the measures of risk by increasing the number of sample banks merged into the hypothetical banks. We examine the effects of the geographic dispersion of banking offices on risk by merging banks across larger and larger geographic areas, holding constant the number of sample banks merged into the hypothetical banks. At one extreme, each hypothetical bank has all of its offices in one LMA; at the other extreme, each hypothetical bank has offices in more than one Census division of the nation.

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[1] Mergers between community banks (each with assets below $400 million) accounted for about one third of all bank mergers during this period.

Our results indicate that scale economies dominate the merger-related benefits of geographic diversification in reducing community bank risk. Mergers of banks with all of their offices in the same LMA have about the same effects on risk as mergers of banks with offices in different parts of the nation. This simulation evidence is consistent with the pattern of mainly in-state and often in-market mergers among community banks observed during 1998-2000. Of course, geographic diversification might have been more valuable in earlier periods, but our recent sample period provides unambiguous support for the dominance of achieving scale over geographic dispersion as a risk-reduction strategy for community banks.

2. Overview and Literature Review

Diamond (1984) formalized the basic intuition of portfolio diversification as a source of risk reduction for banks. Diamond's insight was that a bank, as an investor in risky assets, benefits from portfolio diversification, however it is obtained. A bank can reduce the default risk of its portfolio of assets without a corresponding decline in expected return by combining assets with payoffs that are less than perfectly correlated, even if they are exposed to many of the same risks (e.g., the local economy). For example, a bank can operate on a more favorable risk-return frontier simply by increasing the size of its asset portfolio—in principle, without limit. Alternatively, a bank could achieve a more favorable risk-return tradeoff at any given scale of operation by holding more diverse assets. Our study attempts to separate the "pure" scale effect on risk reduction from the conceptually distinct geographic diversification effect on risk, holding scale constant. As our literature review shows, this distinction is not easy to maintain when studying actual mergers, which typically combine increases in scale and geographic diversity.

2.1 Diversification Through Increasing Scale

In practice, no market economy comes close to a monolithic banking-sector structure. A voluminous literature has attempted to answer the question, "Why aren't banks few in number and very large, as Diamond predicted?" An important part of the answer involves restraining and offsetting effects. Government regulation of industry structure in all market economies prevents a monopoly bank from forming; in the United States, chartering restrictions and merger guidelines tend to keep individual banks small with respect to the size of the national economy (and relative to leading firms in other industries). However, economic rather than regulatory (antitrust) constraints probably are more relevant in the vast majority of actual or potential bank mergers (Kwast, 1999, pp. 634-35).

The literature has identified economic reasons why banks remain much smaller than Diamond's theory predicts. In particular, there appear to be diseconomies of scale—due to managerial inefficiencies, for example—that offset pure portfolio diversification effects as a bank becomes larger. As banks grow, organizational diseconomies may increase at an increasing rate while efficiency gains from scale economies increase at a decreasing rate.

Studies using many different datasets and methodologies have identified a maximum efficient size for U.S. banking organizations that lies far below the largest existing institutions, each of which, in turn, represents only a small fraction of the entire banking sector. Most estimates of maximum efficient size lie in the range of $100 million to $25 billion of assets (Berger *et al.*, 1999, pp. 158-59), whereas the largest U.S. banks have hundreds of billions of dollars of assets and total banking assets are measured in trillions of dollars. A recent set of empirical estimates based on several parametric and non-parametric estimation methods, for the period 1985-94, locates the maximum efficient size for banks between $300 million and $500 million of assets (Wheelock and Wilson, 2001). On average, banks below this range face increasing returns to scale, while banks in or above the range face constant or decreasing returns to scale.

2.2 Diversification Through Geographic or Industry Risk-Pooling

Beginning in the 1980s, banking crises occurred in different regions of the country and among banks that had specialized in different economic sectors, including agriculture, energy and commercial real estate. Many researchers suggested that greater portfolio diversification—with associated improvements in the risk-return frontier facing many banks—might be achieved not through greater scale alone but by pooling exposures to a variety of "environmental portfolios" (defined by Gunther and Robinson (1999) in terms of industries and/or geographic locations). Many papers identify hypothetical or actual cost-, risk- or profit-efficiency gains through greater geographic or industry diversification (Liang and Rhoades, 1988; Boyd *et al*. 1993; Levonian, 1994; Rose, 1996; Demsetz and Strahan, 1997; Rivard and Thomas, 1997; Gunther and Robinson, 1999; Laderman, 1999; Hughes *et al.*, 1999; Allen and Jagtiani, 2000; Berger and DeYoung, forthcoming). Because most of these papers focus on medium- or large-sized banks, it is not clear whether their conclusions apply to small banks.

Two issues concerning potential risk-reduction gains from geographic diversification are particularly important for smaller banks. First, given that risk reduction from increasing scale may not be exhausted for these banks, geographic-diversification gains may turn out to be relatively small and unimportant in comparison. Second, greater geographic dispersion of a small bank's operations may induce significant operational inefficiencies, detracting from the potential benefits of geographic diversification. Informal discussions with experienced bank supervisors indicated that "over-reaching" by small banks diversifying out of their local market can become a significant operational risk.

2.3 Which Type of Diversification—Increasing Scale or Geographic Diversity— is More Important for Community Banks?

In theory, all banks—including small ones—could benefit from geographic diversification. However, Neely and Wheelock (1997) find that small banks are not well diversified geographically. Profit-maximizing owners of small banks, therefore, may not expect geographic expansion to be profitable. Alternatively, Meyer and Yeager (2001) show that small rural banks are not particularly exposed to local (county-level) economic fluctuations. Consequently, expansion of a bank with all of its offices in one community into the immediate surrounding area may not deliver much geographic-diversification benefit.

Diversification benefits from increasing scale, on the other hand, appear plentiful for small banks. Boyd and Graham (1998) find significant cost- and profit-efficiency gains after small-bank mergers, whereas most studies find no such gains on average for mergers involving medium and larger banks. Berger (1998) studies "megamergers" (greater than $1 billion in resulting assets) and "minimergers" (less than $1 billion) separately and finds that the degree of overlap between merging banks (either mega or mini) has no independent effect on cost, profit, or "alternative profit" efficiency gains. This result implies that in-market and out-of-market mergers of small banks have about the same effect in terms of risk reduction.

In a study of 7,000 banks, Berger and DeYoung (forthcoming) present evidence that is consistent with the conclusion that geographic expansion may be quite costly for small banks. They find that the ability of a banking organization to impose its standard for efficient operation diminishes as the distance increases between the headquarters of the banking organization and a bank affiliate. Berger and DeYoung conclude that there is no particular optimal geographic scope for a banking organization. Whalen (2001) finds that small banks with all of their offices located in one community tend to be more profitable than small banks with offices in more than one community. This result also is consistent with the observation that small banks may be justified in remaining relatively undiversified geographically. Finally, Rose and Wolken (1990) find that banks associated with geographically diversified holding companies have no competitive advantage over independent banks.

