Industry Mix and Lending Environment Variability: What Does the Average Bank Face?

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The industrial restructuring of regional economies has resulted in a widespread and substantial reduction in the environmental risk faced by banks.

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Behind that old proverb "don't put all your eggs in one basket" lie the potential benefits of diversification. However, the idea that diversification is always enhanced by using more baskets can be misleading. In the world of equity investing, for example, the introduction of an additional stock to a portfolio can either increase or reduce the variability, or risk, of the portfolio's return. The new stock is more likely to reduce portfolio variability if changes in its return over time are not closely associated with changes in the return of the original portfolio.

In the same way individuals can hold portfolios of stocks, banks can be said to own a portfolio of earning assets. The most important collection of assets for most banks is their loan portfolio. And diversification in banks' loan portfolios is just as important as diversification in individuals' portfolios. A well-diversified loan portfolio does not eliminate all the risks banks face. But diversification can substantially limit banks' exposure to economic shocks and help reduce the variability of bank earnings.

Many banks in Texas experienced financial difficulties in the last half of the 1980s because their loan portfolios were concentrated in oil and real estate, industries that suffered severe shocks at that time. If the Texas banks had also been lending heavily in states with a significantly different industry mix, lending profits in those states may have helped offset the severe losses on loans extended in Texas. On the other hand, having additional lending operations in another heavily oil-dependent state, such as Oklahoma, would not have done much to help reduce the earnings variability of Texas banks.

If the benefits of diversification are well known, why might banks not have pursued a more diversified loan portfolio? One explanation might lie in legal restrictions the U.S. banking industry faced that limited diversification opportunities. Chief among these are the longstanding restrictions on interstate banking and branching that U.S. banks operated under until fairly recently. Individual states controlled the degree of branching allowed within their own borders, as well as the degree of interstate banking allowed across their borders. Although several methods were used to partially overcome these obstacles, geographic restrictions nevertheless made it difficult for banks to spread their operations across several regions.

In the late 1970s, restrictions on banks' geographic expansion began to ease. States increasingly allowed out-of-state banking organizations to acquire in-state banks, and intrastate branching restrictions were eliminated. This pro-

cess culminated with the passage of the Riegle–Neal Interstate Banking and Branching Efficiency Act of 1994, which authorized interstate banking and branching.

Given the breakdown of geographic banking restrictions, banks' diversification opportunities may have improved. In addition, recent structural changes within regional economies in many cases have left relatively volatile industries with a diminished role. These changes also may have improved diversification opportunities for banks by making the regional economies themselves more diversified.

We look for evidence on the potential risk-reducing effects of these changes by concentrating on the implications of a bank's location for the nature of its lending landscape. Our representation of a bank's lending environment is obtained by forming industry portfolios for U.S. banking organizations based on the extent of their presence in different states and the mix of economic activity found in those states. We generate these "environmental portfolios" using data from 1985, just prior to the oil-price-induced regional recessions that occurred in the latter 1980s, and 1996, the latest year for which data on state gross domestic product are available.

If the stability of the bank lending environment has improved, we would expect that the variability underlying banks' environmental portfolios declined over this period, which is indeed what we find. We then investigate whether this reduction in risk stems from a geographic restructuring of the banking system, or whether the states now have a more diverse mix of economic activity, or both. Our evidence indicates both of these effects are at work, with the industrial diversification of state economies providing the most benefits.

EVIDENCE ON BANK DIVERSIFICATION

Diversification benefits are often possible when the cash flows or earnings potentials from different stocks, loans, or any type of economic activity or asset do not move in tandem. By choosing new markets or new products whose earnings move differently from those generated by existing lines of business, the variability of overall firm earnings often can be reduced. On the other hand, if the returns generated by individual markets tend to move together while the new markets are significantly riskier than existing markets, geographic expansion might actually increase risk.[1]

Using stock market data, Demsetz and Strahan (1997) find a negative relationship between banking organization size and measures of firm-specific risk, indicating that diversification and bank size are linked. However, these authors also find that larger banking organizations tend to operate with higher amounts of leverage and greater commercial loans and that these riskier portfolio components can offset the risk-reducing benefits of diversification.

Economic researchers have studied bank diversification mostly from a geographic perspective.[2] Geographic diversification would allow losses incurred in one region of the country to be offset with profits made in another. In this regard, Benston, Hunter, and Wall (1995) find that a desire for greater earnings diversification played a significant role in motivating bank mergers and acquisitions in the early to mid-1980s.

