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WORKING PAPER NO. 98-10

THE DOLLARS AND SENSE OF BANK CONSOLIDATION

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ABSTRACT

For nearly two decades banks in the United States have consolidated in record numbers—in terms of both frequency and the size of the merging institutions. Rhoades (1996) hypothesizes that the main motivators were increased potential for geographic expansion created by changes in state laws regulating branching and a more favorable antitrust climate.

To look for evidence of economic incentives to exploit these improved opportunities for consolidation, we examine how consolidation affects expected profit, the riskiness of profit, profit efficiency, market value, market-value efficiencies, and the risk of insolvency. Our estimates of expected profit, profit risk, and profit efficiency are based on a structural model of leveraged portfolio production that was estimated for a sample of highest-level U.S. bank holding companies in Hughes, Lang, Mester, and Moon (1996). Here, we also estimate two additional measures that gauge efficiency in terms of the market values of assets and of equity.

Our findings suggest that the economic benefits of consolidation are strongest for those banks engaged in interstate expansion and, in particular, interstate expansion that diversifies banks' macroeconomic risk. Not only do these banks experience clear gains in their financial performance, but society also benefits from the enhanced bank safety that follows from this type of consolidation.

JEL Codes: G2, D2, G21, G28
Key Words: bank, consolidation, mergers, diversification, efficiency

THE DOLLARS AND SENSE OF BANK CONSOLIDATION

1. Introduction

For nearly two decades banks in the United States have consolidated in record numbers—in terms of both frequency and the size of the merging institutions. From 1980 to 1994, there was an average of 423 mergers per year—a total of 6,347 mergers, which amounted to 43 percent of all banks in existence in 1980 (Rhoades, 1996). Some of the largest mergers in banking history took place during this period. Prior to 1980 almost no mergers occurred where the acquired bank as well as the acquiring bank had assets in excess of $1 billion; however, during the period 1980-1994, 142 mergers involved pairs of large banks (Rhoades, 1996). Because state laws restricting interstate banking were relaxed during this period, 56 percent of the 142 large-bank mergers were interstate transactions.

Rhoades hypothesizes that changes in state laws regulating branching and a more favorable antitrust climate were the main factors behind the wave of bank mergers, especially interstate mergers. He also argues that as the trend toward interstate consolidation became clear, many banks formulated *intrastate* merger policies that would make them large enough to compete with potential out-of-state entrants as well as with other in-state banks. Since most state laws allowed out-of-state entry only by merger with or acquisition of an existing bank, banks' merger policies also sought to make the banks either more valuable takeover targets or too large to tackle.

Increased opportunities for expansion alone are not sufficient motivation for bank consolidation. While expansion may provide benefits of better diversification of assets and liabilities, spreading of overhead costs, and a wider scope of products and services, it may also increase the complexity of organization, which can raise costs of production and lead to greater inefficiency due to hard-to-control agency problems between managers and owners of the firm.[1] This paper examines whether there is evidence of net economic benefits from exploiting the improved opportunities for consolidation. We empirically test whether consolidation benefits banks by enhancing profit, efficiency, and market value,

[1]Williamson (1967) and McAfee and McMillan (1995) model these agency costs and, therefore, the degree of inefficiency, as an increasing function of the length of a firm's managerial hierarchy. Mester (1991) finds empirical evidence of such agency costs in the S&L industry.

and further, whether it improves bank safety in terms of the probability of remaining solvent. To address these issues, we synthesize the market-value approach and the production-based approach to examining the effect of consolidation on banks' economic performance. This synthesis allows us to account for the effect of consolidation on banks' expected current profitability and *ex ante* profit risk as well as on the market value of the banking firm.

Our production-based measures of performance—expected profit, profit risk, profit inefficiency, and insolvency risk—are based on a structural model of leveraged portfolio production, which was estimated using 1994 data on a sample of 441 highest level U.S. bank holding companies (BHCs) in Hughes, Lang, Mester, and Moon (1996). In our synthesis of this approach with the market-value approach, we demonstrate that the capital markets price our measures of expected profit and profit risk, since these estimated variables explain nearly all of the variation in the market value of equity. Using a model developed by Hughes, Lang, Moon, and Pagano (1998), we then estimate two additional measures that gauge efficiency in terms of the market value of assets and the market value of equity. Our market-value measures of efficiency can be derived only for the subsample of 190 publicly traded BHCs, while the production-based measures can be used to consider consolidation's effects on privately as well as publicly held banks. However, since inefficiency measured by the production-based technique is priced by capital markets, we can infer from our production-based results how the market values of privately held banks are influenced by consolidation.

Rather than examine the details of merger events and analyze banks' performance before and after particular mergers, we propose an alternative approach. Our approach identifies banks that have been active in consolidating by their structural characteristics that are correlated with all their past mergers and considers how the structural characteristics of different merger strategies affect performance. For example, a BHC that has made numerous interstate acquisitions may operate 1400 branches in 12 states. We show that a bank's consolidation activities are highly correlated with its asset size, the number of branches it operates, the number of states in which these branches are located, and the dispersion of the bank's deposits across these states. We also find a somewhat smaller correlation between these measures of consolidation activities and the degree to which the bank's macroeconomic risk is diversified. Using these structural correlates as proxies for BHCs' consolidation activities, we ask how they are related to both production-based and market-value measures of performance.

We simulate the effects of different consolidation strategies on our performance measures by proportionately varying different subsets of the structural characteristics. For example, a consolidation strategy that involves w*ithin-state expansion* is simulated by allowing asset size and number of branches to increase proportionately while holding constant the indices of across-state deposit dispersion and macroeconomic diversity. In contrast, an *interstate expansion* is simulated by proportionately increasing not only asset size and branches, but also the number of states in which the bank operates and the index of deposit dispersion. To simulate an *interstate expansion into economically similar neighboring states*, we hold the index of macroeconomic diversity constant, while to simulate an *interstate expansion that improves geographic diversity*, we also proportionately increase the index of macroeconomic diversity. Note that our approach allows us to simulate different consolidation strategies without having to account for the complications of specific merger events.

We find strong evidence that interstate consolidation strategies, particularly ones that increase the degree of macroeconomic diversification, improve market-value efficiency and production efficiency and reduce BHCs' insolvency risk. However, consolidation strategies that do not enhance geographic diversity lower insolvency risk but fail to affect efficiency. We investigate whether our results are similar for BHCs that have recently acquired assets and those that have not. In most cases, we could not find significant differences for these two groups. We did, however, find that while geographic diversification is related to lower insolvency risk for all BHCs, the effect is smaller for banks that have recently engaged in acquisitions. This might suggest that the full benefits of diversification in terms of lower insolvency risk are seen only several years after acquisitions occur, or that there are diminishing returns to geographic diversification, since acquirers, as a group, have higher average levels of geographic diversification than nonacquirers over this period.

In summary, our findings provide evidence to support Rhoades' hypothesis that consolidation offers its most significant gains in financial performance to BHCs whose consolidation strategy involves interstate expansion, particularly interstate branching that diversifies macroeconomic risk. Not only do these BHCs experience clear gains in their financial performance, but society also benefits from the enhanced BHC safety that follows from this type of consolidation.

2. Assessing the Economic Incentives to Consolidate

Making sense of the merger wave must ultimately translate into dollars and cents. However, who benefits from these transactions is an unsettled matter. Acquiring banks claim to benefit by increasing their profitability and shareholder value. Among their rationales for merging are scale economies that follow from consolidating adminstrative and back-office operations and from consolidating branches when the merging banks' branching networks overlap. Scale economies can also result from diversification of assets and liabilities that reduces the costs of risk management. Moreover, given the current emphasis on relationship banking, many merger partners cite scope economies they expect to achieve by combining their different product lines in a single institution. With a broader array of financial products, the consolidated bank expects to increase the potential revenues that can be obtained from any particular relationship and to reduce the average costs of marketing these products. Nevertheless, while expansion may provide many, if not all, of these benefits, it may also increase the complexity of the organization, which can raise the costs of production and the costs of controlling agency problems. On balance, the existence of consolidation benefits is an empirical issue.

Indeed, the academic literature frequently questions the existence of such gains and often attributes the incentive to consolidate to agency problems and managerial self-aggrandizement that compromise efficiency and destroy shareholder value. Although some studies have found benefits in consolidation both for acquirers and for the acquired, most studies either obtain inconclusive results or find that acquirers generally suffer a loss of market value. Moreover, the academic evidence for the cost economies often claimed by merging banks is no more conclusive. Pilloff and Santomero (1996) and Calomiris and Karceski (1998) provide a critical review of this literature.