3. Methodology

3.1 Challenges in Measuring the Effects of Mergers on Bank Risk

Several complications arise when studying the effects that bank mergers have on risk. These complications include (1) separating scale effects from geographic diversification effects, (2) controlling for sequential mergers, (3) controlling for banks with different initial levels of geographic diversification, and (4) accounting for the endogeneity between risk and return—that is, the fact that banks may choose to use diversification gains to target higher expected returns rather than lower risk. As we explain below, our simulation method controls for these complications. Of course, simulation has its own limitations as a means of studying the effects of mergers on risk. We believe, however, that our simulation technique allows us to distinguish more clearly between the effects on risk of scale and geographic dispersion of banking offices than the studies that use actual data from banks with different degrees of geographic dispersion among their offices.

A potential problem researchers confront when comparing pre- and post-merger bank risk is separating scale effects from geographic diversification benefits. Bank mergers may reduce idiosyncratic risk because the post-merger bank has a larger customer base; negative credit and liquidity shocks from individual customers have smaller effects on the overall portfolios of larger banks. With this in mind, the scale effects of a merger on risk are likely to be small for a bank that was large prior to the merger because it had already diversified away much of its idiosyncratic risk before the merger. The effects of scale on risk may be greater for mergers among community banks.

Sequential mergers also may create challenges for measuring the effects of mergers on risk. Ideally, we would like to measure the effects of mergers over a consistent period of time. To illustrate, suppose Bank A merges with Bank B at the same time that Bank D merges with Bank E. Two years hence, however, the post-merger Bank A-B merges again, this time with Bank C. Because of the sequential merger, risk reduction benefits from the mergers that created Bank A-B-C cannot be compared directly with the risk reduction benefits from the merger that created Bank D-E.

Another challenge in measuring the effects of mergers on risk involves adjusting for the degree of geographic diversification of banks prior to mergers. If greater dispersion of offices reduces banking risk, the effects of a merger on risk will depend on the degree to which the banks involved in a merger had exploited the benefits of geographic diversification prior to the merger.

A fourth complication in studying bank mergers is that the tradeoff between risk and return is endogenous. After two or more banks merge, bank management may respond to an advantageous shift in the risk-return frontier by changing its portfolio of assets in a way that increases its expected return. Even though the bank is operating on a more favorable risk-return frontier, *measured* risk may decrease, increase, or remain unchanged. Boyd and Gertler (1994) and Boyd and Runkle (1993) present evidence that larger banks tend to choose riskier portfolios of assets.

3.2 Our Method: Simulate the Effects of Mergers on Risk

Our methodology controls for these four complications. We use bank call report data from the Federal Financial Institutions Examination Council (FFIEC) to simulate the effects that mergers among community banks have on risk. The simulated mergers take place at the beginning of 1989. We track performance measures of the merged banks over a 10-year period through year-end 1998. Using merger data from the FFIEC and summary of deposits data from the Federal Deposit Insurance Corporation (FDIC) and Office of Thrift Supervision (OTS), we include only banks that did not merge and had all of their deposits in a single county between 1989 and 1998. These criteria for the sample banks control for sequential mergers and different initial levels of diversification. In addition, we separate scale effects from geographic diversity effects by simulating mergers across various geographic boundaries and comparing those results with in-market mergers, which capture only scale effects. If the measures of risk are lower for the hypothetical banks with offices located in different geographic areas than for the hypothetical banks of comparable size with all of their offices in the same LMAs, we attribute the difference to geographic diversification. Finally, the simulated-merger approach eliminates the endogeneity of the risk-return frontier. Because the mergers are artificial, bank managers do not have the opportunity to change their behavior. In this way we capture the pro forma effects of mergers on risk for given portfolios of assets.

The technique of simulating mergers does have limitations as a means of analyzing the effects of mergers on risk. In particular, simulated mergers do not allow for operational (as opposed to pure accounting) economies of scope or scale. That is, management of a merged bank might be able to raise cost or profit efficiency by applying best practices to the combined entity. The merged bank may be able to produce its array of products at a lower cost than the unmerged banks, or it could choose a new mix of outputs producing higher revenues at no greater cost. The inability of merger simulations to capture operating economies of scope or scale means that we may understate the potential merger benefits. At the same time, actual mergers also may produce diseconomies of scope or scale that are not indicated by the merger simulations; managing larger banks with offices dispersed over wider geographic areas or a broader product mix can be very challenging. Thus, the potential efficiency biases inherent in our simulation technique are two-sided and it is not obvious whether our results will understate or overstate merger benefits. Similarly, actual merged banks may change their risk profiles in ways that simulations cannot capture, but again we do not know the direction of bias *ex ante*.

Our sampling procedure also could restrict the information in the individual bank data. In essence, we sample from among the banks that are relatively small and previously *inactive* in mergers and acquisitions. It could turn out that this group differs systematically from the community bank population as a whole, either in terms of efficiency, risk profile, or even geographic location.

Although there are drawbacks to this approach, simulations provide a clean separation of risk-reduction benefits arising from scale and geographic diversification in community bank mergers. Any in-market risk reduction we observe, for example, must be driven by scale economies, not by operational economies of scope or scale or changes in managerial control. Further risk reduction from out-of-market mergers must be due to geographic diversification. In addition, studies of actual mergers may suffer from distorted measures of risk because banks often incur restructuring charges associated with mergers. A time series of the profit rate of a bank involved in a series of mergers will reflect a series of such charges. Simulations avoid these accounting issues.

Other studies in the banking literature analyze the effects of mergers on risk through simulation. Boyd *et al.* (1993), Laderman (1999) and Allen and Jagtiani (2000) analyze the effects that mergers among banks and firms in other financial industries have on risk by measuring the risk of hypothetical financial conglomerates created by combining the data for banks and nonbank financial firms. Our approach, instead, simulates the effects of mergers on risk within the banking industry.

We conduct the merger simulations along two dimensions. The first dimension is the number of banks involved in the merger, holding constant the geographic dispersion of the offices of the banks involved in the merger. The number of banks varies from two to five. We limit the number of sample banks in the mergers because relatively few LMAs have more than five community banks that qualify for our sample. The second dimension is the degree of geographic dispersion of banking offices, holding constant the number of banks involved in the merger. We specify four categories of geographic dispersion. The first category has no geographic diversification in that the banks in each merger are located in the same LMA**.** The second category of geographic dispersion involves mergers of banks located in the same state but in different LMAs. The third category is banks located in different states but in the same Census division. The Census Bureau identifies nine mutually exclusive Census divisions, each composed of contiguous states. The final category of geographic dispersion is banks located in different Census divisions.