Neely and Wheelock (1997) find evidence that U.S. banks are not very geographically diversified. In their analysis, state-level bank earnings are affected by state-level per capita income growth. As these authors point out, "If the investment and deposit bases of banks were extensively diversified across states, we would not expect to find this systematic relationship between a bank's earnings and the per capita income of the state in which it is headquartered" (Neely and Wheelock, 1997, p. 31).

Liang and Rhoades (1988) find a negative relationship between geographic expansion and different measures of risk. However, these authors also find lower levels of earnings and capital for banks with more geographic coverage. Rose (1995) finds some evidence that at sufficiently high levels of geographic expansion, earnings are more stable and risks reduced. Fraser et al. (1997) use stock price data to estimate the effects of the Office of Thrift Supervision's decision to allow interstate branching for federally chartered savings and loan associations. These authors find significant positive wealth effects associated with this decision for both large banks and thrifts.

Finally, for some evidence that removal of intrastate branching restrictions improves bank efficiency and contributes to economic growth, see Jayaratne and Strahan (1997).

ASSESSING A BANK'S ENVIRONMENTAL PORTFOLIO

Previous studies have used different variables to measure the extent of a bank's geographic coverage. Some examples are the percentage of consolidated assets booked by affiliate out-of-state banks and the number of states

Table 1
Components of State Gross Domestic Product

- Agriculture, forestry, and fishing
- Mining (less oil and gas extraction)
- Oil and gas extraction
- Construction
- Durable goods manufacturing
- Nondurable goods manufacturing
- Transportation and public utilities
- Wholesale trade
- Retail trade
- Finance, insurance, and real estate
- Services
- Government

in which an interstate banking organization has a full-service office.[3]

Our starting point is that a bank's lending activity can be expected to be heavily influenced by economic activity within the bank's operating environment.[4] As a result, in the context of diversification, the most relevant aspect of a bank's geographic location may be the industry mix of the region or regions in which the bank operates.

With these considerations in mind, we take a novel approach by constructing environmental portfolios of industries for banking organizations based on the extent of the banks' presence in individual states and the mix of economic activity found in those states. For example, a bank operating only in Texas will likely find its earnings sensitive to the mix of economic activity in that state. But a banking organization with operations in both Texas and California would be affected by the economic structure of both these states, most likely in proportion to the magnitude of its presence in each state.

To measure the mix of economic activity within individual states, we use data from the Bureau of Economic Analysis on state gross domestic product and its major components (*Table 1*). For each state, we calculate the relative importance of each major component in 1985 and 1996. For example, in Texas the oil industry accounted for almost 14 percent of state gross domestic product in the mid-1980s, whereas by the mid-1990s oil's share had slipped to about 7 percent. These economic components are used as weights or measures of the relative importance of different industries in determining the lending environment banking organizations face in a given state.

We also need a measure of the relative importance of a banking organization's presence in each state. For this measure, we use the share of the organization's total deposits in every state in which it operates. A bank with 80 percent of its deposits in Texas is assumed to be highly exposed to the ups and downs of the state's prominent industries. These state deposit shares are calculated for 1985 and 1996 using branch-level deposit data from the FDIC's Summary of Deposits.

For our environmental portfolios, the industries listed in Table 1 represent the counterparts to portfolio assets, and annual industry growth rates represent the counterparts to asset returns. To arrive at the overall return for a bank's environmental portfolio, each industry growth rate, or return, must be weighted by both the relative importance of the industry in each state and the share of the banking organization's total deposits in each state (see the box titled "Constructing Environmental Portfolios").

MEASURING PORTFOLIO RISK

Improvements in diversification are measured by how much risk is reduced. For our purposes, we want to estimate whether the overall risk of banks' operating environments has declined from the mid-1980s to the mid-1990s.

One component of our measure of the overall risk underlying environmental portfolios is known as portfolio variance, which represents the variability of the portfolio's return. If the industry growth rates were all independent of each other, calculation of the overall variance of each bank's environmental portfolio would be simple. In this case, the variance of an environmental portfolio would simply be the sum of the industry growth variances, with each industry variance weighted by a measure of the importance of that industry in the portfolio.

However, because the growth rates of the various industries are correlated, or move together, the variance of a given bank's portfolio also must take account of the *covariance* of the industries that make up the portfolio. The covariance is a measure of how the industries move together (or covary). If the industry growth rates move in the same direction, their covariance is positive; if they move in opposite directions, their covariance is negative. If the growth rates are totally unrelated, their covariance is zero.