Whether studies measure the benefits of consolidation in terms of cost economies and profit efficiency or in terms of the market's assessment of these gains, they generally focus on the merger event itself. These studies attempt to capture the financial performance of the merging institutions before and after the merger to determine who benefits from the transaction. But, as Pilloff and Santomero (1996) and Calomiris and Karceski (1998) point out, the merger event is a complicated transaction that can easily confound analytical attempts to investigate it. Studies that focus on the merger event must define a before-and-after time period to compare either stock-price reactions or other measures of financial performance. However, as the period is widened—to capture the leakage of information prior to the event in the case of event studies and to allow for enough time after the merger that its benefits can be realized in the case of other measures of performance—it becomes more difficult to distinguish the merger's effect on performance from other influences. In addition, some studies try to isolate the effects of mergers by considering banks that have engaged only in a single merger in the before-and-after time period. But evidence from such studies may not be applicable to the large number of banks engaged in multiple mergers.

For studies that use the reaction of stock prices to the announcement of the merger event to assess its before-and-after effects on financial performance, expectations and informational asymmetries can generate misleading results. Calomiris and Karceski (1998) contend that a negative market reaction to the announcement of a particular merger may not imply that the merger is unprofitable but, rather, that the market had already capitalized an alternative, more valuable merger strategy that it expected and is now adjusting to a less valuable strategy. Drawing on a study by Pilloff (1996) that finds that post-merger financial performance seems unrelated to the stock-price reaction to the merger announcement, Pilloff and Santomero (1996) suggest that markets may have a difficult time gauging how successfully the merged banks will be integrated. A merger may promise benefits that are not realized because the integration process is itself inefficient.[2]

To overcome these problems, which arise from focusing on merger events, we use an alternative approach that considers, instead, the structural characteristics that summarize the histories of BHCs' mergers and that characterize their merger strategies. By focusing on the effects of structural characteristics on BHCs' financial performance, we are able to simulate different consolidation strategies without having to account for the complications of specific merger events. We do not have to define a before-and-after time period, since we estimate the effects of the structural variables in a cross section. By including *all* the BHCs in the cross section, we can avoid the selection bias that results from selecting just the BHCs that engage in a single merger in the relevant time period. To gauge how capital markets respond to consolidation, we ask not how it reacts to the announcement of a merger, but how different consolidation strategies characterized by our structure correlates affect BHCs' market value.

Just as the previous merger studies have failed to uncover strong evidence on the benefits of consolidation, perhaps the most puzzling and often-cited result in the literature is the absence of scale economies. Like the negative findings of the merger studies, this result contradicts the testimony of merger participants, who usually list scale economies among their motives for merging. Again, methodological issues might be at the crux of the puzzle. Several recent studies have suggested that the key to uncovering these elusive scale economies is to account for how banks' risk-taking endogenously responds to an increased scale of operations (Hughes and Mester, 1998; Hughes, Lang, Mester, and Moon, 1995, 1996). In banking, greater size implies the potential for improved diversification at any given expected return. That is, enhanced diversification improves the risk-return tradeoff for the institutions.[3] In turn, better diversification reduces the marginal and average costs of risk management

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[2]DeYoung (1997) finds that the efficiency gains of bank mergers are concentrated among banks that have made frequent acquisitions.

[3]Benston, Hunter, and Wall (1995) consider bank mergers during the period 1981-86 and find evidence that acquiring banks sought to diversify earnings "in an effort to generate higher levels of cash flow for the same levels of risk" (p. 778).

(e.g., the same degree of protection against financial distress can be attained at a lower capital-to-asset ratio). This lower cost of risk management contributes to the potential for scale economies. But the overall level of risk is an endogenous choice of the bank, and the lower cost of risk management due to better diversification may encourage a bank to take on more risk since it now receives greater marginal benefits in the form of higher expected returns. *If larger banks tend to take on more risk and if this additional risk-taking is costly, failing to account for the cost-increasing effect of additional risk-taking can mask potential scale economies that result from better diversification.*

Scale economies should measure the effect on cost of a proportional variation in outputs, *holding endogenous risk constant*, but the standard studies of scale economies ignore risk and, thus, measure the effect on cost of both increasing output and increasing endogenous risk. Hence, they are less likely to detect the cost-savings of better diversification. Hughes and Mester (1998) and Hughes, Lang, Mester, and Moon (1995, 1996) control for endogenous risk-taking by accounting for the endogeneity of banks' equity capital demand and its influence on banks' risk-taking, and they find evidence of large scale economies that increase with asset size, a result that suggests that the largest banks have not yet been observed. These studies attribute the unexploited scale economies to the once pervasive restrictions on intrastate and interstate branching in the U.S. As states have relaxed these restrictions, they have created the opportunity for banks to exploit these previously unattainable scale economies by consolidating their branching networks.

Several studies have confirmed that greater diversification leads to higher profits and higher endogenous risk-taking. These studies use either a market-value approach or a production model approach to measure bank performance. Using stock market returns and the event-study method, Chong (1991) finds that interstate consolidation increases profitability and risk. Chong concludes that while geographic expansion reduces the risk of a given portfolio, it also expands banks' opportunities to take risks. A similar conclusion is reached by Demsetz and Strahan (1995), who examine stock market data and find that improved diversification reduces risk only when they control for banks' portfolio composition and activities. When they allow banks to adjust their portfolios and activities to respond to improved diversification, risk is no longer reduced.

Estimating a structural model of production that allows for risk-return tradeoffs, Hughes, Lang, Mester and Moon (1996) (hereafter, HLMM) estimate efficiency relative to an estimated risk-return frontier. Consistent with the market-value-based estimates cited above, they find that geographically diversified BHCs have higher expected returns and higher return risk. Akhavein, Berger, and Humphrey (1997) estimate efficiency using a production model to demonstrate that large bank mergers significantly improve profit efficiency and hypothesize that this improvement results from increases in loan-to-asset ratios and increases in leverage. They conclude that the larger scale of these merged banks and their greater geographic diversity allow them to increase their loan-to-asset ratios and their leverage without increasing risk.

Whether, in fact, better diversification leads to greater risk-taking depends on several factors. Value-maximizing banks must balance the higher expected profit of riskier investment strategies and the higher option value of mispriced deposit insurance against the effect of additional risk on both the discount rate applied to profit and to the potential for costly episodes of financial distress. Financial distress costs derive from the potential for liquidity crises, regulatory intervention in a bank's operations, and even loss of a bank's valuable charter. Thus, although diversification improves banks' risk-return tradeoffs, it does not necessarily imply that value-maximizing banks will choose less risky investment strategies.[4] Nor, does it necessary imply that banks will choose investment strategies that reduce their likelihood of insolvency. On the one hand, if consolidation's promised scale and scope economies increase profitability at any given level of risk, it reduces the probability of insolvency at any given level of risk. On the other hand, if consolidation leads banks to adopt higher risk investment strategies, it could increase the risk of insolvency.

[4]Blair and Heggestad (1978) and Koehn and Santomero (1980) have made similar points regarding the effects of more stringent regulation on banks' choice of risk.

To investigate the economic incentives to consolidate and to consider consolidation's effect on bank safety, i.e., the probability of insolvency, we synthesize the production-based and market-value approaches, which allows us to consolidate their respective advantages. In particular, production-based approaches rely on accounting data and typically estimate a frontier profit or cost function from which efficiency and scale economies can be gauged. Since market data are available only for publicly traded banks, studies using accounting data include a much broader sample of banks. In addition, because frontier methods measure banks' inefficiency, they can consider the incentives to consolidate that are created by efficiency differences among banks, and they can examine the effects of consolidation on profit and cost efficiency. However, frontier methods based on standard profit and cost functions typically fail to account adequately for banks' risk.

