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Changes in market assessments of bank risk following the Riegle–Neal Act of 1994

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Abstract

We examine changes in bank risk following the passage of the Riegle–Neal Act of 1994 and find a significant decline in bank risk. The extent of interstate banking activity and the status of state-level interstate banking laws are important in explaining the risk reduction. Banks with assets in multiple states experience a significant reduction in risk whereas banks with assets in one state experience no significant change in risk. Banks in states with the most restrictive interstate banking provisions experience a significant decrease in risk whereas banks in states with more liberal interstate banking provisions experience a significant increase in risk.

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Keywords: Bank risk; Risk shift; Regulation; Riegle–Neal; Interstate banking

1. Introduction

The ability of banks in the United States (US) to expand geographically has been constrained by a variety of regulations at both the federal and state levels. Over the years, the barriers have gradually been reduced as several states liberalized their restrictions. By 1994, the trend toward unrestricted nationwide interstate banking and branching was accelerated by the passage of the Riegle–Neal Act of 1994. The Act

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paves the way for bank holding companies (BHCs) to acquire a bank in any state, subject to certain conditions, and consolidate their interstate banks into a branch network. It also permits free-standing banks to merge with other banks across state lines. In effect, the passage of Riegle–Neal on September 29, 1994 has set the stage for full nationwide interstate banking to become a reality in the US.

This defining piece of legislation has important implications for bank value, efficiency, and risk. With respect to the impact on bank value, Carow and Heron (1998) provide evidence that Riegle–Neal's passage had a positive impact on the value of BHCs, with banks that are more likely to become acquisition targets experiencing the greatest gains. With respect to the impact on bank efficiency, Hughes et al. (1996) examine quarterly data for a sample of 443 BHCs during 1994, the year of Riegle–Neal's passage, and find significant economies of scale that increase with size and geographic diversification. They conclude that increased geographic diversification (particularly an increase in branches) improves efficiency by moving inefficient institutions closer to the efficient frontier. Riegle–Neal's impact on bank risk, however, is still an open question.

This study examines changes in risk for a sample of BHCs and banks following the passage of Riegle–Neal. This examination is important because the potential for full nationwide banking has implications for the safety and soundness of the banking system. From a regulatory standpoint, the total risk of an institution is relevant (Mingo, 1978). Peltzman (1976) argues that regulation alters the riskiness of the regulated firm by lowering the variability of earnings, which should reduce both systematic and unsystematic risks. Given the pivotal role that banks play in the economy, any change in bank risk is of interest to regulators. Thus, an important policy interest is served by a better understanding of the impact of the liberalization of interstate banking regulations on bank risk. Further, the results have important implications for bank shareholders. Stockholders who hold well-diversified portfolios are primarily concerned with the systematic risk of an institution. Thus, if Riegle–Neal's passage does not impact systematic risk stockholders should be indifferent to this type of regulation. If, however, Riegle–Neal's passage changes the level of systematic risk, stockholders should change their required returns accordingly.

The risk shift analysis is conducted using several capital market measures of risk; total, systematic, interest rate, and unsystematic risks. The study utilizes a methodology similar to that employed by Smirlock (1984), and Aharony et al. (1986, 1988). The methodology estimates the risk measures over a pre- and post-Riegle–Neal period for all banks and several equally weighted portfolios based on size, capitalization, and credit risk. The analysis is also conducted for portfolios based on the status of interstate banking laws in the state in which each sample bank is headquartered at the time of Riegle–Neal's passage and the extent of interstate activity prior to Riegle–Neal.

The results show that bank risk has changed significantly since Riegle–Neal's passage. Banks experience a significant decline in both unsystematic and total risks, but systematic risk is largely unaffected by Riegle–Neal's passage. Our results suggest that the observed decline in risk is not related to a reduction in market-wide risk because market risk does not change significantly over the sample period. In addition,

the results do not appear to be driven by the record profitability that banks experienced in the mid-1990s. Indeed, when we control for factors related to geographic diversification we find significant differences across the bank portfolios that are consistent with the implications of these factors for changes in bank risk following Riegle–Neal. Specifically, we find that the extent of interstate banking activity and the status of state-level interstate banking laws are important in explaining the extent of the risk reduction. Banks with assets in multiple states experience a significant reduction in risk whereas banks with assets in one state experience no significant change in risk. Furthermore, banks in states with the most restrictive interstate banking provisions experience a significant decrease in risk while banks in states with the most liberal interstate banking provisions experience a significant increase in risk. This suggests that the competitive environment in each state is a major factor driving the results.

