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The Effect of Interstate Banking on Large Bank Holding Company Profitability and Risk

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Using data from the early stage of widespread interstate banking, a recursive system of profit and risk equations is estimated to determine whether large bank holding companies operating subsidiary banks in other states experienced higher rates of return on assets and/or lower levels of volatility risk and risk of bank failure. This paper finds empirical evidence that interstate bank holding companies did experience a significantly higher level of profitability than strictly intrastate banking organizations during the 1988–1991 time period. The empirical findings also support the argument that interstate banking activity lowers earnings volatility and risk of bank insolvency.

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I. Introduction

During the 1980s, interstate banking in the United States evolved from concept to reality. Historical barriers limiting banking operations to a single state gave way to federal exemptions provided in the Garn-St. Germain Act for interstate acquisitions of failed thrift institutions and, even more importantly, to state laws authorizing out-of-state bank holding companies to acquire in-state banks.[1] In 1994, Congress enacted and the President signed the Riegle-Neal Act permitting nation-

[1] See Chong (1991) for a concise summary, and Rose (1989, pp. 47–76) for a complete examination, of the legislative evolution of interstate banking in the United States. Calem (1993) and McLaughlin (1995) give a current account of the status of interstate banking.

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wide interstate banking, finally eliminating the last vestiges of interstate banking prohibitions.[2]

The emergence of widespread interstate banking has intensified the long-standing controversy among bankers, academicians, and regulators over the potential effects of geographic diversification on the profitability of banks and the level of risk to banks and the banking system.[3] The effect of interstate banking on profitability and risk is an empirical issue because an array of factors can either enhance or diminish the profitability and risk experienced by interstate bank organizations.

Most empirical studies have attempted to forecast the effects of interstate banking by either drawing on the experience of a small number of interstate banks grandfathered by the Bank Holding Company Act of 1956 [Goldberg and Hanweck (1988)] or by drawing indirect conclusions based on the experience of intrastate bank expansion in states which relaxed restrictions on statewide branching [Curry and Rose (1984); Liang and Rhoades (1988, 1991)]. Using event study methodology and capital market data for the period 1982–1985, Chong (1991) tested for significant effects on market value and market risk of bank stocks around the time of passage of state-level interstate banking acts. Chong found evidence that passage of interstate banking bills increased stock values as well as bank exposure to market risk. Chong's (1991) study, because it focused on *expected* effects of interstate banking on profit and risk as reflected by presumably efficient capital markets, failed to examine the banking industry's *actual* experience with interstate operations.

Only recently has experience with interstate banking provided a sufficient historical record of performance to allow direct empirical analysis of profitability and risk. The current state of empirical research on the effects of interstate banking is still accurately summarized by Rose (1989, p. 98):

> In many ways the findings of recent research on interstate banking and its impact on individual banks and the public are disappointing. There are few identifiable benefits, and many of these alleged benefits are disputed by inconsistent findings in the relevant research literature. Interstate banking still shows no undisputed evidence that it ... increases bank profitability, or reduces the risk of bank failure.

This paper uses data now available on the actual experience of interstate bank holding companies—interstate banking is only possible at the holding company level—to determine whether bank organizations operating across state lines have enjoyed higher levels of profitability and lower levels of risk than holding companies operating within a single state.

A portfolio theory approach suggested by Clark (1986) is employed to model the simultaneous determination of profitability (as measured by return on assets) and

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[2] Until now, interstate *branching* has been prohibited, and interstate banking has been carried out by multibank holding companies in which a bank holding company in one state operates a subsidiary bank, or holding company, in another state. The new law will allow consolidation of banks in different states, effective June 1, 1997. This study was conducted with data which precedes the 1994 legislation.

[3] Surveys of bankers involved in intrastate mergers reveal that higher expected profitability and lower levels of risk are the major factors considered in making organizational changes [Rose (1989, p. 95)].

the level of bank holding company risk (as measured by either volatility risk or insolvency risk). Using the four-year time period 1988–1991, the earliest time period during which a majority of states allowed interstate banking, a recursive system of profit and risk equations is estimated to determine whether bank holding companies operating subsidiary banks in other states actually did experience: 1) significantly higher rates of return on assets and/or 2) lower levels of volatility risk and risk of bank failure. This paper finds empirical evidence that interstate bank holding companies did experience a higher level of profitability than strictly intrastate banking organizations during the period 1988–1991. In addition, the empirical findings offer support for the argument that interstate banking activity reduces earnings volatility and risk of insolvency.

The next section describes the data and defines the variables used in the analysis. Section III sets forth the empirical model used to estimate the effects of interstate banking on profitability and risk. Section IV presents and interprets the estimation results. The last section summarizes results and offers concluding remarks.