The efficiency measure based on the standard profit frontier would count as equally efficient two banks that have the same predicted profit and are otherwise identical except that one is riskier than the other. When the risk difference is priced by capital markets, the bank that does not manage risk as well will suffer a lower market value. *Substituting historical measures of risk into standard profit functions does not remedy this problem*. In particular, the logical apparatus of the standard profit and cost functions cannot generate a measure of the *ex ante* riskiness of the production plans that banks choose. These functions are based on the assumption that banks maximize profit without regard to risk. However, if banks maximize value rather than profit and if banks' riskiness affects their discount rate on their expected profits, production-based efficiency measurement must account for ex ante risk as well as profitability to capture the market's evaluation of banks' performance. Moreover, if there is the potential for costly episodes of financial distress, *trading current profitability for reduced risk, not maximizing current profit, is a value-maximizing strategy*.[5] Although profit and cost functions based on profit maximization aim to gauge the effects of consolidation on cost and profitability, they are logically

[5] Firms might trade profitability for reduced risk for reasons in addition to distress costs. See Smith and Stulz (1985) and Tufano (1996).

unable to account for its effects on endogenous risk taking and how the expected profitability and risk of banks' production plans influence their market value.

An important advantage of the market-value approach is that the final arbiter of how to evaluate profitability and risk is, of course, the *market's valuation.* While studies of bank consolidation based on market-value approaches implicitly account for risk and its endogeneity, they do not measure banks' efficiency and consolidation's effect on it. This suggests the advantages of combining these two approaches. In our synthesis we show that our production-based measures of expected profit and profit risk explain market value and, hence, that our measure of profit efficiency that controls for *ex ante* risk is priced by capital markets. Our market-value efficiency measures also confirm this relationship.

Rather than focus on the before-and-after effects of a merger, our empirical strategy is to characterize different merger strategies by their effects on BHC structure and geographic diversity. First, we examine the effects of variables indicating structure and geographic diversification on BHC performance by regressing production-based and market-value-based performance measures on these variables. Thus, we use OLS to estimate the following equation for each performance measure:

$$ln\,(\text{Performance})_i = \delta_0 + \delta'\mathbf{x_i} + \epsilon_i\,, \qquad (1)$$

where $\mathbf{x_i}$ represents a vector of measures of BHC structure and geographic diversification (and other control variables).[6] Then, by analogy to scale economies, which measure how a proportionate increase in output changes costs, we estimate the effects on performance of proportional variations in different groups of the BHC structure variables that characterize different consolidation strategies.[7]

[6]We report White heteroscedasticity-consistent standard errors and use these in all tests (White, 1980). Note that in our regressions, the dependent variables are based on estimates. As Saxonhouse (1976) shows, when the dependent variable is estimated, this can introduce heteroscedasticity into the regression. His method for treating heteroscedasticity that can arise when estimated parameters are used as dependent variables is not applicable here, since our dependent variables are nonlinear (i.e., logarithmic) transformations of estimates for which we can compute estimated values of their standard errors but not exact values. Instead, we handle the potential heteroscedasticity problem by computing White heteroscedasticity-consistent standard errors of our regression coefficients.

[7]Most of our geographic diversification and consolidation variables are entered into the regression equation in logarithmic form, so that the coefficient on such a variable is an elasticity. The

3. Production-Based Performance Measures: Expected Profit, Profit Risk, Profit Inefficiency, and Insolvency Risk

Banks use labor, physical capital, and various funding sources, including equity (financial) capital, to produce investments in financial outputs, principally loans and securities. This production plan is characterized not only by the quantity of inputs and outputs but also by their quality (riskiness). A bank's choice of production plan reflects, in part, its managers' beliefs about how stochastic market conditions interact with the *ex ante* production plan to imply a conditional, subjective probability distribution for realized profit. However, the choice of production plan also reflects managers' preferences.

Different production plans imply different probability distributions for profit. Management's ranking of production plans can be interpreted as a preference ordering of conditional subjective probability distributions of profit (Hughes and Moon, 1997). If managers maximize profit, they rank plans only by the first moment of the distribution. However, if they maximize value, higher moments of the distribution will matter in the ranking because risk influences the discount rate on profit.

Managers who act in the interests of shareholders choose the production plan that maximizes the value of the bank's equity. If there are no agency problems that lead to risk shifting and the expropriation of value from debtholders, maximizing the value of equity is equivalent to maximizing the sum of the market values of debt and equity—i.e., the market value of assets. The market value of equity is the present value, V_0, of the net cash flows,

$$V_0 = \sum_{t=1}^{\infty} \frac{CF_t}{(1+\theta_t)^t} \qquad (2)$$

where θ is the required return on equity and CF is expected net cash flow. The expected net cash flow that follows from any particular production plan consists of two components: expected profit and expected costs of financial distress. Financial distress costs are costs associated with liquidity crises,

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effect of a proportionate increase in a group of these **x** variables is just the sum of the coefficients on these variables.

regulatory intervention and, in extreme cases, the costs associated with insolvency and the loss of the valuable charter.

When episodes of financial distress are costly to the bank, managers maximize the value of the bank's equity and, in the absence of agency problems, the value of the bank's assets by choosing a production plan that trades expected profit for a reduced expected cost of financial distress. Moreover, the required return on the bank's equity depends on the bank's exposure to systematic risk, which depends, in turn, on the bank's choice of production plan. From (2) it is clear that value-maximizing banks must balance a production plan's expected profitability not only against its expected distress costs, but also against its effect on the bank's exposure to systematic risk and on the resulting discount rate on cash flows.

The market's evaluation of (2) is readily observable for BHCs that are publicly traded. However, the components of (2) must be inferred from production data. The standard profit function is not suitable for this task, since it neither incorporates risk nor does it allow for any production plan other than the profit-maximizing one. Maximizing value requires that production plans be assessed not just for their contribution to expected profit but also for their contribution to market-priced risk and to expected distress costs. A plan that increases expected profit but also raises the discount rate can reduce the present value of the expected profit. Thus, a production-based model of bank performance must be able to estimate both return and risk.

The production-based performance measures we use here include estimates of expected profits, profit risk, profit inefficiency, and bank insolvency risk measured by the inverse z-score.[8] These estimates are derived from HLMM (1996). Based on the logic of managerial utility maximization, their model of production allows managers to rank production plans by higher moments of their implied

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[8]The inverse z-score is defined as the standard deviation of return on equity/(1+expected return on equity). There is a difference between the insolvency risk of a BHC and that of the individual subsidiaries. However, several factors tie the two together. The "cross guarantee" provisions of FIRREA (1989) make commonly controlled depository institutions liable for any losses. In addition, BHCs can borrow to supply capital to their bank subsidiaries.

probability distributions of profit and, hence, accommodates value maximization as well as profit maximization and the case where the potential for costly episodes of financial distress makes trading profit for reduced risk a value-maximizing strategy.

The HLMM production system uses the Almost Ideal Demand System to obtain the functional forms for the profit share equation, input share equations, and a first-order condition defining the optimal demand for financial capital. Just as estimating this demand system using consumption data allows one to recover consumers' preferences for goods and services, estimating it with production data allows one to recover managers' preferences for production plans and their implied probability distributions of profit. HLMM specified five outputs: liquid assets, short-term securities, long-term securities, loans and leases net of unearned income, and other assets; both the output levels and prices appear in the profit and input share equations. Six inputs were specified: financial (equity) capital, labor, physical capital, insured deposits, uninsured deposits, and other borrowed money; the level of financial capital, and prices of the other inputs appear in the model. As indicators of a BHC's output quality, the model included the amount of nonperforming assets and a risk premium measured by the average contractual return on assets relative to the risk-free return. Since managers are permitted to rank production plans by higher moments of their implied probability distribution of profit, certain variables that would be excluded by the logic of profit maximization are also included—in particular, the federal plus state tax rates and noninterest income. (When the restrictions implied by assuming that firms maximize profits are imposed on the Almost Ideal Demand System, its functional form becomes identical to the standard translog profit system.)

Nonlinear two-stage least squares was used to estimate the system of equations comprising the profit share equation, the input share equations, and the first-order condition for equity capital. Adding-up conditions and certain symmetry conditions were imposed. The data were obtained from the balance sheets and income statements of U.S. BHCs as reported on the FRY-9 Financial Statements for the four quarters of 1994. Excluded were BHCs located in unit banking states, BHCs that consisted primarily of nonbank banks, and special purpose banks. *De novos*, defined as BHCs that were not operating as of June 1986, were also excluded. The final sample included 441 highest-level BHCs, ranging in size from \$32.5 million to \$249.7 billion in consolidated assets. Interested readers may refer to HLMM for a full description of the model, variable definitions, and estimation method.