The remainder of the paper is organized as follows. First, a review of the relevant literature is presented followed by the development of the hypotheses, the description of data and methodology, the discussion of results, and the summary of the primary conclusions.

2. Review of literature

It is well documented that changes in bank regulation can have a significant impact on bank risk (Mingo, 1978; Koehn and Stangle, 1980; Smirlock, 1984; Allen and Wilhelm, 1988; Bundt et al., 1992; Sundaram et al., 1992). Mingo (1978) finds that the imposition of deposit-rate ceilings increased a bank's total risk whereas Koehn and Stangle (1980) find that systematic risk was not affected by deposit rate ceilings. Smirlock (1984) provides evidence that the deregulation of deposit rates resulting from the passage of the Depository Institutions Deregulation and Monetary Control Act (DIDMCA) of 1980 had no impact on either systematic or unsystematic risk. Similar findings are documented by Allen and Wilhelm (1988). However, Aharony et al. (1988) find that DIDMCA's passage resulted in an increase in total risk for both money center and regional banks but resulted in a decrease in total risk for thrifts. More recently, Bundt et al. (1992) provide evidence that DIDMCA's passage resulted in increases in both systematic and unsystematic risks. Sundaram et al. (1992) show that the passage of the Financial Institutions Reform, Recovery, and Enforcement Act (FIRREA) of 1989 increased the risk of both banks and savings and loans (S&Ls). More recently, Bhargava and Fraser (1998) find that banks experienced a significant increase in both unsystematic and total risks in response to Federal Reserve board decisions allowing BHCs to participate in investment banking.

Several studies have examined the impact of geographic diversification on bank risk, profitability, and efficiency. Liang and Rhoades (1988) find that although some composite risk measures are reduced by geographic diversification, some individual components actually increase. Although Liang and Rhoades examine the impact of diversification on risk, they examine the issue over the 1976–1985 sample period and focus exclusively on *intrastate* geographic diversification. Their results may not be

applicable to the post-Riegle–Neal era because of the increased opportunities for *interstate* expansion. Indeed, Liang and Rhoades acknowledge that since intrastate expansion provides fewer opportunities for diversification, the results of their study are weaker than if their tests had been based on interstate diversification. Chong (1991) finds that interstate expansion increases both bank profitability and risk. He argues that although geographic diversification reduces the risk of certain activities, it also provides opportunities for banks to participate in more risky activities. More recently, Hughes et al. (1996) examine the issue of efficiency gains from interstate banking. Using quarterly data for a sample of 443 BHCs during 1994, the year of Riegle–Neal's passage, they find significant economies of scale that increase with size and geographic diversification. In addition, they find that geographic and/or depositor diversification enhance expected return, and an increase in branches moves inefficient institutions closer to the efficient frontier in both the risk and return dimensions.

These studies suggest that the expanded ability of banks to diversify geographically in the wake of Riegle–Neal's passage should have a significant impact on risk. Previous studies that have examined the impact of geographic diversification on bank risk have focused on a more restrictive era. Prior to Riegle–Neal, several states had liberalized their intra-state and interstate banking provisions providing limited opportunities for banks to diversify. Riegle–Neal contains several important provisions including allowing BHCs to acquire a bank in another state as long as the BHC is adequately capitalized and managed, allowing free-standing banks to merge across state lines, and allowing nationally or state-chartered banks to open de novo branches in a state where the bank does not presently have a branch as long as the state specifically authorizes such activity. [1] Since these provisions pave the way for full interstate banking in the US, bank risk is likely to change in the post-Riegle–Neal era. Carow and Heron (1998) examine the wealth effects of Riegle–Neal's passage. We extend their study by examining Riegle–Neal's impact on bank risk.

3. Hypotheses regarding the impact of Riegle–Neal on bank risk

In this section, we present the arguments supporting the hypotheses that Riegle–Neal may result in either an increase or a decrease in bank risk. We also present arguments supporting the null hypothesis of no change in risk.