II. Description of the Sample and Variables

Data from the consolidated financial statements of the highest tier bank holding company for each reporting institution were obtained from the Federal Reserve Bank Holding Company tapes for the sixteen quarters 1988(I)–1991(IV). These quarters represent the earliest period of time for which a sufficient level of interstate banking activity could generate a meaningful historical record. In order to eliminate those bank organizations which may have been characterized by special circumstances associated with recent entry or looming exit, only the bank holding companies reporting for the full 16 quarters were included in the sample. To eliminate bank organizations which were experiencing acute financial distress, those bank holding companies with average owner's equity less than 3% of total assets over the period were also deleted from the sample. As almost all of the *interstate* bank holding companies have more than one billion dollars in assets, all bank holding companies with less than one billion dollars in total assets were dropped in order to eliminate size distortions. The remaining sample used to estimate the structural model consists of 218 bank holding companies.

In the sample of 218 bank holding companies, 92 of them operated at least one subsidiary commercial bank or holding company outside of their home state, while 126 bank organizations operated in just a single state. In this study, only bank holding companies which operated at least one chartered commercial bank in a state outside the home state of their highest tier holding company are considered to be operating interstate. Operation of a loan production office, Edge Act corporation, mortgage corporation, consumer finance company, or a non-bank bank in another state are *not* considered to be engaging in interstate banking.

Measure of Profitability

Profitability is measured as the bank holding company's average accounting return on assets (*ROA*) over the sample period. Return on assets better measures profitability than return on equity because *ROA* is not distorted by high equity

multipliers, and *ROA* represents a better measure of the ability of the firm to generate returns on its portfolio of assets.[4]

Use of accounting values and returns is common in banking studies, even though accounting data may not exactly reflect economic profitability.[5] Reported banking data are generally less problematic than data for most other industries because of the financial nature of the primary assets and liabilities, and the more uniform reporting requirements imposed by regulators. All of the empirical studies cited—except Chong (1991), which is an event study—used accounting data to measure profitability.

Measures of Volatility and Solvency Risk

Two types of risk are analyzed: 1) *volatility risk*, which is present because banks face uncertain asset returns and costs of financing, and 2) *insolvency risk*, which is present because a bank may find itself unable to meet its obligations to depositors and other creditors. Volatility risk, denoted *SDROA*, is measured by the standard deviation of the quarterly return on assets over the 16-quarter time period. *SDROA* measures the riskiness of the income stream produced by each bank holding company.[6]

Bank regulators, and the public, are generally more concerned with the risk that a particular bank will become insolvent than with the volatility risk of a bank. Liang and Rhoades (1991) and McAllister and McManus (1992) presented an index for comparing insolvency risk levels among institutions. The insolvency risk index is a ratio in which the numerator is a measure of volatility of realized earnings and the denominator is a sum of the expected earnings plus a (relative) measure of owners' equity:

$$\text{Insolvency risk index} = \frac{\text{Volatility of earnings}}{\text{Expected earnings} + \text{Owners equity}}$$

The insolvency risk index rises as earnings become more volatile for a given level of expected returns and owners' equity. For a given level of earnings volatility, the risk of insolvency diminishes if the expected earnings are high—an earnings shortfall will not have as severe an impact as the same deviation from a lower level of expected earnings. In addition, a highly-capitalized institution provides a cushion of

[4] The stock market return of a bank holding company, also a possible measure of profitability, is not used because many holding company stocks are closely held and/or not actively traded. The use of stock market returns to measure profitability would substantially reduce sample size. Additionally, bank regulators do not use market returns, but rather use accounting returns, to evaluate the performance of commercial banks.

[5] Long and Ravenscraft (1984) cited a substantial amount of evidence demonstrating the usefulness of accounting profit data. They noted that accounting earnings and stock market prices are statistically positively related. To the extent that stock market investors use economic profit information in their buying and selling decisions, changes in accounting returns are economically meaningful.

[6] Although the coefficient of variation is sometimes used to measure risk, taking the standard deviation of an income stream over time is a widely-used method of measuring volatility risk [see Clark (1986)].

equity to protect creditors from adverse earnings. Thus, the lower the insolvency index, the safer a particular bank should be in the eyes of bank regulators.

The insolvency risk index, denoted *INSOLV*, is calculated by dividing *SDROA* (the volatility of earnings) by the sum of *ROA* plus *EQR*. The *ex post* mean return on assets for each bank holding company (*ROA*) is treated as a proxy for expected earnings. The ratio of owners' equity to total assets (*EQR*) provides a relative measure of the owners' equity component of solvency risk.

Measures of Balance Sheet Composition and Quality

Portfolio theory suggests that the expected level and variability of a firm's earnings will be related to the mix of assets held, and possibly the total amount of assets held, as well as the way in which the assets are financed. To account for these portfolio effects on risk and return, several items from the balance sheet of bank holding companies are included in the specification of the profit and risk equations in Section III. These balance sheet variables and their possible effects on profitability and risk are now discussed.

Two broad measures of asset composition, the ratio of total loans to total assets (*TLTA*) and the ratio of liquid assets—U.S. Treasury securities and cash—to total assets (*LIQ*), were calculated for each quarter and the mean value calculated for each bank holding company in the sample. A bank holding a large share of its assets in loans is generally expected to have a higher, but more volatile, rate of return on assets than a similar bank holding a larger percentage of liquid assets (and smaller percentage of loans). The absolute level of total assets may also affect either, or both, profitability and risk. Large banks may experience various economies of size [see Berger and Humphrey (1991); Faulhaber (1994)] which may affect either or both cost and revenue streams. Bank holding company size (*SIZE*) is measured by the 16-quarter average of total assets.