The estimates of expected profit, the risk of profit, profit inefficiency, and insolvency risk for each BHC are based on the estimated production model. ***Expected profit*** is measured as the predicted profit from the estimated profit share equation. ***Profit risk*** is measured by the standard error of predicted profit. Hence, both expected profit and profit risk depend on the BHC's production decisions and its economic environment, which are variables in the production model. ***Insolvency risk*** can then be measured as profit risk/(financial capital + expected profit). ***Profit inefficiency*** can be derived from estimates in HLMM of a best-practice risk-return frontier. Expected return was measured as expected profit divided by equity capital and return risk was measured by profit risk divided by equity capital. Then the best-practice risk-return frontier was computed by using stochastic frontier estimation techniques. Expected return divided by its standard deviation, ER', was specified as a quadratic function of return risk divided by its standard deviation, RK':

$$ER_i' = \Gamma_0 + \Gamma_1 RK_i' + \Gamma_2 RK_i'^2 + \epsilon_i. \tag{3}$$

A composite error term, $\epsilon_i = \nu_i - u_i$, is used to distinguish inefficiency from statistical noise. The two-sided component, ν_i, is distributed $N(0,\sigma_v^2)$ and accounts for any unmeasured randomness in the data-generation process of risk and return. The one-sided component, $u_i > 0$, is distributed half normally, i.e., it is the absolute value of a variable distributed $N(0,\sigma_u^2)$, and gauges inefficiency, the failure to achieve the frontier return at a given level of risk. Maximum likelihood estimation was used, and return inefficiency was measured by the conditional expectation of u_i given ϵ_i.[9] As shown in HLMM, this frontier is positively sloped, indicating that higher *expected* return is accompanied by higher return risk. (In contrast, studies that use historical measures of risk and return often find that higher risk is

[9]See HLMM for a more complete discussion of this methodology.

accompanied by lower *realized* return.)

Here, rather than use return inefficiency, we define ***profit inefficiency*** as return inefficiency multiplied by the BHC's financial (equity) capital. It can be interpreted as a shortfall in a BHC's expected profit relative to the best-practice profit, for a given level of risk.

Profit inefficiency derived from the managerial utility-maximizing model of HLMM differs from that derived from the standard frontier profit function in at least two important ways. First, it controls for risk. Two BHCs that are equally profitable and otherwise identical except that one does not control risk as well would be judged equally efficient by the standard model but not by the HLMM model.

Second, the standard analysis fits the best-practice frontier using the profit function. Hence, its efficiency measure controls for the arguments in the profit function. When some of these arguments are, in fact, endogenous, measured inefficiency will be understated because it has not accounted for the effect on profitability of poor choices of these arguments. For example, output prices are a standard argument in the profit function. In the case of banking, output prices often represent interest rates earned on assets, and these interest rates reflect the contractual rates set by banks and the resulting risk banks have chosen to take. Banks that set higher rates expect higher profit and higher risk, but higher rates do not necessarily yield higher return. When the standard analysis controls for these prices in measuring efficiency, it does not capture any inefficiency due to a poor choice of contractual rates. The profit inefficiency measure based on our production model does capture this type of effect because we fit the best-practice return frontier not to the arguments of the model's profit function, but to the return and risk derived from the profit function. While our model's profit function and its prediction depend on these prices, the best-practice return at any given level of risk does not—i.e., it is simply the highest, noise-adjusted return observed for any choice of prices at the given level of risk. Hence, our production-based efficiency measure derived from this frontier accounts for the optimality of these prices and similar arguments in the profit function.[10]

One drawback of our profit inefficiency measure is that it measures each BHC's inefficiency at its observed level of risk. Our inefficiency measure would fail to pick up the extent to which a BHC is operating at a level of risk that was not optimal, since our production model is unable to generate a market price of risk. Capital markets are, of course, the ultimate arbiters of the optimality of a BHC's risk. Thus, we use two additional measures of efficiency that are based on the market values of BHCs' assets and equity, which we describe in the next section.

4. Market-Value Performance Measures: Market-Value of Equity, Market Value of Assets, and Market-Value Inefficiency

In addition to the production-based measures of performance, we also use measures based on market values at the end of 1994. The market-value data were obtained from the stock-price database of the Center for Research in Securities Prices (CRSP) and from Standard & Poor's Compustat database and were available for the subsample of 190 of our 441 BHCs that were publicly traded. Our measures include the market value of equity, the market value of assets, and market-value equity inefficiency, and market-value asset inefficiency, which are described below. We investigate how closely these market-value measures of performance are related to our production-based measures for the 190 BHCs for which we have both. A close relationship would give us confidence in our production-based measures for the privately held BHCs for which market values are not available.

As discussed in the previous section, the required return on the BHC's equity, θ, depends on the BHC's exposure to systematic risk, and this exposure depends on the BHC's choice of production plan. Our production model's estimate of expected current profit and profit risk are, in principle, components

[10]See Hughes (1998) for a more detailed discussion of these issues. To the extent that banks exercise market power, the loan rates and deposit rates they set may reflect not just risk, but also their market power. Hence, our efficiency measure captures market advantage as well as inherent managerial efficiency. Akhavein, Berger, and Humphrey (1997) do not find statistically significant evidence that large-bank mergers have affected these prices. Using event-study methods, Siems (1996) examined large-bank mergers in 1995 and rejected the market-power hypothesis as a motive for mergers.

of equation (2), since expected profit influences expected cash flows in period 1 and profit risk influences period 1's required rate of return, θ_1. If the production model's proxy for risk is closely related to the required return on equity in current and in future periods, θ_t, and if its measure of expected profit based on the estimated profit share equation accurately gauges expected current profit and proxies well for future, unobserved profit (at t = 2, ... , ∞), then the production model should be able to explain the part of market value that excludes expected distress costs. (If the production plan is a good proxy for expected distress costs, the production model may well explain the second component of market value.) To determine how well our measures of expected profit and risk explain variations in the ***market value of equity*** and to explore the effects of BHC structure and geographic diversification (characterized by a vector of variables, **x**), on the market value of equity, instead of estimating equation (1) with the market value of equity as a performance measure, we use the Generalized Method of Moments technique to estimate the following system of equations:

$$\begin{aligned} ln\,(\text{Market value of equity})_i &= \alpha_0 + \alpha_1\, ln\,(\text{Expected profit})_i + \alpha_2\, ln\,(\text{Profit risk})_i + \epsilon_i \\ ln\,(\text{Expected profit})_i &= \beta_0 + \beta'\mathbf{x_i} + \xi_i \\ ln\,(\text{Profit risk})_i &= \gamma_0 + \gamma'\mathbf{x_i} + \zeta_i\,. \end{aligned} \tag{4}$$

The R^2 on the market-value-of-equity equation in the system indicates the degree to which our measures of expected profit and risk from the production model explain variations in the market value of equity. In addition, we investigate the relationship between the ***market value of assets*** and geographic diversity, estimating equation (1) using the market value of assets as the performance measure.[11]

We also compute two inefficiency measures using market values of equity and of assets (see Hughes, Lang, Moon, and Pagano, 1998), and estimate equation (1) using these inefficiency measures as measures of performance. These two inefficiency measures gauge the ability of the bank to create

[11]The market value of assets is the sum of the discounted cash flows to debt and equity, but the production model does not give us an expected cash flow on debt. Thus, we cannot use the system in (4) to estimate the effects of consolidation on the market value of assets.

franchise value from efficient practices and market opportunities, including the exercise of market power (see footnote 11). And, as discussed above, they alleviate a drawback of our production-based measure of inefficiency, as they are able to account for whether the BHC's choice of risk is optimal.