3.1. Riegle–Neal may result in a significant decrease in bank risk

We expect that bank risk should decline in the wake of Riegle–Neal's passage because the opportunity to diversify geographically has the potential to reduce insolvency risk primarily by reducing liquidity and credit risks. Hughes et al. (1996)

[1] See Carow and Heron (1998) for a historical overview of interstate banking in the US and a discussion of key provisions of the Riegle–Neal Act.

note that geographic diversification can reduce a bank's liquidity risk by expanding the bank's deposit base and reducing the variability of deposit flows. Furthermore, banks can also reduce their credit risk by making loans to diverse borrowers in different geographical areas. Liang and Rhoades (1988) note that in the presence of geographic restrictions, banks with risk averse managers may be forced to accept higher risk levels than they desire. Thus, more liberal interstate banking provisions may lead to less risk since the bank may be willing to trade-off additional profitability for less risk.

3.2. Riegle–Neal may result in a significant increase in bank risk

It is also possible that bank risk may actually increase with geographic diversification (Chong, 1991). In particular, geographic diversification may lead to an increase in the loan-to-assets ratio which may increase credit risk. It should be noted, however, that this increased risk may be accompanied by an increase in the expected return. In effect, diversification would improve the risk-return tradeoff (Hughes et al., 1996).

3.3. Riegle–Neal may have no significant impact on bank risk

Finally, it is possible that Riegle–Neal's passage may have no effect on bank risk. Hughes et al. (1996) argue that the ability of banks to capitalize on the new opportunities created by Riegle–Neal's passage depends on the risk-return preference of each bank. In effect, bank risk is largely endogenous with each bank choosing its desired level of risk subject to regulatory constraints. Thus, a bank that is operating at its preferred risk-return position prior to Riegle–Neal's passage may choose the same risk-return position after geographic diversification. Thus, the issue of whether bank risk increases, decreases, or remains the same is an empirical issue.

The following null hypotheses (H) are tested for the sample of all banks:

H1: There is no significant difference in total risk in the pre- and post-Riegle–Neal era for the equally weighted portfolio of all banks.

H2: There is no significant difference in unsystematic risk in the pre- and post-Riegle–Neal era for the equally weighted portfolio of all banks.

H3: There is no significant difference in systematic risk in the pre- and post-Riegle–Neal era for the equally weighted portfolio of all banks.

H4: There is no significant difference in interest rate risk in the pre- and post-Riegle–Neal era for the equally weighted portfolio of all banks.

The hypotheses are also tested for several portfolios based on size, capitalization, and credit risk. Previous studies have indicated that size may be an important factor affecting the benefits of geographic diversification (Carow and Lee, 1997; Fraser et al., 1997). This is because large banks generally have more resources and should be better positioned to capitalize on the opportunities to diversify across state lines (Billingsley and Lamy, 1992). With respect to capitalization, well-capitalized banks

may benefit more from Riegle–Neal's passage since banks must meet certain capital standards in order to expand geographically. To the extent that a bank is already well capitalized, it is more likely to obtain regulatory approval for expansion. With respect to credit risk, we hypothesize that banks with a relatively high level of credit risk will experience the greatest risk reduction because they now have the opportunity to diversify their loan portfolio.

The analysis is also conducted for bank portfolios formed on the basis of the extent of interstate activity. Fraser et al. (1997) note that this may affect the ability of institutions to capitalize on the opportunity to expand across state lines. Thus, we hypothesize that banks with assets in multiple states are more likely to expand resulting in the greatest risk reduction.

The analysis also considers the status of interstate banking laws in each state prior to Riegle–Neal's passage. Four different arrangements existed at the time of Riegle–Neal's passage: regional banking pacts at the state level with reciprocity, national interstate banking with reciprocity, national interstate banking without reciprocity, and no interstate banking permitted. [2] We expect that banks in states with more restrictive arrangements (no interstate banking permitted and state or national with reciprocity) should experience the most significant change in risk because these arrangements effectively constrain the level of competition within the state by restricting the ability of out-of-state banks to enter the state. At the other end of the spectrum, banks in states with less restrictive arrangements (national without reciprocity) may experience a different reaction since out-of-state banks were already permitted to enter those states more freely, possibly creating a higher level of competition in those states.