Because each of the two dimensions has four categories, we simulate 16 merger scenarios. We first select a pair of banks at random from the same LMA, then three banks, four banks, and five banks. We then select two banks at random from different LMAs but the same state, then three banks, and so forth. We do likewise for banks in the same and then different

Census divisions.   For each of the 16 simulation scenarios, we use sampling without replacement to create up to 1,000 hypothetical mergers. The actual number of mergers is far less than 1,000 in several of the 16 scenarios because in many cases too few sample banks fit the criteria for selection. Finally, as discussed below, we run separate simulations for urban banks (in MSAs) and rural banks (not in MSAs) because their initial risk characteristics were quite different. Rural banks had significantly lower risk levels than urban banks. Table 1 lists the number of hypothetical mergers for each of the 16 merger scenarios for both the urban and rural banks. The number of hypothetical mergers among banks located in the same LMAs declines precipitously as the number of sample banks in each merger increases from two to five. The numbers of mergers in the other scenarios fall off more slowly.

4. Risk Measures

We simulate the effects of mergers on several measures of the risk assumed by banks: estimated failure probability, insolvency risk, and variance of return on average assets (ROA).

4.1 Seer Failure Probabilities

One of the models the Federal Reserve System uses for bank surveillance is the System for Estimating Examination Ratings (SEER) risk rank model, which uses current call report data to estimate the probability that a bank will fail over the next two years. We use the SEER risk rank model to calculate the probability of failure of: (i) each bank in our sample and (ii) each hypothetical bank created by merging the call report data of the sample banks. Because of the paucity of bank failures since the early 1990s, the coefficients of the SEER risk rank model have been "frozen" since 1991. Gilbert, Meyer and Vaughan (forthcoming) conclude that this model continues to be relevant for bank surveillance. They found that the SEER risk rank model predicted the banks that would be classified as problem banks in future periods almost as accurately as a model designed to predict problem bank status that is re-estimated each year. The fact that the coefficients of the SEER risk rank model do not change over time is an advantage for this study, since the predictions of the model provide a consistent risk measure over time.

One of the independent variables in the SEER risk rank model is the asset size of the bank. The hypothetical banks created through simulated mergers tend to have lower probabilities of failure simply because their assets are larger than those of the individual sample banks used for creating the merged banks. We want to determine the degree to which mergers reduce the probability of bank failure independent of these increases in total assets. To make this adjustment, we measure the total assets of the merged banks as the average assets of the sample banks used in the hypothetical mergers. For example, if we merge a bank with $40 million in assets and a bank with $60 million in assets, we compute the merged bank's failure probability as if its assets were $50 million.

We compute three risk measures using estimates of failure probabilities.

Failure Probability above 2 Percent -- Surveillance staff at the Board of Governors put a bank on the Federal Reserve watch list if its failure probability is above 2 percent. Surveillance staff at the relevant District bank are expected to monitor closely the bank's condition. The first risk measure is based on the 2 percent threshold for failure probabilities. We compute the ratio of the total number of quarters that the merged banks' failure probabilities cross the 2 percent threshold, relative to the average number of quarters that the unmerged banks' failure probabilities cross the 2 percent threshold.

The following example illustrates how this risk ratio is calculated. We simulated 893 mergers of banks located in rural LMAs with other sample banks located in the same LMAs. In each of these simulated mergers we combine the call report data of a bank identified as "Entity 1" with the call report data of another bank in the same LMA, which we call "Entity 2."

For each entity, we compute the probability of failure 37 times over the 40 quarters between 1989 and 1998. The first three quarters were needed for the computations. Therefore, the maximum number of quarters that all 893 "Entity 1" banks could have exceeded the 2 percent failure probability threshold was 33,041 (893 banks x 37 quarters per bank). In fact, the failure probabilities of the Entity 1 banks exceeded 2 percent in 1283 quarters. Using the same logic, the maximum number of times that all 893 "Entity 2" banks could have exceeded the 2 percent failure probability threshold was 33,041. In fact, failure probabilities for these banks exceeded 2 percent 1009 times. Failure probabilities for all the merged entities exceeded 2 percent 513 times. The ratio of the total number of quarters that the merged banks' failure probabilities crossed the 2 percent threshold (513), relative to the average number of quarters that the unmerged banks' failure probabilities crossed the 2 percent threshold ((1283 +1009)/2), is 44.8 percent. Lower ratios indicate lower risk of failure for the merged entities relative to the actual entities.

Failure Probability in the Top 10 Percent -- The 2 percent failure probability threshold is somewhat arbitrary, especially because the bank samples differ significantly depending on the number of banks used in the mergers and the degree of geographic dispersion specified. As an alternative to the 2 percent threshold for failure probabilities, we substitute the 90th percentile of failure probabilities among the sample banks. First we ranked the estimated failure probabilities for each sample bank in each quarter from lowest to highest and found the 90th percentile. Then we computed the number of bank quarters in which the failure probabilities of the merged entities exceeded the 90th percentile as a percentage of the average number of bank quarters that the failure probabilities of the sample banks exceeded the 90th percentile. Again, the lower the percentage, the greater the risk reduction from bank mergers.

Mean Failure Probability -- The final SEER risk measure is the mean SEER failure probability. For example, in the scenario of two banks located in the same LMA, we compute the mean failure probability for the banks selected as Entity 1, for the second set of banks selected as Entity 2, and then for the merged banks. We do this for each merger scenario and then compare the mean failure probabilities across the 16 scenarios. All else equal, lower mean failure probabilities indicate greater risk reduction.

4.2 Insolvency Risk Index

The insolvency risk index is an alternative measure of failure probability.

$$Involvency\,Risk = \frac{\displaystyle\sum_{t=1}^{25} \frac{(sd\ ROA)_{t,t+15}}{E(ROA)_{t,t+15} + \left(\dfrac{EQ}{TA}\right)_{t+15}}}{25} \tag{1}$$

where $(sd\ ROA)_{t,t+15}$ = standard deviation of ROA between quarters t and t+15,

$E(ROA)_{t,t+15}$ = expected value of ROA between quarters t and t+15,

$(EQ/TA)_{t+15}$ = equity to total assets at time t + 15.

Intuitively, the insolvency risk index is a measure of the likelihood that a negative shock to earnings will deplete bank capital. The higher the insolvency risk index, the greater the probability that negative earnings will leave equity negative.

Unlike the SEER failure probability model, the insolvency risk index for each bank is based on a time series of its ROA. Consistent with Rivard and Thomas (1997), we use a 16-

quarter horizon to calculate the standard deviation and expected value of ROA. To make the index forward looking, we measure the ratio of equity to assets as of the end of each period for which we measure the mean and standard deviation of ROA. For each sample bank and for each merged bank, we calculate the insolvency risk index on a rolling basis 25 times and then simply compute the average of those values because we don't know the time path of the index in advance.