The mix of loan types within the loan portfolio, as well as the quality of loans, is also expected to affect bank holding company profitability and risk. The fraction of total loans accounted for by each of three major types of loans—business loans, consumer loans, and real estate loans (denoted *BL*, *CL*, and *RL*, respectively)—were calculated for each institution and averaged over the sample period. Other loan types collectively make up the balance of the loan portfolio.[7]

To the extent that managers adjust a bank's loan loss reserves in accordance with their perception of the riskiness of a bank's loan portfolio, the ratio of loan loss reserves to total loans (*LLR*) tends to be inversely related to the overall quality of a bank's loan portfolio. Although the loan loss reserve ratio may not perfectly reflect the quality of bank loan portfolios, *LLR* is frequently relied upon to measure loan quality given the absence of a clearly superior alternative measure.

As noted, the way a bank structures the financing of its assets is expected to play a role in determining risk and profitability levels. The primary source of funding for assets is customer deposits. The ratio of total deposits to total assets (*DEPR*)

[7] The fraction of loans falling into the "other loans" category varies substantially across bank holding companies, which allows for inclusion of all three loan types (*BL*, *CL*, and *RL*) in the profit and risk equations without creating a high degree of collinearity among the loan type variables.

Table 1. Financial Statement Variables

Variable name	Variable definition[a]	Sample means (medians) Intrastate BHCs $n = 126$	Interstate BHCs $n = 92$
ROA	Return on assets = net income/total assets	0.0036 (0.0044)	0.0049 (0.0052)
SDROA	Volatility risk = standard deviation of *ROA*	0.0043 (0.0032)	0.0035 (0.0030)
INSOLV	Insolvency risk index = *SDROA*/(*ROA* + *EQR*)	0.0689 (0.0393)	0.0529 (0.0405)
SIZE	Size of the bank holding company = total assets of holding company (in billions of dollars)	5.8302 (1.9970)	17.4374 (7.1690)
TLTA	Loan to asset ratio = total loans/total assets	0.6031 (0.6210)	0.6505 (0.6495)
EQR	Equity ratio = owners' equity/total assets	0.0700 (0.0684)	0.0668 (0.0651)
LIQ	Liquid asset ratio = (Gov't securities + cash)/total assets	0.1283 (0.1134)	0.1223 (0.1091)
LLR	Loan loss reserve ratio = loan loss reserves/total loans	0.0199 (0.0171)	0.01892 (0.0164)
DEPR	Deposit to asset ratio = total deposits/total assets	0.7823 (0.8293)	0.7617 (0.7852)
BL	Business loan ratio = business loans/total loans	0.2764 (0.2654)	0.2805 (0.2690)
CL	Consumer loan ratio = consumer loans/total loans	0.1844 (0.1807)	0.2182 (0.2066)
RL	Real estate loan ratio = real estate loans/total loans	0.4402 (0.4432)	0.4077 (0.4027)

[a] All variables, except *SDROA*, are average values for the 16 quarters.

reflects the degree to which deposits are relied upon to finance bank assets. Owners' equity, while small for banking institutions compared to non-financial firms, provides an additional source of funds for acquisition of assets. Equity here is measured as the ratio of owner's equity to total assets (*EQR*). Non-deposit debt can be omitted because it is the only remaining significant source of financing. Again, all ratios are mean values for each institution over the 16 quarters. Table 1 presents a summary of all the variables defined using data from the consolidated financial statements of the 218 bank holding companies with sample means and medians calculated for intrastate and interstate groups.

Interstate Banking Activity and Geographic Location

The extent of interstate banking activity undertaken by an individual banking organization could be measured by calculating the fraction of total deposits, or total loans (or a composite of the two) originating outside the home state of the bank holding company. Given the aggregate nature of available data and complex interbank activity among holding company subsidiaries, it is generally not possible to calculate the fraction of total banking activity which is interstate in nature.

Given that an index reflecting the degree of interstate activity cannot be constructed using available data, a dummy variable (*INTER*) is used to indicate whether or not a top-tier holding company engaged in interstate banking (*INTER* = 1 for holding companies with at least one out-of-state, full-service banking subsidiary, and *INTER* = 0 for single-state bank holding companies).

Using a dummy variable to account for interstate activity implies that the empirical estimates of the impact of interstate banking on profitability and risk are measuring group effects rather than measuring the degree to which interstate banking affects risk and return. The empirical question addressed with a dummy variable is "Did bank holding companies which operated on an interstate basis have either higher or lower levels of return or risk than did bank organizations which operated on an interstate basis, holding constant all other factors which affect profitability and risk?"

The actual profit and risk level realized by a bank holding company is influenced not only by asset and liability composition variables, but also by the economic conditions present in the geographic market in which the bank holding company operates. Geographic market conditions are determined by both demand and supply-side determinants (income levels, interest rates on loans and deposits at rival financial institutions, and local labor costs), as well as by market structure variables (number of rival banks, market concentration, and ease of de novo entry).