4. Data and methodology

The impact of Riegle–Neal on bank risk is examined using daily common stock returns for BHCs and banks. The sample is constructed by identifying all institutions on the Center for Research in Security Prices (CRSP) tapes with 602, 603 or 671 as the Standard Industry Classification (SIC) code and which have returns for 300 trading days in the pre- and post-event period. [3] After generating this list, the *Moody's Bank and Finance Manual* is used to verify that the listed institutions are indeed BHCs or banks. This procedure resulted in a final sample of 425 BHCs and banks.

[2] Data on the status of interstate banking laws prior to Riegle–Neal are obtained from "The price of bank mergers in the 1990s" by E. Brewer III, W.E. Jackson III, J.A. Jagtiani, and T. Nguyen, Economic Perspectives, Federal Reserve Bank of Chicago, First Quarter 2000, p. 9.

[3] Our sample consists exclusively of banks and BHCs. The SIC codes 603 (which pertains primarily to thrifts) and 671 (which includes both bank and thrift holding companies) are included because of misclassification problems inherent in the SIC codes used by CRSP. We initially obtain all firms with these SIC codes and then check the Moody's Banking and Finance manual to determine which firms are actually banks or BHCs. Thus, we screen out all thrifts and ensure that any banks that may have been misclassified under the 603 SIC code are included in the sample.

Table 1
Events surrounding the passage of Riegle–Neal

Event	Date	Event description
1	02-23-94	Senate banking committee votes to permit nationwide branching
2	03-10-94	House banking committee passes bill permitting nationwide branching
3	03-22-94	House approves bill by voice vote
4	04-26-94	Senate approves bill
5	08-04-94	House agrees to Conference report on the bill
6	09-13-94	Senate agrees to Conference report on the bill
7	09-29-94	Riegle–Neal is signed into law by President Clinton

This table shows the seven event dates and a brief description of each event leading up to and including the passage of Riegle–Neal. The event dates and descriptions are obtained from Carow and Heron (1998).

As with most regulations, the legislative process surrounding Riegle–Neal's passage was complex and involved the announcement of various events leading up to the final passage of the law. Table 1 identifies the date of each event and provides a brief description. The event dates and descriptions are obtained from Carow and Heron (1998).

The impact of Riegle–Neal on risk is assessed using the methodology outlined by Aharony et al. (1986, 1988) and Smirlock (1984). The risk measures are estimated over 300 trading days prior to the event period and 300 trading days after the event period. Recognizing that the numerous announcements leading up to Riegle–Neal's passage may have altered the market's expectations, we define the pre-event period as the interval preceding the first announcement on February 23, 1994 that the House subcommittee had voted to permit nationwide branching. Similarly, the post-event period is defined as the interval following the announcement that President Clinton had signed the bill into law on September 29, 1994. The capital market measures of risk are obtained using the two-index model which has been utilized extensively in the banking literature: [4]

$$R_{pt} = \alpha_p + \beta_{mp} R_{mt} + \beta_{ip} R_{it} + e_{pt} \tag{1}$$

where R_{pt} is the return on the bank portfolio on day t; α_p, the intercept term; β_{mp}, the market/systematic risk of the portfolio; R_{mt}, the return on the CRSP equally weighted market portfolio on day t; β_{ip}, the interest rate risk of the portfolio; R_{it}, the daily change in the interest rate on the 30-year Treasury bond; [5] e_{pt}, the disturbance term on the portfolio on day t.

One potential problem in using the two-index model is the need to specify the relationship between the interest rate change and the market return. Some studies have dealt with this problem using orthogonalization (Chance and Lane, 1980; Flannery and James, 1984a,b). However, as noted by Giliberto (1985) and Kane and

[4] See, for example, Flannery and James (1984a,b) and Aharony et al. (1986, 1988).

[5] Kane and Unal (1988) note that bank and S&L stock returns are not responsive to short rates but long rates have a significant effect (Kane and Unal, 1988). Thus, following their methodology, this paper uses the returns on long-term government bonds to proxy the unanticipated changes in the interest rate index.