The underlying variability, or variance, of each bank's environmental portfolio turns out

to be a weighted sum of both the underlying industry growth variances and the covariances of the different industries that make up the portfolio. Lower values of this portfolio variance measure indicate more stable lending environments.

In the analysis that follows, we gauge the risk of environmental portfolios in terms of a related measure known as the coefficient of variation. This measure is equal to the square root of the variance of an environmental portfolio, or its standard deviation, divided by—or scaled by—the portfolio's average growth rate.[5] For more on the calculation of portfolio variance and the coefficient of variation, see the box titled "Constructing Environmental Portfolios."

A CHECK ON OUR RISK MEASURE

Before examining trends in the risk of bank lending environments, we provide some evidence on our methodology's appropriateness. To support our use of environmental portfolios' coefficients of variation as an indicator of risk in bank lending environments, we estimate a bank failure model for the latter 1980s, when many states experienced severe economic and banking difficulties. If our risk measure is accurate, bank failures should have been more likely in regions with the potential for high variability, as indicated by the coefficient of variation. While the reverse may have sometimes occurred, the general tendency should have been for regions with a relatively volatile industry mix to be more susceptible to episodes of economic and banking difficulties.

In the other parts of this paper, we analyze diversification issues at the organization level rather than the bank level because important connections exist among subsidiary banks operated by the same holding company. We do not want to ignore these connections totally by treating affiliated banks as separate organizations. However, because our only purpose at this point is to provide evidence on the relevance of our measure of environmental variability in identifying risk, we maintain direct comparability with the existing literature on bank failure by examining failure at the bank rather than the organization level. Hence, only the state in which the bank is located needs to be considered in constructing its environmental portfolio.[6]

We use five financial indicators, each measured as a percentage of gross assets, to characterize the financial posture of individual banks as of year-end 1985, just before the wave of U.S. bank failures in the late 1980s. Equity capital, which serves as a buffer protecting a bank's solvency against financial losses, is our measure of capital adequacy; more capital is expected to reduce the chance of failure. Troubled assets—

Constructing Environmental Portfolios

A portfolio typically is a collection of earning assets such as stocks, bonds, or, in the case of banks, loans and securities, among other assets. For the purposes of our analysis, we define a bank's environmental portfolio as the mix of industries to which the bank is directly exposed by virtue of the geographic location of its offices.

To construct a given bank's environmental portfolio, we use the composition of economic activity or gross domestic product (*GDP*) in the state or states in which the bank has operations. The industries we use to describe a state's economy are identified in Table 1.

We measure the returns for each industry by calculating the growth rate at the national level of each of the individual components of *GDP*:

$$(1) \qquad g_{i,t} = \frac{GDP_{i,t}}{GDP_{i,t-1}} - 1.$$

From Equation 1, we have, for each period, the returns $g_1, g_2, \ldots g_n$ for the $n = 12$ different components of *GDP* identified in Table 1.

Each bank's environmental portfolio consists of shares (α_i) in each of these industries. The industry shares account for two important factors that potentially affect a bank's returns. The first is how important a bank's presence is in each state, and the second is how important a particular component of *GDP* is in each state:

$$(2) \qquad \alpha_{b,i,t} = \sum_s \left[\frac{DEPOSITS_{b,s,t}}{\sum_s DEPOSITS_{b,s,t}} \right] \left[\frac{GDP_{i,s,t}}{\sum_i GDP_{i,s,t}} \right].$$

In Equation 2, $DEPOSITS_{b,s,t}$ measures the level of banking organization *b*'s deposits in state *s* at time *t*, and $GDP_{i,s,t}$ is component *i* of *GDP* for state *s* in time *t*. The first part of Equation 2 represents the proportion of a bank's total deposits in each state. The second part represents the proportion of each state's *GDP* accounted for by industry *i*.