The structural model presented in the next section accounts for the exogenous influences of geographic market conditions by employing a set of regional dummy variables indicating the Federal Reserve Bank district in which each bank holding company operated.[8] Although geographic markets for bank holding companies can be approximated only crudely by this method, the dummy variables should reflect differences in overall economic conditions across Federal Reserve Bank districts. Eleven geographic dummy variables are defined, and District 12 serves as the benchmark district.

Before examining the structural relations in the next section, it is useful to compare sample mean profit and risk levels between intrastate and interstate bank holding companies controlling for geographic location. Such an analysis of variance can be accomplished by regressing profit and each of the two measures of risk on the interstate banking and geographic location dummy variables. Table 2 presents the results of these three regressions. From these regression results, estimates of the sample mean values of profitability and risk are:

	ROA	*SDROA*	*INSOLV*
Intrastate BHCs	0.0037	0.0039	0.0618
Interstate BHCs	0.0045	0.0032	0.0504

The mean profit level (*ROA*) is significantly higher and the mean level of volatility risk (*SDROA*) is significantly lower for the group of interstate bank holding

[8] Although some of the 130 interstate bank holding companies in the sample may have operated across Federal Reserve Bank districts, the geographic market location is assumed to be the district in which the holding company was chartered. During the time period of this study, many interstate bank holding companies operated in adjacent or nearby states.

Table 2. Comparison of Sample Mean Profit and Risk Levels[†]

Explanatory variables	*ROA*	*SDROA*	*INSOLV*
Constant	0.0037	0.0039	0.0618
	(7.40)[a]	(9.95)[a]	(4.95)[a]
INTER	0.0008	−0.0007	−0.0114
	(1.96)[c]	(1.96)[c]	(−1.06)
$FRBD_1$	−0.0031	0.0024	0.0782
	(−3.46)[a]	(3.47)[a]	(3.53)[a]
$FRBD_2$	−0.0011	0.0018	0.0329
	(−1.32)	(2.88)[a]	(1.62)
$FRBD_3$	0.0011	0.0007	0.0084
	(1.11)	(0.88)	(0.34)
$FRBD_4$	0.0015	0.0002	−0.0059
	(1.54)	(0.24)	(−0.24)
$FRBD_5$	0.0074	0.0001	−0.0047
	(0.97)	(0.17)	(−0.24)
$FRBD_6$	−0.0009	0.0010	0.0177
	(−1.11)	(1.56)	(0.88)
$FRBD_7$	0.0014	−0.0006	−0.0164
	(2.07)[b]	(−1.10)	(−0.94)
$FRBD_8$	0.0009	−0.0005	−0.0151
	(1.06)	(−0.75)	(−0.68)
$FRBD_9$	0.0005	−0.0006	−0.0142
	(0.35)	(−0.58)	(−0.40)
$FRBD_{10}$	−0.0006	−0.0006	−0.0181
	(−0.47)	(−0.62)	(−0.55)
$FRBD_{11}$	−0.0014	−0.0007	−0.0112
	(−1.19)	(−0.73)	(−0.37)
F	4.03	3.40	2.29
$\bar{R}^2$	0.14	0.18	0.07

[†] Values in parentheses are t ratios. Superscripts a, b, and c indicate parameter estimates significant at the 1%, 5%, and 10% levels, respectively.

companies. There is no statistically significant difference in the mean level of insolvency risk. Several statistically significant differences in profit and risk do emerge across geographic regions. In this sample, bank holding companies in Federal Reserve Bank District 1 experienced lower mean profit levels and higher mean levels of both types of risk than banks in benchmark District 12. In District 7, the mean level of profit is higher than the benchmark profit level, and in District 2, the mean level of volatility risk is greater than in the benchmark district.

The regression results presented in Table 2 suggest that, within a given geographic region, the mean profit level for interstate banks is statistically significantly higher and the mean volatility risk level is significantly lower than for intrastate banks. The extremely small values of the adjusted R^2 reported in Table 2 indicate that only a very small fraction of the total variation in profit and risk levels can be explained when there is no control for differences in the composition of assets and liabilities. The recursive system of profit and risk equations developed in the next

section controls for differences in balance sheet composition and quality, as well as allowing risk to affect return.

III. Specification of the Structural Model

Commercial banks can be viewed as firms which seek to maximize an objective function that can be related, under quite general conditions, to the levels of profit and risk. Banks maximize the expected value of this function by choosing the optimal combination of a portfolio of assets and a financial structure, the returns and costs of which are uncertain.[9] In a portfolio model of a banking firm, bank managers make the dual choice of asset composition and financial structure subject to capitalization and asset quality restrictions (both externally and internally imposed). Consequently, both the expected rate of profit *and* the level of risk are simultaneously determined. An empirical analysis of bank profitability and risk level must address this simultaneity, or the estimated effects of interstate banking on profitability and risk will be biased. To explicitly account for simultaneity, Clark (1986) developed a simultaneous system of four structural equations which treats single bank's profit, risk level, asset composition, and liability composition as endogenous variables and controls for differences in market and regulatory structure. The empirical model of bank holding company profit and risk employed in this paper is similar to the portfolio model set forth in Clark (1986), but is modified to correspond to the banking activity of holding companies.