Unal (1988) the orthogonalization procedures produce biased t-tests. Thus, following Kane and Unal (1988) this study uses the unorthogonalized two-index model. [6]

The variances of the portfolio returns are given as:

$$\mathrm{Var}(R_p) = \beta_{mp}^2 \mathrm{Var}(R_m) + \beta_{ip}^2 \mathrm{Var}(R_i) + \mathrm{Var}(e_p) \tag{2}$$

where $\mathrm{Var}(\cdot)$ is the variance operator. The terms $\mathrm{Var}(R_m)$ and $\mathrm{Var}(R_i)$ reflect market-wide factors, whereas β_{mp}^2, β_{ip}^2, and $\mathrm{Var}(e_p)$ are affected by portfolio specific characteristics. Thus, changes in the variance of bank returns ($\mathrm{Var}(R_p)$) could be due to changes in market risk ($\beta_{mp}^2 \mathrm{Var}(R_m)$), interest rate risk ($\beta_{ip}^2 \mathrm{Var}(R_i)$), or unsystematic risk ($\mathrm{Var}(e_p)$). The variances are estimated using daily returns over a 300-day period prior to and following Riegle–Neal. The F-statistic is used to determine if the variances in the post-period are significantly different from the variances in the pre-period.

Eqs. (1) and (2) are estimated for all banks and several additional portfolios based on size (large, medium sized, and small banks), capitalization (well capitalized, moderately capitalized, and poorly capitalized banks), and credit risk (high-, moderate-, and low-credit-risk banks). Large banks are banks with more than $50 billion in assets, medium sized banks have total assets greater than or equal to $10 billion and less than or equal to $50 billion in assets, and small banks have less than $10 billion in total assets. The portfolios based on capitalization and credit risk are determined by partitioning the sample into thirds; upper, middle, and lower third for each measure. Data on size, capitalization, and credit risk are obtained from the Bank Report of Condition and Income database on the Federal Reserve Bank of Chicago's web site. The data from the Bank Report of Condition and Income are matched to the original sample of banks using the Moody's Bank and Finance Manual. The equations are also estimated for portfolios based on the extent of interstate activity and the status of state-level interstate banking laws at the time of Riegle–Neal's passage.

5. Results

Table 2 provides a summary of the sample. The full sample consists of 425 banks of which 14 are large, 46 are medium sized, and 365 are small banks. The 425 banks average $7.18 billion in total assets, 7.77% capital-to-asset ratio, and 2.93% nonperforming loans-to-total asset ratio. The capital-to-asset ratio is relatively uniform across banks of various sizes. However, credit risk varies considerably across banks. Small banks have the highest ratio of nonperforming loans-to-total assets (3.35%) compared to 0.59% for large banks and 0.40% for medium-sized banks.

[6] To provide further justification for using the unorthogonalized two-index model, Eq. (1) is re-estimated as follows. First, the following equation is estimated: $R_{it} = \alpha_{pt} + \beta_{mp} R_{mt} + e_{pt}$. Then, the residuals from the equation are substituted into Eq. (1) for the interest rate index (Chance and Lane, 1980; Aharony et al., 1986). The results using this orthogonalized model are qualitatively similar to those obtained using the unorthogonalized model. Hence, the results for the unorthogonalized model are reported. The complete results are available from the authors.

5.1. Changes in total and unsystematic risks

Table 3, Panel A shows changes in total and unsystematic risks surrounding Riegle–Neal's passage. [7] The significance of the changes is tested using an F-statistic under the null hypothesis that the variances of returns are equal in the pre- and post-Riegle–Neal periods. [8] The portfolio of all banks experiences a decline in total risk of approximately 22% (0.000023–0.000018), which is significant at the 5% level. Large banks experience a decline of 30% (0.000128–0.000090), significant at the 1% level. Similar results are documented for medium-sized and small banks. Moderately capitalized banks also experience a significant reduction in total risk although the decline is only marginally significant at the 10% level. No significant change is observed for well- and poorly- capitalized banks. Moderate- and low-credit-risk banks experience a significant decline in risk while banks with high-credit-risk experience no significant change in risk.

The portfolio of all banks also experiences a 23% decline in unsystematic risk (0.000013–0.000010), which is significant at the 1% level. Similar results are documented for all size-based portfolios. Moderately capitalized and moderate- and low-credit-risk banks also experience a significant decline in unsystematic risk.

Panel B shows that the variance of the market portfolio does not change significantly over the same period suggesting that the decline in risk is not driven by a reduction in risk for the market as a whole. Interest rate risk does not change significantly, further bolstering the conclusion that the decline in bank risk is unrelated to changes in market-wide forces.