Since we are ultimately concerned with identifying whether banks' environmental portfolios have become more diversified, we need to calculate the variance of the returns on these environmental portfolios. Assuming normality, the variance formula is given as:

$$(3) \qquad V_{b,t} = \sum_{i=1} \sum_{j=1} \alpha_{b,i,t} \, \alpha_{b,j,t} \, \sigma_{i,j} \, .$$

In Equation 3, $\sigma_{i,j}$ is the covariance of industry *i* with industry *j*. When *i* equals *j*, this term is the variance of growth in industry *i*. There are *n* variance terms and $n(n-1)$ covariance terms.[1]

The variability statistics reported in the paper are based on the coefficient of variation, which is equal to the square root of the variance of an environmental portfolio, or its standard deviation, divided by—or scaled by—the portfolio's average growth rate. The average growth rate of a portfolio characterized by the industry shares α_i is calculated as:

$$(4) \qquad G_{b,t} = \sum_{i=1} \alpha_{b,i,t} \, \bar{g}_i \, .$$

In Equation 4, $\bar{g}_i$ represents the average rate of growth for industry *i*. Hence, our measure of risk is given as:

$$(5) \qquad R_{b,t} = \frac{\sqrt{V_{b,t}}}{G_{b,t}}.$$

We construct environmental portfolios for each banking organization in both 1985 and 1996. The variances and covariances of the g_i, which are needed to calculate the portfolio variances, are calculated using national data from 1947 through 1996. These data were obtained from the Bureau of Economic Analysis.

[1] For more on the calculation of portfolio variances, see Fama and Miller (1972, pp. 234–35).

Table 2
Estimated Influences on the Probability of Bank Failure, 1986–89

Variable	Parameter estimate
Constant	–2.705 (.123)
Equity capital	–5.149 (.906)
Troubled assets	10.708 (.751)
Net income	–5.846 (1.240)
Investment securities	–2.554 (.228)
Large certificates of deposit	2.831 (.202)
Coefficient of variation	2.523 (.198)

NOTES: Standard errors are in parentheses. Each variable is significant at the 1-percent level. The estimates were obtained using the probit model. For more on this statistical procedure, see Maddala (1983, pp. 22–27). Of the 13,988 banks used in the analysis, 684 failed during 1986–89.

including loans past due ninety days or more and still accruing interest, nonaccrual loans, and other real estate owned (which, for the most part, consists of foreclosed real estate)—serve as our measure of asset quality. More troubled assets should increase the probability of failure. We use net income to measure the strength of earnings. Higher income would be expected to reduce the likelihood of failure. Liquid assets, such as investment securities, enable a bank to respond quickly to unexpected demands for cash and typically reflect relatively conservative financial strategies. As such, large holdings of investment securities might reduce the chance of failure. On the other hand, volatile liabilities, such as large certificates of deposit, often reflect relatively aggressive financial strategies, impose high interest expenses, and are subject to quick withdrawal. As a result, a high funding dependence on large certificates of deposit might increase the probability of failure.

In addition to these financial indicators, we include in the failure model the coefficient of variation for each bank's environmental portfolio in 1985. A finding that banks in states with a relatively high coefficient of variation tended to fail at a higher rate during 1986–89 would support our use of the coefficient of variation as an indicator of environmental risk.

The estimation results for the bank failure model are shown in Table 2. Each of the financial indicators is statistically significant and has the expected effect on the likelihood of failure. In addition, a high coefficient of variation for a bank's environmental portfolio raises the bank's probability of failure. This finding indicates our methodology is useful in identifying risk in bank lending environments.

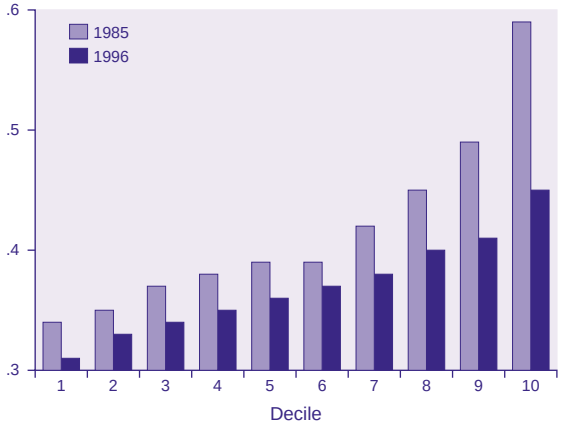
PORTFOLIO RISK: 1985 VERSUS 1996

What, then, has happened to the risk of bank lending environments in recent years? We calculated the average variability of banks' environmental portfolios for both 1985 and 1996. In calculating these averages, we weighted each bank's coefficient of variation by the bank's share of total industry deposits. Weighting by deposit size allows large banks to have a greater influence on the results of our analysis, reflecting their greater presence in the industry as measured by their market share. For 1985, we were able to collect data on 11,331 U.S. banking organizations. Reflecting the consolidation trends in the U.S. banking industry, only 6,700 banking organizations reported the branch deposit data necessary to construct the 1996 portfolios. In 1985, the average coefficient of variation for banks' environmental portfolios was 0.416. By contrast, in 1996, average environmental variability was 0.369, a reduction of 11 percent.