As with the SEER failure probabilities, we compute a threshold for relatively high values of the insolvency risk index as the 90th percentile for the sample banks. We calculate the number of bank quarters that the insolvency risk index for the merged banks exceeds this threshold relative to the average number of bank quarters that the insolvency risk index for the sample banks exceeds this threshold. The lower this percentage, the greater the risk reduction through mergers. We call this risk measure the "insolvency 10th percentile."

We also compute the mean insolvency risk indices for each of the 16 sets of merged banks. All else equal, the lower the mean insolvency risk index of the merged banks, the greater the risk-reduction benefit from the mergers.

4.3 Variance of ROA

The final risk measure is the average variance of ROA. We expect the merged banks to have smaller variance of ROA than the sample banks if the mergers reduce idiosyncratic or market risk. We calculate the variance of ROA for each merged bank over the full 40 quarters and then average those variances over the merged banks in each of the 16 merger scenarios.

5. Bank Sample

We include only banks that had all of their deposits in a single county each quarter between 1989 and 1998 and had no merger activity over the same period. Despite this limitation, our remaining bank sample included a few extremely large banks such as credit card banks and separately chartered entities of large financial institutions. Because the focus of our research is on community banks, we imposed an asset size limit of $400 million, which excluded the largest one percent of the banks that met the other criteria for sample banks. The remaining sample of 4,250 banks used for creating mergers represented all 50 states and, therefore, all nine Census divisions. At the end of 1998, median asset size of the sample banks was $49.1 million and average asset size was $68.3 million. Just 33 percent of the banks operated in MSAs; the rest were rural banks.

The urban banks in our sample have higher risk measures on average than the rural banks. This difference creates a potential bias in the comparisons of risk measures for the hypothetical banks in our merger scenarios because some simulations pull a higher percentage of banks from urban areas. In the merger scenario for two banks in the same LMA, for example, 36 percent of the sample banks are located in urban areas. In contrast, in the merger scenario for five banks in the same LMA, urban banks account for 57 percent of the sample banks because an economic market must be relatively large to support five banks that meet our criteria for sample banks. The mean failure probability of the sample banks in the two-bank mergers is 1.01 percent compared with 1.44 percent for the sample banks in the five-bank mergers. The risk measures, therefore, increase with the percentage of urban banks drawn from the sample. We adjust for this effect by reporting the results separately for urban and rural banks.

Before presenting our results for hypothetical mergers, Table 2 provides a snapshot of actual recent community bank mergers. There were 475 community bank mergers during the 1998-2000 period, of which 92 percent were among banks in the same state. Nearly one third of community bank mergers were within the same LMA. The eight percent of mergers that crossed state or census division lines could, in fact, overstate the geographic reach of actual community bank mergers. This is because some relatively nearby regions—for example, rural counties on opposite sides of the Mississippi River in Illinois and Missouri—are parts of different census divisions.

6. Results

6.1 Failure Probability

The first risk measure that we report is the mean SEER failure probability. To verify that the merged banks had significantly lower mean failure probabilities than the sample banks that contributed to the mergers, we conducted t-tests of the differences in mean failure probabilities between each set of banks that contributed to a given merger and the merged banks. The null hypothesis that the means are equal is rejected at the one percent level for each of the 112 comparisons, implying that the merged banks have significantly lower mean failure probabilities than the unmerged entities.[2]

Results from mean SEER failure probabilities reported in Table 3 indicate that mergers reduce significantly both idiosyncratic and local market risk. Both rural and urban banks reduce their mean SEER failure probabilities by increasing their scale of operations. Idiosyncratic risk reduction is observed by reading across a given row, which holds constant the degree of geographic dispersion while increasing the number of banks in the mergers. For example, the mean failure probability that results from merging two rural banks in the same state is 0.25 percent, while a merger of five rural banks in the same state reduces the mean failure probability to 0.09 percent.

We tested whether the idiosyncratic risk reductions as measured by mean failure probabilities were statistically significant. Specifically, we conducted t-tests comparing, for a given level of geographic diversification, the mean SEER failure probabilities of hypothetical banks created by merging two banks, three banks, four banks and five banks. We also compared a three-bank merger with a four-bank merger, and so on. There were six t-test comparisons for each level of geographic diversification resulting in 24 t-tests overall for each set of rural and urban banks. In general, we found that idiosyncratic risk reduction was statistically significant at the 5 percent level for all but the in-market mergers for both rural and urban banks. The lack of statistical significance for the in-market mergers appears to be driven by the small bank samples and the relatively high standard deviation of failure probabilities from the two-bank mergers.

Although community bank mergers reduce idiosyncratic risk, market risk is not affected significantly. Market risk reduction is observed by reading down a given column in Table 3; the number of banks participating in mergers is held constant while the degree of geographic dispersion increases. For example, the mean SEER failure probability at urban banks declines from 1.37 percent for mergers of two banks located in the same LMA to 0.94 percent for mergers of banks located in different Census divisions. We conducted t-tests of the differences in mean failure probabilities across geographic boundaries, holding the number of banks in the merger constant. With minor exceptions, the t-tests consistently fail to reject at the 5 percent level of

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[2] There are 14 t-test comparisons (2+3+4+5) for each level of geographic diversification. Given the four

significance the hypothesis that the means are equal. In other words, geographic diversification per se has a statistically insignificant effect on community bank risk. That is, a bank can reduce its risk as much by merging with another bank in the same LMA as it can by merging with a bank in a different part of the state or country.

Although mean SEER probabilities are useful measures of bank risk, bank supervisors often are more interested in the outliers in the upper tail of the distribution. Figure 1 presents the number of bank quarters for which the SEER failure probabilities of the *merged* rural banks exceeded 2 percent as a percentage of the average number of bank quarters that the SEER failure probabilities of the *unmerged* rural banks exceeded 2 percent threshold. Merger results suggest that risk-reducing economies of scale are significant and diminish rapidly at rural banks. Idiosyncratic risk reduction is measured as the absolute value of the slope of each of the four curves. In particular, the ratio drops to less than half for two-bank mergers and declines more slowly thereafter, falling to one-fourth and lower for three or more banks involved in a merger. The implication is that a rural community bank's risk of exceeding a SEER failure probability of 2 percent is cut in half by merging with a bank from the same LMA and is reduced to one-fourth or lower by merging with three or more banks.

In mergers of urban banks, idiosyncratic risk falls more slowly as the number of sample banks participating in the mergers rises. As Figure 2 illustrates, a two-bank merger reduces the SEER 2 percent threshold by about one-fourth. The ratio declines to about 55 percent for in-market and in-state mergers and to about 30 percent for same-census and cross-census mergers as the number of banks that contribute to a merger increases to five.

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diversification categories and the urban/rural sample split, we obtain 112 (14 x 4 x 2) comparisons.

For both rural and urban banks, the absolute value of the slope of each of the lines decreases with the number of merged banks, suggesting that the reduction in idiosyncratic risk declines as we add one more bank to the merger. In other words, risk reduction from scale effects diminishes rapidly.