The Model

Bank holding companies, in contrast to individual commercial banks, frequently operate in multiple markets and face multiple regulatory structures, especially those operating subsidiary banks outside the home state. This characteristic, together with the aggregate nature of publicly-available data for bank holding companies, requires that Clark's (1986) model be modified in two ways for bank holding companies. First, market concentration measures (such as four-firm concentration ratios or Herfindahl indexes) and measures of variations in local market demand for banking services have limited explanatory power in the context of bank holding companies operating subsidiaries in multiple markets. As previously noted, the structural model in this paper accounts for possible variation in market conditions across geographic regions by employing dummy variables to indicate the Federal Reserve Bank district in which the bank holding company operated. Second, because meaningful measures of interest rates earned by holding companies on loans and paid on deposits cannot be constructed from publicly-available data, structural equations for asset composition and liability composition are not

[9] See Santomero (1984) for an extensive review of the literature on modeling banking firms.

estimated. With these modifications, the following simultaneous system of two equations represent the profitability and risk levels for bank holding companies:

$$ROA_i = \alpha_0 + \alpha_1 RISK_i + \alpha_2 SIZE_i + \alpha_3 TLTA_i + \alpha_4 EQR_i + \alpha_5 LIQ_i + \alpha_6 DEPR_i + \alpha_8 BL_i + \alpha_9 CL_i + \alpha_{10} RL_i + \sum_{j=11}^{21} \alpha_j FRBD_j + \alpha_{22} INTER_i + u_i \quad (1)$$

and

$$RISK_i = \beta_0 + \beta_2 SIZE_i + \beta_3 TLTA_i + \beta_4 EQR_i + \beta_5 LIQ_i + \beta_6 DEPR_i + \beta_7 LLR_i + \beta_8 BL_i + \beta_9 CL_i + \beta_{10} RL_i + \sum_{j=11}^{21} \beta_j FRBD_j + \beta_{22} INTER_i + v_i \quad (2)$$

where $i = 1, \ldots, 218$. As already noted, all of the variables except *RISK* and *INTER* are 16-quarter average values for the i^{th} holding company. *RISK* is defined alternatively as volatility risk (*SDROA*) and insolvency risk (*INSOLV*), as previously discussed.

The triangular specification of the return and risk equations captures the simultaneity of profitability and risk levels by allowing risk to contribute to the determination of profit, while risk itself is determined by portfolio factors, size, and interstate status. A triangular model was suggested by Clark (1986) and supported by statistical testing. Using a version of Hausman's test for specification error, the presence of simultaneity in the profit function could not be rejected, and when *ROA* was included as an explanatory variable in either version of the risk equation, no statistical evidence of simultaneity was found.[10] Testing for correlation between the error terms u_i and v_i revealed no significant correlation between the disturbances in the two equations. The system was treated as recursive and estimated using OLS [see Kmenta (1986)].

Expected Structural Relations

Fundamental concepts in portfolio theory, coupled with empirical literature on the banking industry, permit determination of the expected signs for many of the parameters in the structural equations. For each explanatory variable, the expected relation to profitability and risk are now discussed.

[10] Following a two-step procedure suggested by Gujarati (1995) to perform a Hausman test for specification error, the null hypothesis that there is no simultaneity can be rejected for both variants (1a) and (1b) of the profit equation ($t = 2.87$ and $t = 4.83$, respectively). When *ROA* was included in both the volatility risk and insolvency risk equations, the null hypothesis was of no simultaneity could not be rejected ($t = -1.39$ and $t = -0.30$, respectively).

Bank holding company profitability varies directly with the level of risk—as measured by either volatility risk (*SDROA*) or insolvency risk (*INSOLV*)—when banks operate along the efficient risk-return frontier where higher returns can only be obtained by holding riskier asset portfolios. Under the assumption that bank managers were indeed efficiently managing their asset portfolios, $\hat{\alpha}_1$ is expected to be positive.

The impact of bank holding company size, measured by combined total assets of all subsidiaries, on profitability depends not only upon the extent to which subsidiary banks experienced either economies or diseconomies of scale, but also upon any benefits from cost-sharing among subsidiaries which may have arisen as banking organizations grew in size. The sign of $\hat{\alpha}_2$ could be either positive or negative. With respect to volatility risk, larger banking organizations generally have greater opportunity to diversify their asset portfolios ($\hat{\beta}_2 < 0$). In the case of insolvency risk, as measured by the index *INSOLV*, bank size could have either increased or decreased risk of bank failure, and the sign of $\hat{\beta}_2$ is ambiguous for insolvency risk.