Given the book value of a bank's assets adjusted to remove goodwill, we estimate the following frontiers using stochastic frontier estimation techniques:

$$\text{Market Value of Equity}_i = \Phi_0 + \Phi_1 \text{Adjusted Book Value of Equity}_i + \Phi_2(\text{Adjusted Book Value of Equity}_i)^2 + \xi_i^E, \quad (5)$$

$$\text{Market Value of Assets}_i = \Psi_0 + \Psi_1 \text{Adjusted Book Value of Assets}_i + \Psi_2(\text{Adjusted Book Value of Assets}_i)^2 + \xi_i^A, \quad (6)$$

where the adjusted book value of equity is the book value of equity minus goodwill and the adjusted book value of assets is the book value of assets minus goodwill; $\xi_i^E \equiv \nu_i^E - u_i^E$ and $\xi_i^A \equiv \nu_i^A - u_i^A$ are composite error terms, with ν_i^E and ν_i^A normally distributed with zero means, and u_i^E and u_i^A positive and half normally distributed.[12] The ***market-value equity inefficiency*** of a BHC is then measured by the conditional mean of u_i^E given ξ_i^E. It is interpreted as the dollar amount by which the BHC could increase the market value of its equity if it were as well positioned in the marketplace and as efficient as the best-practice BHCs that define the frontier. Similarly, the ***market-value asset inefficiency*** of a BHC is measured by the conditional mean of u_i^A given ξ_i^A, and represents the amount by which the BHC could increase the market value of its assets if it were as well positioned in the marketplace and as efficient as the best-practice BHCs. When there are no agency problems that result in risk shifting and the expropriation of value from debtholders, maximizing the value of equity is equivalent to maximizing the value of assets. Hence, the two measures of market-value efficiency should yield qualitatively similar

[12] Since goodwill is a component of market value, the book value of assets is adjusted to remove goodwill. See Demsetz and Strahan (1995).

results. However, when there are such agency problems, measuring efficiency using the asset-based measure will capture the inefficiency due to risk shifting.

It is important to note that these market-value measures of inefficiency are conditioned on the BHC's size while profit inefficiency, based on the production model, is not. That is, the market-based measures do not account for inefficiency due to a poor choice of size while the production-based measure does. But the production-based measure does not account for a nonoptimal risk choice by the BHC, while the market-value inefficiency measures do.

5. Measures of BHC Structure and Consolidation

From one-bank holding companies operating in a single state with limited branch networks to huge multibank holding companies operating in many states with extensive branch networks, a BHC's structure reflects its history of consolidation activities. This structure is reflected in a BHC's asset size along with various other measures of its geographical extension and diversity.

Consolidation affects the ***extensiveness of a BHC's branch network***, which we measure by the ***number of branches*** and the ***number of states*** in which the BHC operates and by the degree to which assets and deposits are dispersed over the network.[13] We measure the degree of a BHC's ***deposit dispersion*** by the inverse of the sum (over the states in which it operates) of the squared proportion of its deposits in each state: $1/\sum_{i=1}^{N} s_i^2$, where N = number of states in which the BHC operates and s_i = the share of the BHC's deposits in state I. Hence, this ratio equals one when the BHC's operations are located in one state and exceeds one to the degree that deposits are spread over more than one state, and given the number of states, to the degree that deposits are more equally dispersed over these states.[14] In our regressions we also include a dummy variable ***OBHC*** equal to one if the BHC is a one-bank holding

[13]The data on the number of branches and deposits per branch are from the FDIC's Summary of Deposit reports.

[14]An alternative measure using asset shares yields essentially the same values. The correlation between the two measures is 0.992.

company and equal to zero otherwise to allow for differences across holding company type.

Two BHCs with the same level of deposit dispersion may nevertheless benefit quite differently from geographic diversity when the macroeconomic environments in which they operate differ. When fluctuations in macroeconomic activity in the various states in which a BHC operates are not perfectly correlated, a BHC's geographic diversity can reduce its exposure to systematic risk. Hence, to control for these differences, we also characterize geographic diversity by a measure of ***macroeconomic diversification***. To obtain this measure, we first compute a variance-covariance matrix for state unemployment rates over 1985-94. Then for each BHC, we compute the inverse of the standard deviation of its weighted-average unemployment rate in the states in which it operated in 1994, using its deposit shares in its states as the weights. That is, if V is the matrix of variances and covariances in state unemployment rates over 1985-94 and s is a vector of a BHC's deposit shares in each state, the BHC's macroeconomic diversity = $1/[s'Vs]^{1/2}$.

Finally, we include the BHC's 1994 ***asset level*** and ***asset growth rate*** between 1993 to 1994 to separate the effect of size from that of change in size.

Table 1, column 1, shows the mean and median values of our BHC performance measures and geographic diversification measures (recall that the market value measures are available only for the 190 BHCs in our sample that are publicly traded).

Geographic diversification is a natural byproduct of industry consolidation and, prior to the Riegle-Neal legislation, mergers and acquisitions were the main method BHCs had to achieve geographic diversification. The data shown in columns 2 and 3 of Table 1 confirm this. There we show the means and medians of our geographic diversification variables (and of our BHC performance measures) for two subsamples: BHCs that, on net, acquired assets over the period 1992-94, and all other BHCs.[15] As the difference in mean and median tests show, net asset acquirers are more often multibank

[15] A BHC is said to have acquired assets, on net, if the volume of assets it acquired over 1992-94 exceeded the volume of assets it sold. Of the 249 BHCs in the full sample that, on net, did not acquire assets over the 1992-94 period, only 23 were net sellers of assets.

holding companies; they operate in 2-3 states on average as opposed to 1-2 states; they have significantly more branches; and their levels of deposit dispersion and macroeconomic diversity are also higher than for nonacquirers.[16,17] (The differences in performance measures between acquirers and nonacquirers suggest that they are operating at different points on the return-risk frontier, with acquirers having higher expected profits and higher profit risk.)

The correlations shown in Table 2 provide further confirmation that our measures of BHC structure and geographic diversification are indicators of acquisition behavior. In all cases the volume of net assets acquired and net institutions acquired are positively correlated to our measures of geographic diversification, and except for the correlation between macroeconomic diversity and net assets acquired or total assets, these correlations are highly significant.

Consolidation can affect BHC structure and performance in various ways. Our estimated equations allow us to consider, in turn, the effects on performance and market value of the number of branches, the number of states, the index of deposit dispersion, and the index of macroeconomic diversification, controlling for size and change in size. Defining the ***branch network*** of a BHC by the number of its branches and states and by its index of deposit dispersion, we consider how a proportionate expansion in its branch network affects its performance, controlling for size, change in size, and macroeconomic diversification. Then, we consider how a more expansive branch network that entails better macroeconomic diversification affects performance by proportionately varying both the size of the network and the index of macroeconomic diversification.

Next, we investigate the effect of geography when ***asset size is allowed to vary***. Holding the number of states constant to establish a benchmark, we consider the effects of a proportionate variation in total assets and branches. This type of expansion represents a ***within-state consolidation strategy*** that

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[16]When we say nonacquirers, we mean the BHCs did not acquire, on net, assets in the 1992-94 period. They could have acquired assets earlier.

[17]The results discussed below are quite similar to those obtained when we divide the sample into those BHCs that, on net, acquired institutions in 1992-94 and those that did not.

does not diversify state-specific macroeconomic risk. To isolate the effect of ***interstate expansion***, we then add the number of states and the index of deposit dispersion to the list of variables that vary proportionately. This expansion simulates a consolidation strategy that, for example, involves moving into neighboring states whose macroeconomic conditions are similar to the home state, so that the index of macroeconomic diversification is not affected. Then, to identify the contribution of macroeconomic diversification, we allow it to vary, too. This expansion represents a consolidation strategy that both enlarges the bank and geographically diversifies it.

Finally, we examine whether our results differ for BHCs that were net asset acquirers in 1992-94 and those that were not by estimating equation (1) and the system of equations (4) allowing all the coefficients to vary for these two groups of BHCs. Wald tests are used to determine whether the restricted model, which does not allow for any difference across the groups, can be rejected in favor of the unrestricted model. Differences in the results on the effects of geographic diversification on performance across the two groups are examined in cases where the restricted model is rejected.

6. Empirical Results

Our first set of results is reported in Table 3. The effects of consolidation on expected profit, profit risk (the standard error of expected profit), the degree of profit inefficiency, and insolvency risk (the inverse z-score) are reported for the entire sample of 441 BHCs, while its effects on the market value of equity and on market-value inefficiency are computed for the subset of 190 BHCs that are publicly traded.[18] For the exogenous variables that are in logs, the coefficients are elasticity estimates. Note that our production-model-based performance measures, expected profit and profit risk, do appear to be priced in capital markets, since the R^2 for the market-value-of-equity equation is 0.96. In other

[18]We also estimated the expected profit, profit risk, profit inefficiency, and insolvency risk regressions on the subsample of 190 publicly traded BHCs. The results are similar to the ones reported in the paper for the full 441 BHC sample.

words, our performance measures explain 96 percent of the variation in equity value.[19]

6.1. Asset size and asset growth. Turning first to the effects of asset size and growth, we find that a higher growth rate is associated with reduced profit risk, with reduced risk of insolvency, and with reduced profit inefficiency. Although a higher *growth rate of assets* is associated with a lower market value of equity, this relationship may simply signify that more highly levered BHCs grow more rapidly. A better indication of the effect of growth on market value can be obtained from its effect on market-value inefficiency. The coefficients in the last two columns of Table 3 show that, in fact, the growth rate has no statistically significant effect on either asset-based or equity-based market-value inefficiency.