In an effort to look behind these aggregate results, we ranked the banks by their environmental variability and divided them into ten groups, both for 1985 and 1996. Each of the ten groups represents approximately 10 percent of total industry deposits. We then calculated the deposit-weighted average coefficient of variation for each group. The result is shown in Figure 1. The average coefficient of variation for each group of banks is markedly lower in 1996 than in 1985. The average coefficient of variation for the low-variability group (group 1) was 0.337 in 1985 versus 0.313 in 1996, a reduction of 7 percent. The average coefficient of variation for the high-variability group (group 10) was 0.593 in 1985 versus 0.447 in 1996, a reduction of 25 percent.

From these results, U.S. banks have experienced a substantial reduction in the underlying variability of their operating environment. What remains unanswered, though, is whether this

Figure 1
Banking System Diversification
Coefficient of variation, deposit-weighted average



NOTES: Rank based on coefficient of variation, defined as the standard deviation of the portfolio divided by the average return on the portfolio. Each of the ten groups represents approximately 10 percent of total banking industry deposits.

SOURCES: FDIC Summary of Deposits; Bureau of Economic Analysis.

result is due to a geographic restructuring of the banking system, an industrial restructuring of regional economies, or some combination of these two possibilities.

IS IT THE BANKS OR THE ECONOMY?

To discover the possible sources of the observed reduction in environmental variability, we conducted some simulations by changing the nature of the weights used in forming the banks' environmental portfolios for 1996. In the first experiment, we calculated the banks' portfolios using the deposit shares as they existed in 1996 but represented the industry mix of state economies using the industry shares that had prevailed in 1985. This simulation represented the combination of 1996 banking structure and 1985 economic structure. We then compared the environmental variability associated with this simulated 1996 environment to underlying economic variability in 1985. The difference between the two provides an estimate of the effect of bank structure changes on the underlying risk of bank operating environments.

Similarly, in the second experiment, we calculated the banks' portfolios using the state industry shares as they existed in 1996 but represented the geographic location of banking offices using the deposit shares that had prevailed in 1985. This simulation represented the combination of 1996 economic structure and 1985 banking structure. We then compared the environmental variability associated with this simulated 1996 environment to underlying economic variability in 1985. The difference between the two provides an estimate of the effect of structural changes in state economies on the underlying risk of bank operating environments.

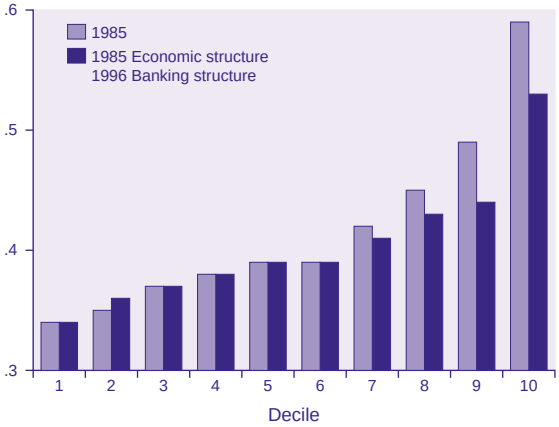
These experiments can provide only a qualitative assessment of the relative importance of the types of effects—bank structure changes and economic structure changes. The assessments are only qualitative because they do not succeed in decomposing the total effect into two parts; that is, the sum of the two simulated effects is not necessarily equal to the observed overall change in environmental variability.

Effect of Bank Structure Changes

Figure 2 shows the results from simulating portfolio variances in 1996 using actual banking structure in that year combined with the industrial structure from 1985. The banks were again ranked based on their coefficient of variation and segmented into ten groups. While the industrywide reduction in variability from 1985 to the simulated 1996 environment is only about 3 percent, portfolio variance fell appreciably for the high-variance groups of banks. For the group with the highest variability (group 10), the results indicate a 10-percent reduction in environmental portfolio variance, from 0.593 in 1985 to 0.534 in 1996.