Of all the types of assets a bank may hold, loans have the highest yield and the greatest risk. The larger the fraction of total assets held as loans, the higher the expected levels of profitability and risk—both $\hat{\alpha}_3$ and $\hat{\beta}_3$ should be positive. The impacts of individual loan types (*BL*, *CL*, and *RL*) depend upon the marginal return and marginal risk of each loan type, holding the total loan-to-total-asset ratio constant. Thus, the signs on the coefficients of *BL*, *CL*, and *RL* in both the profit and risk equation are ambiguous. Liquid assets (cash and U.S. government securities) are the lowest yielding and least risky assets held by banks, so $\hat{\alpha}_5$ and $\hat{\beta}_5$ are both expected to be negative. As discussed earlier, the overall quality of a bank's loan portfolio is inversely related to the loan loss reserve ratio (*LLR*). The higher the *LLR*, the greater the level of both types of risk ($\hat{\beta}_7 > 0$).

Higher levels of equity financing generally reduce a firm's insolvency risk as *EQR* is in the denominator of *INSOLV*, suggesting that $\hat{\beta}_4$ should be negative. There is no clear relationship between equity financing and *ROA*. However, banks which had high equity cushions may have found regulators tolerant of a riskier loan portfolio, which may tend to result in a more volatile, and higher, return on assets for the higher equity banks. Thus, the signs of $\hat{\alpha}_4$ and $\hat{\beta}_4$ are ambiguous. It is also possible for $\hat{\beta}_4$ to be positive for *SDROA* and negative for *INSOLV*.

Compared to other sources of borrowed funds, deposits provide banks with a stable, low-cost source of funds. Banks can obtain federal deposit insurance at artificially low rates. Thus, default risk faced by depositors is reduced, and customers are willing to make deposits without requiring a risk premium as compensation for a bank's risk of failure. Not only does the inefficiently-priced deposit insurance lower the cost of attracting deposits, it also stabilizes deposit levels as insured depositors need not adjust deposit levels with changes in bank risk.[11] Thus, bank holding companies which had higher deposit-to-asset ratios (*DEPR*), all else constant, will tend to have had higher levels of profitability ($\hat{\alpha}_6 > 0$) and lower levels of both types of risk ($\hat{\beta}_6 < 0$).

[11] See White (1989) for a detailed review of the deposit insurance literature.

As discussed in the introduction, the primary objective of this paper is to determine whether interstate bank holding companies experienced a significantly higher level of profitability and/or a significantly lower level of risk than intrastate bank holding companies, controlling for all other factors which affect profitability and risk. The dummy variable, *INTER*, was added to both the profit and risk equations to test the following null and alternative hypotheses:

Profitability	H_0: $\alpha_{22} \leq 0$	H_a: $\alpha_{22} > 0$
Risk	H_0: $\beta_{22} \geq 0$	H_a: $\beta_{22} < 0$

IV. Estimation of the Structural Equations

Table 3 presents the results of estimating the profit and risk equations. Two versions of each equation were estimated: the first version employed volatility risk (*SDROA*) and the second version insolvency risk (*INSOLV*). OLS is appropriate for estimating the parameters in a recursive system.

Profitability Equation (1)

In equation (1), the signs on the estimated coefficients of *EQR*, *LIQ*, and *DEPR* are as expected and significant in both versions of the profit equation. *SIZE* does not have a statistically significant effect on profit. The estimated coefficient on *TLTA* is opposite expectation but is statistically significant only in (1b). Negative and statistically significant estimated coefficients $\hat{\alpha}_8$–$\hat{\alpha}_{10}$ indicate *ROA* falls as the fraction of total loans made to business, consumer, and real estate borrowers increases.

The sign of the estimated coefficient on risk, for both definitions of risk, is negative.[12] The negative value for the estimated coefficient on risk in the profit equation, $\hat{\alpha}_1$, appears to contradict conventional models of portfolio choice. Although the negative value of $\hat{\alpha}_1$ is surprising, an inverse relation between bank return and risk was also reported by McAllister and McManus (1992, p. 12). One possible explanation for this unexpected result is that following the savings and loan debacle, regulators may have become more restrictive toward financial institutions regarded as risky, forcing such institutions to write down poor-quality assets or to hold higher loan loss reserves. Accounting returns would then be depressed for these riskier banks, and they would not have realized the returns expected given their chosen level of risk. Bank regulators may thus have undermined their high-risk/high-return strategy.[13] The apparent risk-return anomaly may simply be due to the particular sample time period. Declining economic conditions during part of the sample period may have had significant negative impact on the earnings of the riskier banks.

Turning now to the impact of interstate banking on profitability, the estimation results indicate that interstate bank holding companies experienced a statistically

[12] The sign on $\hat{\alpha}_1$ remained negative under a variety of alternative model specifications involving different functional forms and alternative specifications of asset mix.

[13] A sign reversal due to a simultaneous equations problem does not appear to explain the negative coefficient on risk in the profit equation because, as explained in footnote 10, a triangular structure cannot be rejected. Indeed, including profit in the risk equation did not result in a positive value of $\hat{\alpha}_1$, and profit was not statistically significant in either version of the risk equation.