Asset size, on the other hand, is positively related to expected profit and profit risk, with its coefficient significantly less than one in the profit regression and significantly greater than one in the risk regression. Hence, a proportionate expansion in asset size is associated with a less-than-proportionate increase in expected profit and a more-than-proportionate increase in risk. This means that an increase in asset size implies a more-than-proportionate increase in profit inefficiency, as shown in the fourth column. And although they are not statistically significant, the positive signs for the effect of asset size on the two market-value measures of inefficiency are consistent with this result. Finally, a proportionate expansion in assets leads to a less-than-proportionate expansion in the market value of equity—a result that may imply that there are scale economies in the use of equity capital (see Hughes and Mester, 1998)

6.2. One-bank holding companies. In addition to controlling for asset size and its growth rate, we include a dummy variable that equals one when the BHC is a one-bank holding company (OBHC). This control variable is not significantly related to expected profit, profit risk, the risk of insolvency, nor to any of the inefficiency measures. However, it is significantly associated with a lower market value of assets.

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[19]Note that this is the R^2 for the single equation of market value of equity regressed on expected profit and profit risk; it does not merely reflect the relationship between the market value of equity and the book value of equity in the reduced form of the model.

Using the same sample of BHCs that we use, Hughes and Moon (1997) also found that measures of expected profit and risk explain 96 percent of the variation in the market value of equity.

6.3. Branch network components. The effects on performance of the components of a BHC's branch network vary across performance measure. When we control for asset size, branches, and deposit dispersion, the *number of states* in which a BHC operates is positively related to expected profit and both profit risk and insolvency risk. Although the number of states is insignificantly positively related to profit inefficiency, its relationship to both market-value measures of inefficiency is positive and significant. When we control for size, the number of states is negatively related to the market values of equity and assets, significantly so for assets. Hence, BHCs that have more extensive interstate operations appear to be taking on more risk in exchange for higher expected profit. When we control for size, the market-value measures of inefficiency indicate that these BHCs are less efficient than those that operate in fewer states. This inefficiency result might be reflecting the fact that since we are controlling for size (as well as the number of branches and deposit dispersion), banks that operate in many states have a smaller average scale of operation in any state than banks that operate in fewer states.

When we hold constant the number of states, deposit dispersion, and asset size, an increase in the *number of branches* is associated with higher expected profit, lower profit risk and insolvency risk, and lower profit inefficiency. It is also negatively related to both measures of market-value inefficiency, but not significantly so. Additionally, it is positively related to both the market value of equity and of assets. These benefits of an expansion in the number of branches, holding assets and the number of states constant, may partly result from better within-state geographic diversity and a potential for greater growth in size afforded by more branches. This positive relationship between branches and performance is consistent with the fact that, while consolidation has resulted in fewer banks, it has also led to an increase in bank branches. For example, between year-end 1980 and year-end 1996, the number of insured commercial banks fell by 34%, but the number of branches rose by 49% (based on FDIC data).

When we hold the numbers of branches and states as well as asset size constant, an increase in *deposit dispersion* is associated with lower insolvency risk and, hence, probably lower profit risk; however, the negative coefficient associated with profit risk is insignificant. Both market-based measures of inefficiency indicate that deposit dispersion is associated with lower inefficiency.

When we hold asset size and growth as well as the branch network constant, an increase in the *index of macroeconomic diversification* is negatively related to both profit risk and insolvency risk. In turn, it is associated with lower profit inefficiency and higher market value of assets; it is also positively related to the market value of equity, but not significantly so. Although the coefficients are not statistically significant, the negative signs of the market-based measures of inefficiency are consistent with the production-based measure.

These two results for deposit dispersion and for macroeconomic diversification indicate that, controlling for size and branch network, better geographic diversity is related to greater efficiency and possibly higher asset value.

6.4. Branch network extensiveness and macroeconomic diversity. We turn next to the evidence on how the extensiveness of the branch network affects performance. We control for asset size, growth, and macroeconomic diversity to consider a proportionate expansion in the number of branches and states and in the index of deposit dispersion. This increase in the extensiveness of the branch network, holding size constant, is associated with increased expected profit, reduced risk of insolvency, and reduced profit inefficiency. The reductions in both the asset-based and equity-based measures of market-value inefficiency provide evidence that the gains in profit efficiency measured by the production model are priced by capital markets. Hence, at any given asset size, BHCs that are more geographically extensive achieve significantly better financial performance and lower insolvency risk than those that are more geographically restricted.

When we vary not just the extensiveness of the branch network but also the index of macroeconomic diversification, we find that, controlling for asset size and growth, a more extensive network that also entails better macroeconomic diversification is significantly related to lower profit risk and insolvency risk. The effect on expected profit is positive but statistically insignificant. As these results would imply, profit inefficiency measured by the production model is lower, and the two market-based measures confirm that this improvement in efficiency is priced by capital markets. *Thus, these benefits of geographic expansion and diversification give banks an important economic incentive to consolidate, especially across state lines.*

6.5. Scale effects. Since a larger volume of assets is thought to facilitate diversification in general and geographic diversity in particular, we turn to the evidence on how the ***scale of geographic expansiveness*** affects performance. To gauge the effects of a within-state consolidation strategy, we hold the number of states constant as well as the indices of deposit dispersion and macroeconomic diversification and find that a proportionate increase in *asset size and branches* alone is associated with a more-than-proportionate increase in expected profit and a less-than-proportionate increase in profit risk. These two effects translate into a reduction in the risk of insolvency and a relative reduction in profit inefficiency, since profit inefficiency increases less than proportionately. Although the signs of the effects on the two market-value measures of inefficiency are consistent with this relative reduction in inefficiency, they are not statistically significant. Thus, within-state expansion confers clear benefits, in terms of reduced insolvency risk, even though there is only weak evidence of its benefits for market value.

To consider an interstate consolidation strategy that does no affect macroeconomic diversification, we vary the number of *states and the index of deposit dispersion as well as asset size and branches*, holding the index of macroeconomic diversification constant, and we find that expected profit, profit risk, and profit inefficiency all increase proportionately, since their elasticities are not significantly different from one. The effect on the risk of insolvency is not significantly different from zero. Both the market value of equity and the market value of assets increase proportionately. In addition, given the book value of equity and assets, the distance from the two respective market-value frontiers, that is, market-value inefficiency, decreases. Hence, an expansion in asset size that involves interstate branching improves market-value efficiency even though it does not significantly reduce insolvency risk.

To consider an interstate consolidation strategy that improves macroeconomic diversification, we lastly consider a proportionate expansion in *asset size, numbers of states and branches, deposit dispersion, and macroeconomic diversification*. Our results show that profit elasticity is again not significantly different from one, so expected profit increases equi-proportionately. The elasticity of profit risk is less than one, but not significantly so. However, the elasticity of profit inefficiency is significantly less than one, so that relative inefficiency improves. This improvement is reflected in the reduced values of the two measures of market-value inefficiency. Moreover, the risk of insolvency is also diminished. *Hence, it appears that larger BHCs, whose more extensive branch networks have afforded them better macroeconomic diversification, achieve greater safety and improved efficiency, which is priced by capital markets.*

6.6. Results for recent net asset acquirers and other BHCs. It is possible that the effects of geographic diversification on performance would differ for BHCs that had recently been more aggressive at acquiring assets than for other BHCs.[20] Our results suggest that this does not, in general, appear to be the case. The Wald test statistics reported in Table 4 indicate that the restricted models (whose results were presented in Table 3), which do not allow the coefficient estimates to vary between BHCs that were net asset acquirers and those that were not, can be rejected only in the case of profit risk and insolvency risk. For these two cases, Table 5 presents the coefficient estimates that significantly differ between net asset acquirers and nonacquirers.[21] As can be seen, while certain effects statistically differ between the two groups, the differences are fairly small. One consistent finding is that greater geographic diversification appears to be related to lower insolvency risk for both groups, but the effect is larger for the nonacquirers. This suggests that it may take some time for the full effects of diversification to be felt. It might also indicate that there are diminishing returns, in terms of reduced insolvency risk, of greater geographic diversification, since our measures of geographic diversification are generally larger

[20]Recall that our groups of BHCs are those that, on net, acquired assets in 1992-94 and those that, on net, did not. The geographic diversity measures—number of states, deposit dispersion, and macroeconomic diversity—would show variation across BHCs in the second group to the extent they acquired assets, i.e., expanded into more than one state, prior to 1992.