Reduction in market risk using the 2 percent SEER threshold is relatively small for rural bank mergers but larger for urban bank mergers. Market risk reduction is measured in Figures 1 and 2 as the vertical distances between the lines given the number of banks participating in the merger. For example, the ratio of bank quarters that a rural four-bank in-market merger exceeds the 2 percent SEER threshold is 25.5 percent; the same ratio for a rural four-bank cross-census merger is just 12.6 percent. For urban banks the market risk reduction from a four-bank merger falls from 60.3 percent to 43.0 percent as the merger banks go from in-market to cross-census. The reduction in market risk increases with the number of banks involved in the merger. In other words, the geographic diversification of banks in a five-bank merger is more important than the geographic diversification of banks in a two-bank merger.

The final SEER risk measure—the SEER 10th percentile threshold—confirms the importance of idiosyncratic risk reduction from mergers. The results (not shown) are nearly identical to the 2 percent SEER threshold risk measures. For example, idiosyncratic risk at rural banks falls from 51.9 percent for two-bank in-market mergers to 25.8 percent for five-bank in-market mergers. Again, idiosyncratic risk reduction at urban banks is less pronounced. The SEER 10th percentile threshold for urban banks declines from 72.5 percent for a two-bank in-market merger to 48.7 percent for a five-bank in-market merger.

Also consistent with the 2 percent threshold results, geographic diversification benefits as measured by the SEER 10th percentile threshold are present at rural banks but much larger at the urban banks. For example, this measure for mergers of four banks falls from 53.1 percent for in-market mergers to 38.8 percent for cross-census mergers, a decline of 14.3 percentage points. The same ratios for rural four-bank mergers are 26.5 percent and 17.8 percent, respectively, a decline of just 8.7 percentage points. Nevertheless, market risk reduction is far less pronounced than idiosyncratic risk reduction in both rural and urban bank mergers.

6.2 Insolvency Risk Index

Results from the insolvency risk indices confirm the importance of idiosyncratic risk reduction while discounting the benefits from market risk reduction. Fully 88 of the 112 t-tests of the differences between the mean insolvency indices of the unmerged banks and their merged counterparts were significant at the 5 percent level, indicating that community bank mergers significantly reduce insolvency risk.

Mean insolvency risk declines significantly as the number of banks involved in a merger increases. Table 4 reports the results. For example, the mean insolvency index for cross-census mergers goes from 3.92 in a rural two-bank merger to 2.83 in a rural five-bank merger. The t-tests of the differences in means of the merged banks overwhelmingly reject the hypothesis that the means are the same, indicating that idiosyncratic risk decreases with bank size, both at rural and urban banks.

Geographic diversification, in contrast, fails to reduce insolvency risk. Indeed, the mean insolvency risk actually increases with greater geographic dispersion of banking offices in some scenarios of urban bank mergers. For example, the mean insolvency risk for a three-bank in-market merger is 4.73; that index rises to 5.33 in a three-bank cross-census merger. At the 5 percent level of significance, the t-tests overwhelmingly fail to reject the hypothesis that insolvency risk indices are similar across different levels of geographic diversification for a given number of banks included in the mergers.

Results for the top 10^{th} percentile are consistent with the results from the mean insolvency risk indices. Idiosyncratic risk reduction at rural banks as a result of scale effects is represented in Figure 3 as the absolute values of the slopes of the four curves. This figure plots the insolvency 10^{th} percentile risk measure. The striking feature of this plot is how close the lines are to one another, suggesting that the degree of geographic diversity has little impact on insolvency risk. Figure 4 plots the similar risk measures for urban banks. Although idiosyncratic risk declines with the number of banks in a merger, the results are not consistent with the hypothesis that greater geographic diversification of banking offices reduces risk.

6.3 Variance of ROA

Because idiosyncratic and market risk should decrease with size and the geographic dispersion of banking offices, respectively, we expect the variance of ROA to decrease with both the number of banks in the mergers and the geographic dispersion of offices. The t-test comparisons of the differences in means of the variance of ROA between the unmerged banks and their merged counterparts show that 87 of 112 are significant at the 5 percent level, suggesting that community bank mergers reduce significantly the variance of ROA. Most of the comparisons in which it is not possible to reject the hypothesis that the means are the same are drawn from the urban bank sample, which has a much higher standard deviation of ROA.

Our results suggest that increasing scale through mergers significantly reduces the variance of ROA. Table 5 presents the mean variance of ROA for each of the 16 merger scenarios for both rural and urban banks. The variance of ROA declines considerably across each of the rows. For example, the mean variance of ROA at urban banks declines from 0.93

percent in a two-bank same-census merger to 0.45 percent in a five-bank same-census merger. The t-tests of differences in the mean variance of ROA across merger scenarios strongly reject the hypothesis that the means are the same. The only exception occurs when going from a four-bank merger to a five-bank merger. In other words, idiosyncratic risk is reduced significantly through mergers, but the benefits are nearly exhausted after four banks contribute to the merger.

Once again, market risk reduction through mergers is absent. Reading down a given column in Table 5, one finds that the mean variance of ROA barely decreases and at times increases, especially at urban banks. The t-test comparisons fail to detect significant differences between the means.

7. Conclusions

Community banks appear to assume more risk than larger banks. This pattern raises the following issues for bank supervision: Does the risk assumed by community banks reflect their small size, the geographic concentration of their banking offices, or both? Should supervisors urge community banks to merge with other local banks in order to reap the benefits of larger scale or penalize them if they don't? Should supervisors encourage banks to establish offices over wider geographic areas or assess special penalties, such as higher capital requirements, against geographically undiversified community banks?

This paper simulates community bank mergers both within and across economic market areas. We use several measures of risk that are relevant to bank supervisors to assess how effective various merger strategies might be in reducing risk. We find that the greatest diversification benefits are achieved by increasing a community bank's size, regardless of where the merger partner is located. We interpret this first-order risk reduction as the pooling of banks' idiosyncratic risks. Further risk reduction by diversifying across different market areas may be possible, but it appears to be of second-order importance at best.

Risk-reducing economies of scale at community banks imply that, all else equal, larger banks can withstand business cycle downturns better than smaller banks. These findings suggest that the historical barriers to intrastate and interstate banking have not been the primary barriers to risk reduction for community banks except to the extent that such barriers prevented mergers from taking place at all, even within a market. In addition, from a pure risk-reduction perspective, bank supervisors should look favorably on community bank mergers, regardless of the location of the bank offices being merged.

These findings may help explain why many community banks have not pursued geographic diversification more aggressively since branching restrictions were relaxed during 1980s and 1990s. Given the operational difficulties and risk-management challenges of expanding into new market areas, many small banks may have decided that the unique contribution that geographic diversification can make to risk reduction is insufficient. Community banks logically would pursue in-market expansion opportunities before looking outside their local market areas.