Table 3. OLS Estimation of Profit and Risk Equations[†]

Explanatory variables	(Parameters)	Profit equations		Risk equations	
		ROA (1a)	*ROA* (1b)	*SDROA* (2a)	*INSOLV* (2b)
Constant	(α_0, β_0)	0.0061	0.0067	−0.0062	−0.0343
		(2.77)[a]	(2.87)[a]	(−2.36)[b]	(−0.40)
SDROA	(α_1)	−0.6829			
		(−10.96)[a]			
INSOLV	(α_1)		−0.0202		
			(−9.28)[a]		
SIZE	(α_2, β_2)	0.00001	0.00001	−0.00002	−0.0007
		(1.29)	(1.18)	(−2.83)[a]	(−2.46)[b]
TLTA	(α_3, β_3)	−0.0024	−0.0035	0.0054	0.1258
		(−1.48)	(−2.08)[b]	(3.34)[a]	(2.38)[b]
EQR	(α_4, β_4)	0.0934	0.0736	−0.0154	−1.8932
		(8.27)[a]	(5.76)[a]	(−1.31)	(−4.95)[a]
LIQ	(α_5, β_5)	−0.0048	−0.0046	−0.0019	−0.0118
		(−1.89)[c]	(−1.72)[c]	(−0.73)	(−0.14)
DEPR	(α_6, β_6)	0.0062	0.0058	−0.0005	−0.0654
		(3.62)[a]	(3.25)[a]	(−0.29)	(−1.15)
LLR	(β_7)			0.1468	2.9001
				(7.43)[a]	(4.50)[a]
BL	(α_8, β_8)	−0.0100	−0.0105	0.0051	0.0928
		(−3.27)[a]	(−3.26)[a]	(1.63)[c]	(0.91)
CL	(α_9, β_9)	−0.0078	−0.0065	0.0031	0.0868
		(−2.66)[a]	(−2.09)[b]	(1.00)	(0.86)
RL	$(\alpha_{10}, \beta_{10})$	−0.0109	−0.0104	0.0087	0.2508
		(−4.09)[a]	(−3.65)[a]	(3.12)[a]	(2.76)[a]
$FRBD_1$	(β_{11}, β_{11})	−0.0007	−0.0008	0.0011	0.0366
		(−1.17)	(−1.24)	(1.78)[c]	(1.83)[c]
$FRBD_2$	$(\alpha_{12}, \beta_{12})$	0.0007	−0.0000	0.0010	0.0080
		(1.25)	(−0.01)	(1.76)[c]	(0.43)
$FRBD_3$	$(\alpha_{13}, \beta_{13})$	−0.0006	0.0004	0.0009	0.0234
		(−0.96)	(0.62)	(1.48)	(1.10)
$FRBD_4$	$(\alpha_{14}, \beta_{14})$	0.0006	0.0005	0.0007	0.0182
		(0.98)	(0.71)	(1.11)	(0.86)
$FRBD_5$	$(\alpha_{15}, \beta_{15})$	0.0002	0.0000	0.0004	0.0057
		(0.52)	(0.13)	(0.80)	(0.33)
$FRBD_6$	$(\alpha_{16}, \beta_{16})$	−0.0003	−0.0007	0.0008	0.0125
		(−0.51)	(−1.29)	(1.58)	(0.70)
$FRBD_7$	$(\alpha_{17}, \beta_{17})$	0.0006	0.0007	−0.0001	−0.0000
		(1.32)	(1.45)	(−0.17)	(−0.01)
$FRBD_8$	$(\alpha_{18}, \beta_{18})$	−0.00004	−0.0000	−0.0000	0.0012
		(−0.07)	(−0.01)	(−0.09)	(0.06)
$FRBD_9$	$(\alpha_{19}, \beta_{19})$	−0.0005	−0.0003	0.0000	0.0075
		(−0.59)	(−0.32)	(−0.04)	(0.25)
$FRBD_{10}$	$(\alpha_{20}, \beta_{20})$	−0.0021	−0.0022	−0.0002	0.0037
		(−2.46)[b]	(−2.34)[b]	(−0.30)	(0.13)
$FRBD_{11}$	$(\alpha_{21}, \beta_{21})$	−0.0014	−0.0015	−0.0008	−0.0222
		(−1.73)[c]	(−1.71)[c]	(−0.95)	(−0.79)
INTER	$(\alpha_{22}, \beta_{22})$	0.0009	0.0011	−0.0006	−0.0151
		(3.01)[aa]	(3.35)[aa]	(−1.84)[bb]	(−1.48)[cc]
F		20.34	17.16	8.04	6.23
Adjusted R^2		0.65	0.61	0.40	0.33

[†] Values in parentheses are *t* ratios. Superscripts *a*, *b*, and *c* indicate parameter estimates significant at the 1%, 5%, and 10% levels, respectively, in two-tailed tests. Double superscripts indicate significance in one-tailed tests.

significant increase in return on assets compared to holding companies which engaged solely in intrastate banking activity. To put the estimated effect of interstate banking in perspective, the average *ROA* ratio for all bank holding companies in the sample is 0.0041. Estimates of $\hat{\alpha}_{22}$ in equations (1a) and (1b) suggest the *ROA* ratio increases due to interstate banking activity by 0.0009 and 0.0011, respectively, which represents a 22% and a 27% gain in *ROA* for interstate organizations.