[21]The full set of regression coefficients are available from the authors.

for the acquirers than for the nonacquirers.[22]

7. Conclusions and Policy Implications

In his study, Rhoades (1996) concluded that increased opportunities for geographic expansion made possible by changes in state laws on branching, coupled with a more favorable antitrust climate, drove the wave of bank mergers during the period 1980-94. But what drove banks to take advantage of their new opportunities to expand and consolidate? Using a variety of measures of financial performance and bank safety, we have found strong evidence that consolidation provides significant gains to BHCs in terms of improved financial performance and safety—gains that are priced by capital markets.

Geographic diversity plays a crucial role in securing these gains. We contrast: (1) a within-state consolidation strategy—a proportionate expansion of assets and branches, (2) an interstate consolidation strategy that does not diversify state-specific macroeconomic risk—a proportionate expansion of assets and branches *plus states and the index of deposit dispersion*, and (3) an interstate consolidation strategy that diversifies state-specific macroeconomic risk—a proportionate expansion of assets, branches, states, the index of deposit dispersion, *plus the index of macroeconomic diversification*. The clearest gains come from expansion *across* state lines, especially when this interstate expansion diversifies macroeconomic risk.

Consolidation that enhances geographic diversity also improves bank safety measured by the risk of insolvency. The contrast between proportionate increases in (1) branches, states, and deposit dispersion and (2) branches, states, deposit dispersion, *plus assets* suggests that enhanced geographic diversity reduces the risk of insolvency while increased size tends to increase this risk, while the contrast

[22]We obtained similar results when instead of allowing the coefficients in the model to differ according to whether the BHC was a net asset acquirer or not, we allowed them to differ in a continuous way with the level of net assets acquired, i.e., when we included interaction terms between the exogenous variables in the model and the level of net assets acquired.

between proportional increases in (1) branches, states, deposit dispersion, and macroeconomic diversification and (2) branches, states, deposit dispersion, macroeconomic diversification, *plus assets* indicates that consolidation that enhances macroeconomic diversification can significantly offset the tendency of larger banks to take more insolvency risk.

In addition to uncovering evidence that bank consolidation in the United States has improved banks' financial performance and has enhanced the safety of the payments system, our investigation has shown the importance of accounting for risk and, in particular, recognizing its endogeneity when one is measuring bank efficiency.

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Table 1. Means and Medians of the Data

Variable		Full Sample	Subsample with Net Assets Acquired > 0	Subsample with Net Assets Acquired ≤ 0
No. of BHCs		441	192	249
Asset Growth	mean	9.79%	16.47%**	4.64%**
	median	7.32%	12.87%**	4.05%**
Assets†	mean	$ 6,809,227,000	$10,625,823,000**	$ 3,866,308,000**
	median	$ 592,074,000	$ 1,826,117,000**	$ 370,412,000**
Percentage that are One Bank Holding Companies	mean	39.5%	15.1%**	58.2%**
	median	0	0**	100%**
Number of States	mean	1.75	2.44**	1.22**
	median	1	2**	1**
Number of Branches	mean	76.21	143.45**	24.36**
	median	14	38.5**	9**
Deposit Dispersion	mean	1.20	1.41**	1.04**
	median	1.00	1**	1**
Macroeconomic Diversity	mean	0.991	1.032*	0.959*
	median	0.955	0.955**	0.955**
Expected Profit	mean	$ 223,871,000	$ 347,808,000*	$ 128,306,000*
	median	$ 18,043,000	$ 56,618,000	$ 11,092,000
Profit Risk	mean	$ 6,621,000	$ 7,936,000	$ 5,607,000
	median	$ 339,000	$ 866,000**	$ 238,000**
Insolvency Risk	mean	0.497%	0.445%**	0.537%**
	median	0.427%	0.406%	0.463%
Profit Inefficiency	mean	$ 69,321,000	$ 81,782,000	$ 59,711,000
	median	$ 3,357,000	$ 8,430,000**	$ 2,114,000**
Net Assets Acquired	mean	$ 929,755,000	$ 2,177,288,000**	−$ 32,198,000**
	median	$ 0	$ 273,576,000**	$ 0**
Net Institutions Acquired	mean	1.99	4.72**	−0.108**
	median	0	2**	0**
Number of BHCs		190	122	68
Market Value of Equity	mean	$ 1,148,052,000	$ 1,328,729,000	$ 823,897,000
	median	$ 252,552,000	$ 463,970,000**	$ 105,495,000**
Market Value of Assets	mean	$12,822,500,000	$14,143,386,000	$10,452,580,000
	median	$ 2,117,923,000	$ 3,722,550,000**	$ 823,661,000**
Market-Value Equity Inefficiency	mean	$ 401,441,000	$ 393,280,000	$ 416,082,000
	median	$ 347,512,000	$ 351,583,000	$ 344,989,000
Market-Value Asset Inefficiency	mean	$ 423,670,000	$ 413,753,000	$ 441,463,000
	median	$ 363,915,000	$ 364,443,000	$ 363,792,000

† Assets reflect book value of assets from the BHC Y-9 reports.
* Significantly different from other subsample's value at the 5 percent or better level.
** Significantly different from other subsample's value at the 1 percent or better level.

Table 2. Correlations Between the Diversification Measures

	Total Assets	No. of States	No. of Branches	Deposit Dispersion	Macroeconomic Diversity	Net Assets Acquired
No. of States	0.634 (0.0001)					
No. of Branches	0.693 (0.0001)	0.806 (0.0001)				
Deposit Dispersion	0.474 (0.0001)	0.754 (0.0001)	0.750 (0.0001)			
Macroeconomic Diversity	−0.0148 (0.757)	0.115 (0.0154)	0.199 (0.0059)	0.145 (0.0023)		
Net Assets Acquired	0.546 (0.0001)	0.602 (0.0001)	0.764 (0.0001)	0.444 (0.0001)	0.0317 (0.5072)	
Net Institutions Acquired	0.283 (0.0001)	0.708 (0.0001)	0.542 (0.0001)	0.719 (0.0001)	0.171 (0.0003)	0.479 (0.0001)

†Pearson correlation coefficients, with p-values of the tests for zero correlation in parentheses.

Table 3. Coefficient Estimates
(t-statistics for test against zero are in parentheses)