The significant risk-reduction benefits of in-market mergers we find raise an obvious question: Why haven't more community banks merged with other local banks already? At least three possibilities are worth mentioning. First, we simply may be in the midst of a consolidation wave that will take many years to play out. Small banks may understand the benefits but are not able to find the right merger partner immediately. Second, anti-trust guidelines may constrain consolidation in some small market areas; that is, banks in a concentrated market area (as defined by the merger guidelines used by the regulators) may be prohibited from merging with each other, even though there might be efficiency and/or risk-reduction benefits. Finally, the objectives of closely held community banks may not be profit maximization or risk minimization. If community bank owners enjoy some non-financial benefits of control, such as community prestige or stature, they may pass up opportunities to merge that would involve losing these benefits.

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TABLE 1

This table lists the number of merger simulations run for each of the merger scenarios. We restricted the simulations to a maximum of 1,000. The number of simulations declines rapidly for mergers in the same labor market area (LMA) as the number of banks in the merger increase because a relatively small number of LMA's contain several community banks with all deposits in a single county and no merger activity between 1989 and 1998.

Number of Merger Simulations Conducted on Rural Banks

	Number of banks in merger			
Degree of diversification	2	3	4	5
Same LMA	893	489	258	133
Same state	994	972	733	583
Same Census division	999	858	647	505
Different Census division	1000	944	715	567

Number of Merger Simulations Conducted on Urban Banks

	Number of banks in merger			
Degree of diversification	2	3	4	5
Same LMA	620	359	242	171
Same state	618	391	270	216
Same Census division	565	331	237	185
Different Census division	697	465	348	278

TABLE 2

The table summarizes merger activity among community banks during the period 1998-2000. The data base was created by combining call report data, savings and loan data, and a merger database from the National Information Center. To be included, both banks (or the S&L) must have had less than $400 million of assets at the end of the quarter prior to the merger. Branch acquisitions are not included. There were 1,546 mergers among banks of all sizes, and 549 community bank mergers. Of these, 74 were eliminated because of missing data. The result is 475 community bank mergers, of which 24 involved a savings and loan.

Community Bank Mergers, 1998-2000

			Number of banks in merger		
Degree of diversification	All mergers	Cumulative percent	Rural with rural	Urban with urban	Rural with urban
Same LMA	154	32.42	53	101	0
Same state	283	92.00	164	29	90
Same Census division	21	96.42	6	7	8
Different Census division	17	100.00	9	6	2
Total	475		232	143	100

TABLE 3

This table lists the mean SEER failure probability percentages for the merged rural and urban banks for each of the sixteen merger scenarios. Idiosyncratic risk reduction is observed by reading across a given row because the rows hold the degree of geographical diversification constant while increasing the number of banks that participate in a hypotheteical merger. In contrast, market risk reduction is observed by reading down a given column because the number of banks participating in a merger is held constant while the degree of geographical diversification increases. Each merged failure probability is significantly lower than the average pre-merger failure probability for the sample banks, which was 0.54 percent for rural banks and 2.03 percent for urban banks. The results--confirmed by t-tests--suggest that community bank mergers reduce significantly idiosyncratic risk. Market risk reduction is less important, but the decline in market risk is more pronounced as the number of banks involved in a given merger increases.

Mean SEER Failure Probability of Rural Banks

Degree of diversification		***Number of banks in merger*** 2	3	4	5
Same LMA		0.22	0.13	0.12	0.11
(standard deviations)		(0.04)	(0.03)	(0.04)	(0.05)
Same state		0.25	0.16	0.11	0.09
		(0.04)	(0.02)	(0.02)	(0.01)
Same Census division		0.22	0.14	0.09	0.06
		(0.03)	(0.03)	(0.01)	(0.01)
Different Census division		0.20	0.11	0.08	0.06
		(0.03)	(0.01)	(0.01)	(0.00)
Average of unmerged banks:	0.54				

Mean SEER Failure Probability of Urban Banks

Degree of diversification		***Number of banks in merger*** 2	3	4	5
Same LMA		1.37	0.86	0.87	0.84
(standard deviations)		(0.20)	(0.15)	(0.22)	(0.24)
Same state		1.10	1.01	0.81	0.77
		(0.13)	(0.16)	(0.18)	(0.16)
Same Census division		0.90	0.51	0.49	0.34
		(0.12)	(0.10)	(0.13)	(0.11)
Different Census division		0.94	0.82	0.48	0.41
		(0.11)	(0.14)	(0.08)	(0.08)
Average of unmerged banks:	2.03				

TABLE 4
Mean Insolvency Risk of Merged Banks

This table lists the mean insolvency risk indices for the merged rural and urban banks for each of the sixteen merger scenarios. Idiosyncratic risk reduction is observed by reading across a given row because the rows hold the degree of geographical diversification constant while increasing the number of banks that participate in a hypotheteical merger. In contrast, market risk reduction is observed by reading down a given column because the number of banks participating in a merger is held constant while the degree of geographical diversification increases. Most mean insolvency indices for the merged banks are significantly lower than the mean pre-merger insolvency inidices for the sample banks, which was 6.95 for rural banks and 8.89 for urban banks. The results--confirmed by t-tests--suggest that community bank mergers reduce significantly idiosyncratic risk. Market risk reduction is insignificant.

Rural Banks

		Number of banks in merger			
Degree of diversification		2	3	4	5
Same LMA		3.95	3.39	3.13	2.85
(standard deviations)		(0.09)	(0.09)	(0.11)	(0.13)
Same state		3.96	3.40	3.09	2.83
		(0.09)	(0.07)	(0.07)	(0.06)
Same Census division		3.95	3.36	3.02	2.78
		(0.09)	(0.08)	(0.07)	(0.06)
Different Census division		3.92	3.39	3.03	2.83
		0.09	0.07	0.07	0.06
Average of unmerged banks:	6.95				

Urban Banks

		Number of banks in merger			
Degree of diversification		2	3	4	5
Same LMA		5.92	4.73	4.52	4.10
(standard deviations)		(0.31)	(0.23)	(0.24)	(0.25)
Same state		5.70	5.04	4.45	4.28
		(0.31)	(0.23)	(0.24)	(0.25)
Same Census division		5.41	4.54	4.20	3.78
		(0.22)	(0.23)	(0.23)	(0.22)
Different Census division		5.95	5.33	4.64	4.32
		(0.26)	(0.28)	(0.21)	(0.22)
Average of unmerged banks:	8.89				

TABLE 5
Mean Variance of ROA of Merged Banks

This table lists the mean variance of return on assets (ROA) for the merged rural and urban banks for each of the sixteen merger scenarios. Idiosyncratic risk reduction is observed by reading across a given row because the rows hold the degree of geographical diversification constant while increasing the number of banks that participate in a hypotheteical merger. In contrast, market risk reduction is observed by reading down a given column because the number of banks participating in a merger is held constant while the degree of geographical diversification increases. Most mean variances of ROA for the merged banks are significantly lower than the mean pre-merger variances for the sample banks, which was 0.97 for rural banks and 4.24 for urban banks. The results--confirmed by t-tests--suggest that community bank mergers reduce significantly idiosyncratic risk but market risk reduction is insignificant.