Although a positive value of $\hat{\alpha}_{22}$ is consistent with proponents' arguments that interstate banking will increase bank profitability, it is also possible that those bank holding companies which were more profitable before widespread interstate banking were also the banking organizations which later chose to expand across state lines. Thus, a question of reverse causality arises: Does a positive estimate of α_{22} indicate that interstate banking creates higher bank profits or does it indicate that more profitable banks tend to engage in interstate banking? To address this question, data for 1983 (the last year prior to the beginning of widespread interstate banking) were examined to see if the bank holding companies which engaged in interstate banking during the period 1988–1991 were also more profitable in 1983, before engaging in interstate banking. A test for differences in mean profitability failed to reject the null hypothesis that holding companies which later became interstate organizations were more profitable than other bank holding companies which remained intrastate holding companies. Profitability in 1983 would not have been a good predictor of which bank holding companies would eventually go interstate, thus suggesting that reverse causality is not the cause of the positive sign on α_{22}.

Notice finally that both versions of the estimated structural equation for profitability explain the total variation in *ROA* much more successfully than the simple analysis of the variance model presented in Table 2. By controlling for the composition of bank assets and liabilities, and allowing risk to effect profit level, more than 60% of the variation in profit can be explained with substantially higher F statistics.

Risk Equation (2)

In both versions (2a) and (2b) of the risk equation, all balance sheet variables have the expected signs though not all are statistically significant. A higher loan-to-asset ratio (*TLTA*) significantly increased both types of bank holding company risk. A higher equity ratio is associated with lower levels of risk, though this effect is statistically significant only for insolvency risk. Bank holding companies with lower quality loans, as reflected by higher loan loss reserve ratios (*LLR*), faced significantly higher levels of risk. It is interesting to note that larger banking organizations experienced significantly lower levels of volatility risk and lower levels of insolvency risk, as suggested by the statistically significant negative estimates of β_2 in both (2a) and (2b). The deposit-to-asset ratio did not significantly influence either volatility risk or solvency risk. Given the positive signs on the estimated coefficients of *BL*, *CL*, and *RL*, each of the three loan types *individually* appear to increase both volatility risk and solvency risk. Only the effects of real estate lending were statistically significant in both (2a) and (2b), while business lending significantly affected only volatility risk. As in the case of the structural equation for

profit, risk equation (2) explains much more of the variation in volatility risk and risk of insolvency than the simple analysis of variance presented in Section II.

The estimation results for volatility risk and risk of insolvency suggest that interstate bank holding companies did experience significantly lower levels of risk than intrastate banks during the period 1988–1991. The estimates of β_{22} in equations (2a) and (2b) indicate that the interstate bank holding companies as a group enjoyed approximately 15% lower volatility risk and 24% lower insolvency risk compared to the intrastate group of banking organizations.[14]

V. Summary and Conclusions

Using data from the early stage of widespread interstate banking, this paper looks for evidence that interstate bank holding companies experienced a higher level of profitability and a lower level of risk than bank holding companies operating on a solely intrastate basis. Apparently, interstate bank holding companies enjoyed a statistically significant advantage over intrastate organizations in generating returns on assets. Furthermore, the higher returns were generated at significantly lower levels of both volatility risk and risk of insolvency.

The specific source of higher returns and lower risk experienced by interstate bank holding companies is not evident from this study. It may be that interstate expansion provides increased access to quality assets (i.e., assets with less risk per unit of return) and increased opportunities for asset diversification. Furthermore, unit cost reductions may be generated by cost sharing and economizing on interstate transactions previously performed in more expensive fashions. When bank holding companies engage in interstate banking transactions through a correspondent bank, duplicate activities generally take place, such as record keeping by both institutions for which the correspondent must be compensated. Interstate banking eliminates such duplication. Increased efficiency, and consequently higher profitability, may also occur [as proposed by Berger and Humphrey (1991)] if the most efficient banks are expanding interstate and absorbing less efficient institutions. Sometimes monopolistic market power gained through interstate expansion is offered as an explanation for higher returns to interstate banks, although it is unclear why intrastate banks could not also enter those markets where monopoly power may exist. Further empirical investigation is required to determine the source(s) of gains to interstate banking.

With the enactment of the Riegle-Neal Act allowing full interstate banking, the federal government has opened a new chapter in the continuing development of interstate banking. This new law will soon permit an out-of-state bank holding company to purchase a bank and merge it into its current bank without regard to state boundaries. The potential of this change to further reduce the costs of interstate operations and enhance efficiencies may be more significant than all other benefits combined. During the period 1988–1991, restrictions inherent in regional reciprocal pacts between states in many cases only allowed expansion into neighboring states which often faced economic fluctuations similar to the bank

[14] The sample mean values for *SDROA* (0.0039) and *INSOLV* (0.0621) were used to calculate the percentage changes in risk levels: $(-0.0006/0.0039) \times 100 = -15.38\%$ and $(-0.0151/0.0621) \times 100 = -24.32\%$, respectively.

holding company's home state. With the passage of Riegle-Neal, federal law replaces the more restrictive regional pacts and wider geographic diversification will likely follow. In the near future, the gains in profitability and reductions in risk levels from interstate banking may well increase beyond those found in this study.

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