	Expected Profit (Log)	Profit Risk (Log)	Insolvency Risk	Profit Inefficiency (Log)	Market Value of Equity† (Log)	Market Value of Assets‡ (Log)	Market-Value Equity Inefficiency (Log)	Market-Value Asset Inefficiency (Log)
Sample Size	441	441	441	441	190	190	190	190
Constant	–3.223***,+++	–8.764***,+++	–0.005120***,+++	–7.338***,+++	–0.4787+++	0.09509**,+++	11.79***,+++	11.79***,+++
	(–18.48)	(–36.24)	(–2.933)	(–16.37)	(–1.418)	(2.286)	(13.05)	(13.00)
Asset Growth	–0.02148+++	–0.3293**,+++	–0.0009686+++	–0.8365***,+++	–0.1574*,+++	0.02023+++	0.05963+++	0.07678+++
	(–0.3821)	(–2.492)	(–1.180)	(–3.090)	(–1.744)	(1.399)	(0.4499)	(0.5481)
Assets (Log)	0.9681***,+++	1.134***,+++	0.001060***,+++	1.212***,+++	0.8552***,+++	0.9944***,+	0.08085+++	0.08700+++
	(59.73)	(53.48)	(6.249)	(30.81)	(30.69)	(298.0)	(1.037)	(1.111)
OBHC	0.01948+++	0.02785+++	0.00005684+++	–0.03715+++	–0.02535+++	–0.0102*,+++	0.01841+++	0.01197+++
	(1.024)	(0.7144)	(0.2153)	(–0.5133)	(–0.6883)	(–1.757)	(0.4118)	(0.2658)
Number of States (Log)	0.08286**,+++	0.2452***,+++	0.001723***,+++	0.1340+++	–0.02858+++	–0.013429*,+++	0.3320**,+++	0.3673**,+++
	(2.390)	(3.970)	(3.720)	(1.159)	(–0.6721)	(–1.794)	(2.325)	(2.538)
Number of Branches (Log)	0.05004***,+++	–0.1920***,+++	–0.001635***,+++	–0.2757***,+++	0.1273***,+++	0.006917**,+++	–0.06063+++	–0.07987+++
	(2.797)	(–7.818)	(–6.688)	(–6.399)	(4.103)	(2.403)	(–0.8370)	(–1.106)
Deposit Dispersion (Log)	–0.06152+++	–0.1300+++	–0.001257*,+++	–0.08264+++	–0.005419+++	0.007560+++	–0.7048***,+++	–0.7146***,+++
	(–1.084)	(–1.253)	(–1.768)	(–0.4503)	(–0.08165)	(0.8193)	(–3.232)	(–3.179)
Macroeconomic Diversity (Log)	–0.02117+++	–0.1630***,+++	–0.0008764**,+++	–0.2403**,+++	0.05831+++	0.01150*,+++	–0.04867+++	–0.08203+++
	(–0.8519)	(–3.246)	(–2.504)	(–2.266)	(1.043)	(1.860)	(–0.6055)	(–1.0201)
R^2	0.9905	0.9626	0.2520	0.8829	0.9597	0.9997	0.2140	0.2254
Prop. increase in branches, states, & dep. disp.	0.0714*,+++	–0.0768+++	–0.001169***,+++	–0.2244*,+++	0.09332*,+++	0.001048+++	–0.5334**,+++	–0.4271**,+++
	(0.07137)	(–1.097)	(–2.777)	(–1.761)	(1.866)	(0.1634)	(–2.365)	(–2.318)
Prop. increase in branches, states, dep. disp., & macro div.	0.05020+++	–0.2398***,+++	–0.002045***,+++	–0.4647***,+++	0.1516**,+++	0.01255+++	–0.4821**,+++	–0.5092**,+++
	(1.08702)	(–3.176)	(–3.828)	(–3.114)	(2.442)	(1.581)	(–2.316)	(–2.450)
Prop. increase in assets & branches	1.018***,+++	0.9422***,+++	–0.0005750***,+++	0.9365***,++	0.9825***	1.001***	0.02022+++	0.007126+++
	(117.6)	(53.84)	(–4.545)	(29.06)	(46.78)	(383.5)	(0.3876)	(0.1363)
Prop. increase in assets, branches, states, & dep. disp.	1.039***	1.057***	–0.0001091+++	0.9878***	0.9485***	0.9955***	–0.3526**,+++	–0.3401**,+++
	(30.48)	(16.34)	(–0.2895)	(8.299)	(20.77)	(186.4)	(–2.418)	(–2.276)
Prop. increase in assets, branches, states, dep. disp., & macro div.	1.018***	0.8943***	–0.0009855*,+++	0.7476***,+	1.007***,+++	1.007***	–0.4012**,+++	–0.4222**,+++
	(25.17)	(12.15)	(–1.906)	(5.160)	(18.54)	(147.0)	(–2.433)	(–2.515)

†These estimates are obtained from estimating system (16) in the text, where **x** is the vector of independent variables shown in the chart. Assets reflect book value of assets in the Compustat data; in all other regressions assets reflect Call Report values.

‡When the *ln*(market value of assets/book value of assets) is used as the dependent variable, the coefficient on the *ln*(market value of assets) becomes –0.0056, with t-statistic –1.67764; the R^2 becomes 0.1133.

*Significantly different from zero at the 10% level, t-test. **Significantly different from zero at the 5% level, t-test. ***Significantly different from zero at the 1% level, t-test.

+Significantly different from one at the 10% level, t-test. ++Significantly different from one at the 5% level, t-test. +++Significantly different from one at the 1% level, t-test.

Table 4. Wald Tests of Restricted Versus Unrestricted Models

Restricted models restrict the regression coefficients for BHCs that were net asset acquirers over 1992-94 to be equal to the regression coefficients for BHCs that were not net asset acquirers over 1992-94.

There are 8 restrictions in each model. The Wald test statistic is distributed χ^2 with 8 degrees of freedom.

	Expected Profit (Log)	**Profit Risk (Log)**	**Insolvency Risk**	**Profit Inefficiency (Log)**
Sample Size	441	441	441	441
Wald Test Statistic (p-value)	10.18 (0.2528)	24.30 (0.00204)	20.07 (0.01008)	10.32 (0.2435)

	Market Value of Equity (Log)	**Market Value of Assets (Log)**	**Market-Value Equity Efficiency (Log)**	**Market-Value Asset Inefficiency (Log)**
Sample Size	190	190	190	190
Wald Test Statistic (p-value)	3.748 (0.8791)	10.41 (0.2376)	5.252 (0.7303)	5.781 (0.6718)

Table 5. Coefficient Estimates That Significantly Differ between Net Asset Acquirers and Others†
(t-statistics for test against zero are in parentheses)

	Profit Risk (Log)			Insolvency Risk		
Sample Size	441			441		
	Unrestricted Model: BHCs with Net Assets Acquired > 0	**Unrestricted Model: BHCs with Net Assets Acquired ≤ 0**	**Restricted Model**	**Unrestricted Model: BHCs with Net Assets Acquired > 0**	**Unrestricted Model: BHCs with Net Assets Acquired ≤ 0**	**Restricted Model**
Constant			−8.764***,+++ (−36.24)			−0.005120***,+++ (−2.933)
Asset Growth	−0.4138**,+++ (−2.424)	−0.8522***,+++ (−3.162)	−0.3293**,+++ (−2.492)	−0.001685+++ (−1.627)	−0.004111**,+++ (−2.398)	−0.0009686+++ (−1.180)
Assets (Log)			1.134***,+++ (53.48)			0.001060***,+++ (6.249)
OBHC			0.02785+++ (0.7144)			0.00005684+++ (0.2153)
Number of States (Log)			0.2452***,+++ (3.970)	0.002349***,+++ (3.756)	−0.003402***,+++ (−3.226)	0.001723***,+++ (3.720)
Number of Branches (Log)			−0.1920***,+++ (−7.818)			−0.001635***,+++ (−6.688)
Deposit Dispersion (Log)	−0.4093**,+++ (−2.467)	−0.6279**,+++ (−2.238)	−0.1300+++ (−1.253)	−0.003429***,+++ (−2.868)	−0.005655***,+++ (−2.736)	−0.001257*,+++ (−1.768)
Macroeconomic Diversity (Log)			−0.1630***,+++ (−3.246)			−0.0008764***,+++ (−2.504)
R^2	0.9645		0.9626	0.2872		0.2520
Prop. increase in branches, states, & dep. disp.	−0.2974**,+++ (−2.595)	−0.4467**,+++ (−2.318)	−0.0768+++ (−1.097)	−0.002506***,+++ (−3.388)	−0.003827***,+++ (−3.036)	−0.001169***,+++ (−2.777)
Prop. increase in branches, states, dep. disp., & macro div.	−0.4351***,+++ (−3.885)	−0.5924***,+++ (−3.194)	−0.2398***,+++ (−3.176)	−0.003143***,+++ (−4.114)	−0.004772***,+++ (−3.721)	−0.002045***,+++ (−3.828)
Prop. increase in assets & branches			0.9422***,+++ (53.84)			−0.0005750***,+++ (−4.545)
Prop. increase in assets, branches, states, & dep. disp.	0.8465*** (7.478)	0.6759***,++ (3.505)	1.057*** (16.34)	−0.001552**,+++ (−2.090)	−0.002863**,+++ (−2.227)	−0.0001091+++ (−0.2895)
Prop. increase in assets, branches, states, dep. disp., & macro div.	0.7088***,++ (6.327)	0.5301***,++ (2.826)	0.8943*** (12.15)	−0.002190***,+++ (−2.813)	−0.003806***,+++ (2.868)	−0.0009855**,+++ (−1.906)

†Unrestricted model coefficients are obtained by estimating system (16) in the text, where **x** is the vector of independent variables shown in the table, allowing the coefficients to differ between BHCs that were net asset acquirers and all other BHCs. The coefficients shown for the unrestricted model are those that significantly differ for the two types of BHCs at the 10 percent level or better.

*Significantly different from zero at the 10% level, t-test. **Significantly different from zero at the 5% level, t-test. ***Significantly different from zero at the 1% level, t-test.
+Significantly different from one at the 10% level, t-test. ++Significantly different from one at the 5% level, t-test. +++Significantly different from one at the 1% level, t-test.