This finding indicates geographic restructuring has played an important role in reducing

Figure 2
Effect of Bank Structure Changes on Diversification
Coefficient of variation, deposit-weighted average



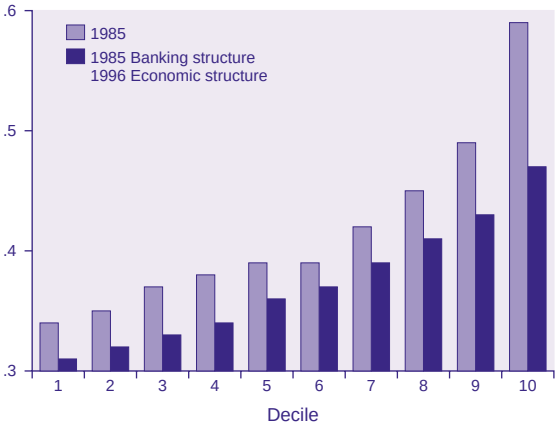
NOTES: Rank based on coefficient of variation, defined as the standard deviation of the portfolio divided by the average return on the portfolio. Each of the ten groups represents approximately 10 percent of total banking industry deposits.

SOURCES: FDIC Summary of Deposits; Bureau of Economic Analysis.

Figure 3

Effect of Economic Structure Changes on Diversification

Coefficient of variation, deposit-weighted average



NOTES: Rank based on coefficient of variation, defined as the standard deviation of the portfolio divided by the average return on the portfolio. Each of the ten groups represents approximately 10 percent of total banking industry deposits.

SOURCES: FDIC Summary of Deposits; Bureau of Economic Analysis.

the environmental variability banks face. Figure 2 shows a tendency for risk-reducing structural change to affect mostly the high-variance components of the banking industry, as the observed declines in variance did not occur across the board. This trend is consistent with the view that consolidation through bank failures, mergers, and acquisitions has whittled down the segments of the industry exposed to the greatest environmental variability.

Effect of Economic Structure Changes

In response to economic shocks experienced during 1985–96, the industrial mix of some states has undergone significant change. A good example is the oil bust of the mid-1980s. Regional economies with a high dependence on oil and gas production initially suffered severe recessions in response to the fall in energy prices. However, many of these economies have since transformed themselves by boosting the importance of other sectors—so much so that when oil prices plummeted more recently, the ill effects were much more limited. As this example shows, painful shocks often result in readjustments that diversify regional economies away from a heavy dependence on relatively volatile industries.

Our purpose in this section is to gauge the importance of these changes in reducing the environmental variability faced by banks. Figure 3 shows the results from simulating portfolio variances in 1996 using the actual economic structure in that year combined with the banking structure from 1985. Overall, average variability fell 10 percent from 1985 to the simulated environment in 1996. The group with the highest variability (group 10) shows a 21-percent reduction in environmental variability, from 0.593 in 1985 to 0.467 in 1996. Hence, we can conclude that industry diversification at the state level has led to a much more stable lending environment for banking organizations.

CONCLUSION

Diversification opportunities have increased for the U.S. banking system. Our results indicate geographic restructuring of the banking industry has helped reduce the variability underlying bank loan markets, and the risk-reducing effects have been concentrated in the high-variance components of the banking industry. In addition, the industrial restructuring of regional economies has resulted in a widespread and substantial reduction in the environmental risk faced by banks.

And these results actually understate the potential for diversification that has emerged in recent years. In our analysis, a bank's lending environment is defined according to the geographic location of its deposit base. Such a regional definition is rapidly losing its relevance as new information technologies enable banks to lend increasingly to individuals and businesses outside the scope of traditional, geographically defined loan markets.

NOTES

[1] As Rose (1995) points out, geographic expansion also might raise operating costs and risks for a banking organization, potentially offsetting any gains from a more diversified portfolio.

[2] For some evidence of diversification opportunities associated with banks' products, see Boyd and Graham (1988); Rosen, Lloyd-Davies, and Humphrey (1989); Templeton and Severiens (1992); and Wall, Reichert, and Mohanty (1993).

[3] See Rose (1995, pp. 304–5) for a number of possible measures of geographic coverage.

[4] Unless otherwise mentioned, we use the term "bank" as a synonym for "banking organization." That is, in most cases, our analysis is conducted using data at the organization level rather than the individual bank level.

[5] The coefficient of variation is a commonly used measure of risk in diversification studies. While we report results in terms of the coefficient of variation, our findings are qualitatively identical when the standard deviation of portfolio growth is used to measure risk.

Scaling the standard deviation by average growth provides a measure of the magnitude of economic variability relative to trend performance.

[6] This was true in 1985 but is not today, given the prevalence of interstate branching.

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