[7] We also assess the wealth effects of the events surrounding Reigle–Neal's passage using a system of seemingly unrelated regressions (Zellner, 1962). This method overcomes the potential cross-correlation among the residuals and allows both wealth effects and changes in systematic risk to be examined simultaneously. The model is estimated using equally weighted portfolio returns for the 252-day period covering the calendar year 1994 and is given as follows:

$$R_{it} = \alpha_i + D_t\alpha_i' + \beta_i R_{mt} + \sum_{k=1}^{7} \gamma_{ki} D_k + \beta_i' D_t R_{mt} + \varepsilon_{it}$$

where R_{it} is the return on bank i on day t, α_i is the intercept term, $D_t = 1$ after the last event date; 0 otherwise, α_i' is the shift in the intercept coefficient for bank i, β_i is the systematic risk of bank i, R_{mt} is the return on the market portfolio on day t, γ_{ki} is the abnormal return for bank i in each event window k (the event day plus the following trading day), $D_k = 1$ for each event window k, β_i' is the shift in systematic risk for bank i, and ε_{it} is the error term for bank i on day t. The results showed that the seven events surrounding the passage of Riegle–Neal had no significant impact on shareholder wealth for the sample as a whole and for subsamples based on size, capitalization, and credit risk. The results are in contrast to those presented by Carow and Heron (1998) who document positive wealth effects surrounding Riegle–Neal's passage. We tested the robustness of the results using the models presented in Bhargava and Fraser (1998) and Carow and Heron (1998) and obtained qualitatively similar results. Perhaps the difference in results is attributable to the fact that Carow and Heron use a sample of 180 BHCs while we use a comprehensive sample of 425 banks and BHCs. Our results suggest that the events surrounding Riegle–Neal's passage were largely anticipated by the market.

[8] We also analyzed the risk shift over a short-term interval (100 days pre- and post-Riegle–Neal), but found no significant changes in risk in the short term for any of the models considered. In the interest of brevity, only the long-term (300 days pre and post) results are reported.

Table 2
Sample characteristics

	Mean total assets (in billions of dollars)	Median total assets (in billions of dollars)	Sample size
All banks	7.18	0.90	425
Large banks	93.32	69.55	14
Medium-sized banks	25.31	25.22	46
Small banks	1.60	0.63	365
	Mean capital-to-asset ratio (%)	Median capital-to-asset ratio (%)	
All banks	7.77	7.53	425
Large banks	7.82	7.04	14
Medium-sized banks	7.88	7.50	46
Small banks	7.75	7.56	365
	Mean nonperforming loans/total assets (%)	Median nonperforming loans/total assets (%)	
All banks	2.93	0.97	425
Large banks	0.59	0.06	14
Medium-sized banks	0.40	0.21	46
Small banks	3.35	1.16	365

This table shows the mean and median total assets, capital-to-asset ratio, and credit risk (measured as nonperforming loans divided by total assets) for all banks and for subsamples of large, medium-sized, and small banks. The values are averaged over the 3-year period prior to Riegle–Neal's passage. Large banks are defined as banks with total assets greater than $50 billion, medium-sized banks have total assets greater than or equal to $10 billion but less than $50 billion, and small banks have total assets less than $10 billion. The sample includes all banks for which return data are available on CRSP for the full sample period and for which data are available on the bank report of condition and income for 3 years prior to Riegle–Neal.

5.2. Changes in systematic and interest rate risk

Changes in systematic and interest rate risk are particularly important to stockholders who hold well-diversified portfolios. The F-statistic is used to test the significance of the changes under the null hypothesis that the betas are equal in both periods. The results are shown in Table 4. The bank portfolios do not experience a significant change in systematic or interest rate risk. The fact that there is no change in interest rate risk is not entirely surprising since Riegle–Neal does not explicitly address the issue of interest rate risk. Consequently, banks are not motivated to alter their interest rate exposure in the wake of Riegle–Neal's passage.