Rural Banks

		Number of banks in merger			
Degree of diversification		2	3	4	5
Same LMA		0.40	0.28	0.22	0.18
(standard deviations)		(0.03)	(0.02)	(0.02)	(0.02)
Same state		0.42	0.31	0.23	0.20
		(0.03)	(0.02)	(0.01)	(0.01)
Same Census division		0.42	0.30	0.24	0.18
		(0.03)	(0.03)	(0.02)	(0.01)
Different Census division		0.44	0.29	0.23	0.19
		(0.06)	(0.02)	(0.01)	(0.01)
Average of unmerged banks:	0.97				

Urban Banks

		Number of banks in merger			
Degree of diversification		2	3	4	5
Same LMA		1.05	0.57	0.47	0.36
(standard deviations)		(0.17)	(0.07)	(0.05)	(0.04)
Same state		0.85	0.65	0.51	0.48
		(0.10)	(0.09)	(0.08)	(0.08)
Same Census division		0.93	0.66	0.55	0.45
		(0.15)	(0.12)	(0.10)	(0.09)
Different Census division		1.18	0.74	0.59	0.47
		(0.31)	(0.11)	(0.09)	(0.06)
Average of unmerged banks:	4.24				

FIGURE 1

Percentage of Rural Bank Quarters Relative to Unmerged Banks with SEER Failure Probabilities Above 2 Percent

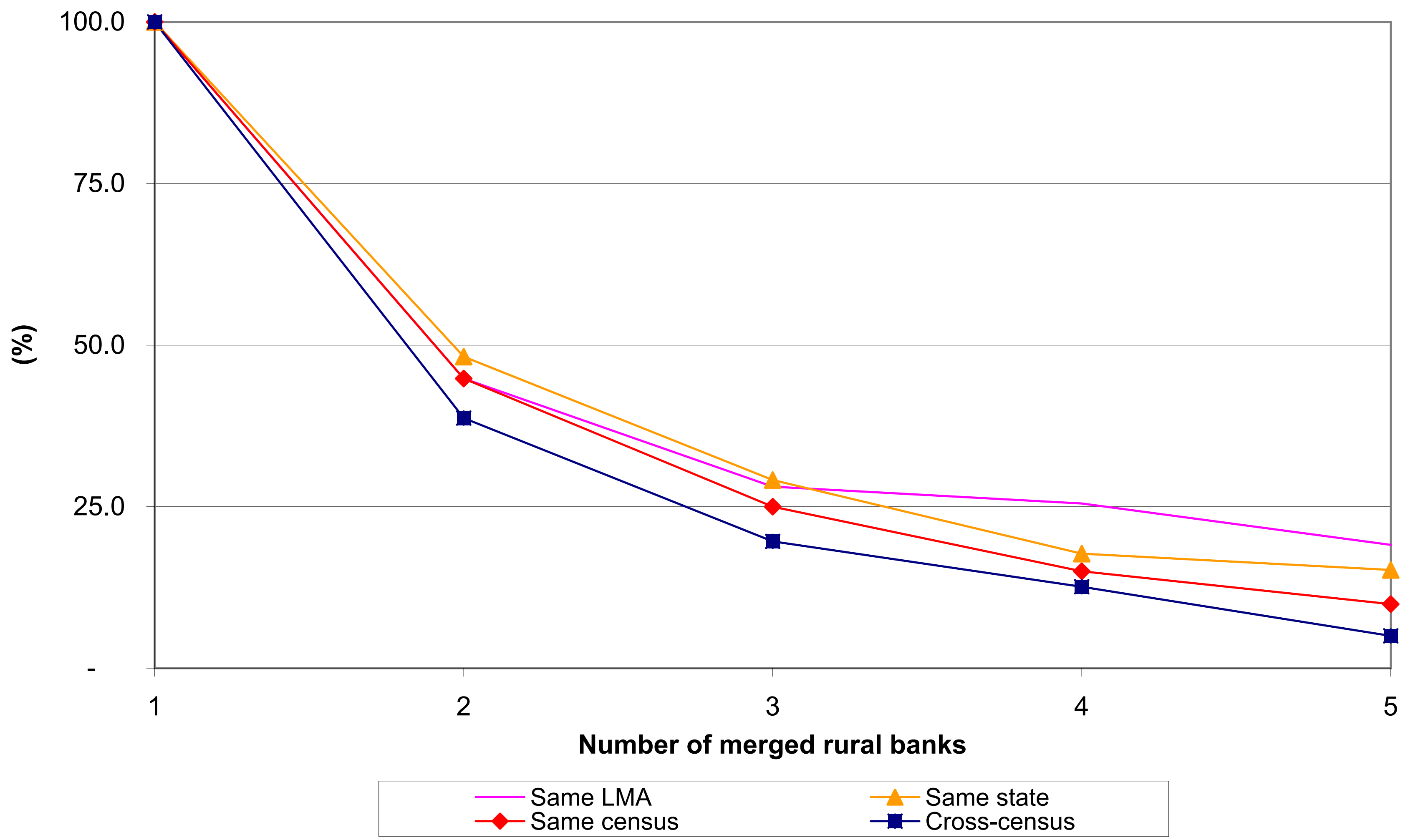

FIGURE 2
Percentage of Urban Bank Quarters Relative to Unmerged Banks with SEER Failure Probabilities Above 2 Percent

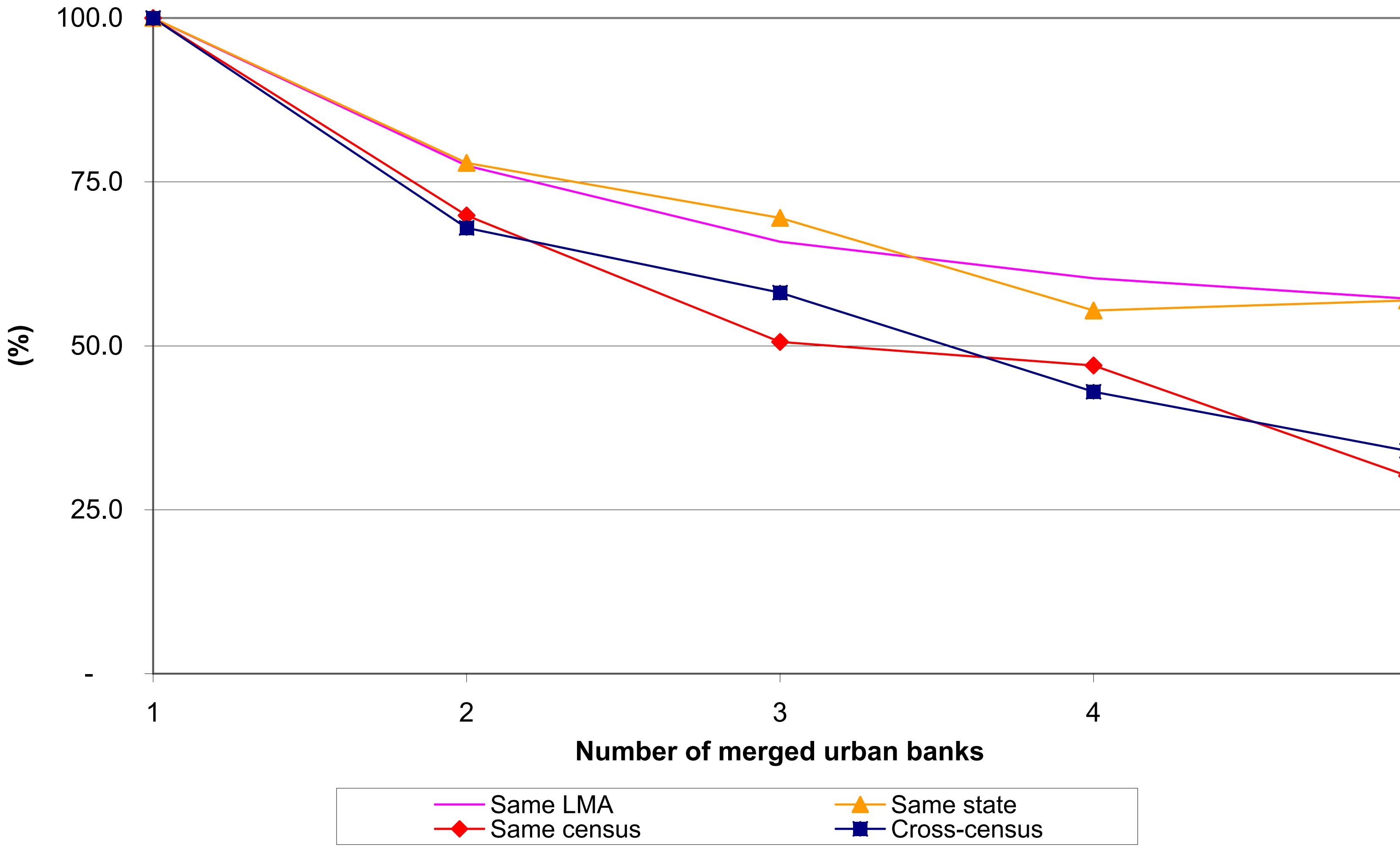

FIGURE 3
Percentage of Rural Bank Quarters Relative to Unmerged Banks with Insolvency Risk Indices in the Top 10% of the Distribution

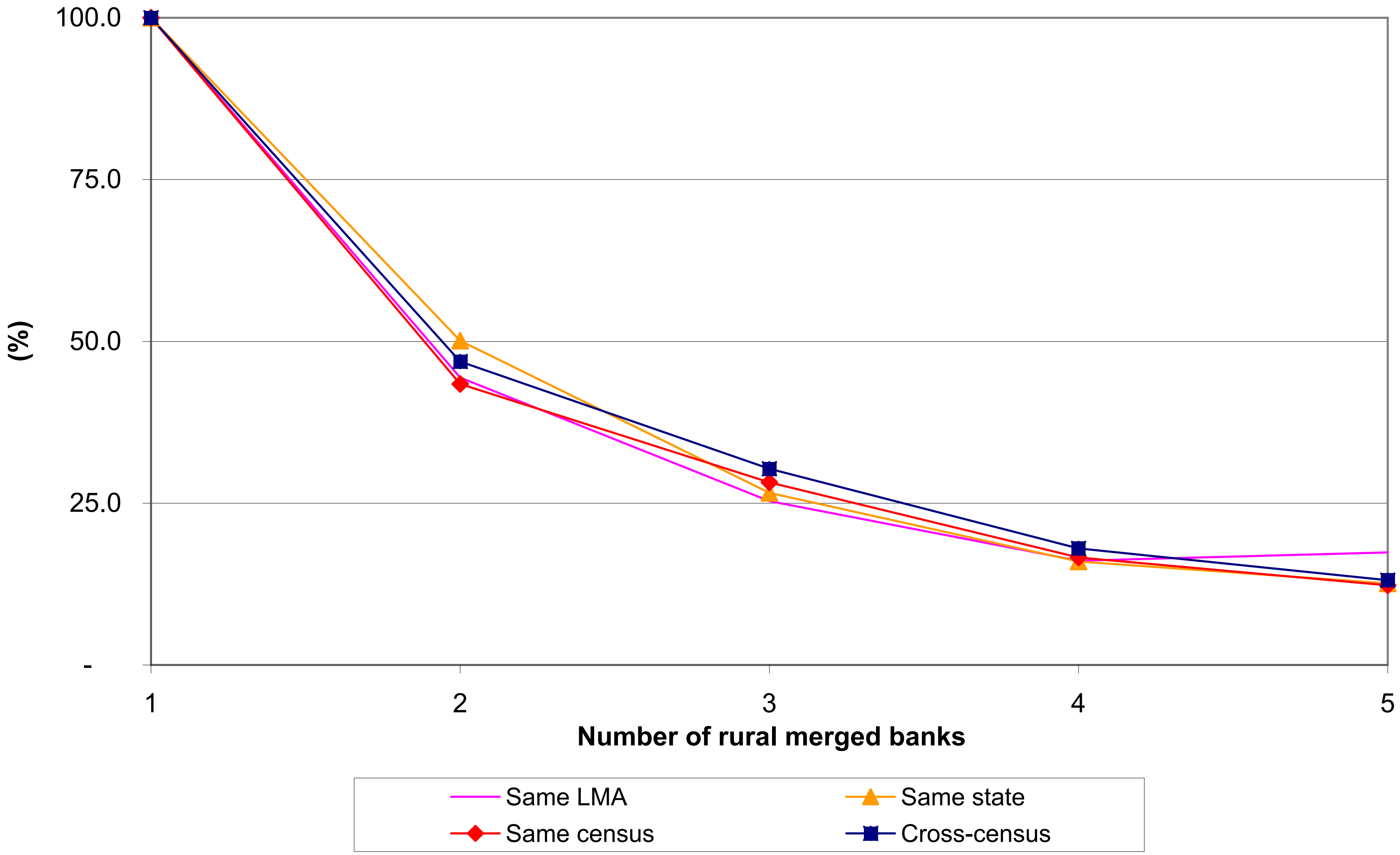

FIGURE 4
Percentage of Urban Bank Quarters Relative to Unmerged Banks with Insolvency Risk Indices in the Top 10% of the Distribution