5.3. Impact of interstate activity and interstate banking laws on risk shift

Table 5 provides additional insights into the results. We first consider whether the extent of interstate activity affects the risk shift by comparing the reaction of banks with assets in multiple states to banks with assets in only one state prior to Riegle–Neal. We expect that banks with assets in multiple states are more likely to expand following the new legislation and would, therefore, experience the greatest risk

Table 3
Estimates of shifts in total risk ($\mathrm{Var}(R_p)$) and unsystematic risk ($\mathrm{Var}(e_p)$) by bank size, capitalization, and credit risk and estimates of shifts in ($\mathrm{Var}(R_m)$) and ($\mathrm{Var}(R_i)$)

Portfolio	Pre-Riegle–Neal	Post-Riegle–Neal	F-statistic
Panel A: Bank portfolio risk			
All banks ($n = 425$)			
$\mathrm{Var}(R_p)$	0.000023	0.000018	1.30**
$\mathrm{Var}(e_p)$	0.000013	0.000010	1.38***
Large banks ($n = 14$)			
$\mathrm{Var}(R_p)$	0.000128	0.000090	1.42***
$\mathrm{Var}(e_p)$	0.000115	0.000076	1.40***
Medium-sized banks ($n = 46$)			
$\mathrm{Var}(R_p)$	0.000069	0.000050	1.38***
$\mathrm{Var}(e_p)$	0.000055	0.000035	1.55***
Small banks ($n = 365$)			
$\mathrm{Var}(R_p)$	0.000023	0.000018	1.28**
$\mathrm{Var}(e_p)$	0.000013	0.000010	1.27**
Well-capitalized banks ($n = 142$)			
$\mathrm{Var}(R_p)$	0.000019	0.000016	1.19
$\mathrm{Var}(e_p)$	0.000012	0.000010	1.11
Moderately-capitalized banks ($n = 142$)			
$\mathrm{Var}(R_p)$	0.000023	0.000019	1.22*
$\mathrm{Var}(e_p)$	0.000016	0.000012	1.35***
Poorly-capitalized banks ($n = 141$)			
$\mathrm{Var}(R_p)$	0.000055	0.000049	1.12
$\mathrm{Var}(e_p)$	0.000034	0.000036	1.08
High-credit-risk banks ($n = 142$)			
$\mathrm{Var}(R_p)$	0.000052	0.000049	1.06
$\mathrm{Var}(e_p)$	0.000040	0.000040	1.01
Moderate-credit-risk banks ($n = 142$)			
$\mathrm{Var}(R_p)$	0.000022	0.000015	1.46***
$\mathrm{Var}(e_p)$	0.000014	0.000010	1.50***
Low-credit-risk banks ($n = 141$)			
$\mathrm{Var}(R_p)$	0.000031	0.000023	1.38***
$\mathrm{Var}(e_p)$	0.000021	0.000013	1.61***
Panel B: Market risk factors			
Market portfolio	0.000016	0.000016	1.02
Interest rate index	0.000222	0.000234	1.06

This table shows changes in total and unsystematic risks for the bank portfolios and changes in the variance of the market factors over a 300-day pre- and post-event period. F-statistics for the variances are based on (299,299) degrees of freedom in the numerator and denominator respectively and are calculated under the null hypothesis that the variances in the pre- and post-Riegle–Neal period are equal. F-statistics are calculated as Var(Group A)/Var(Group B) where Group A refers to the group with the larger variance. F-statistics are based on a two-tailed test.

*Significance at 10% level.

**Significance at 5% level.

***Significance at 1% level.

Table 4
Estimates of systematic (β_{mp}) and interest rate risks (β_{ip}): pre- and post-event results by bank capitalization, size, and credit risk

Portfolio	Time interval	(β_{mp})	t-statistic	F-statistic	(β_{ip})	t-statistic	F-statistic	R^2
All banks ($n = 425$)								
	Pre	0.8013	15.13***		−0.0039	−0.28		0.4355
	Post	0.7205	16.14***	1.36	−0.0045	−0.39	0.00	0.4675
Large banks ($n = 14$)								
	Pre	0.9186	5.88***		−0.0175	−0.42		0.1050
	Post	0.8964	7.07***	0.01	−0.0116	−0.35	0.01	0.1443
Medium-sized banks ($n = 46$)								
	Pre	0.9590	8.85***		0.0038	0.13		0.2092
	Post	0.9636	11.21***	0.00	0.0034	0.15	0.00	0.2972
Small banks ($n = 365$)								
	Pre	0.7768	14.64***		−0.0046	−0.33		0.4194
	Post	0.6781	14.57***	1.96	−0.0052	−0.42	0.00	0.4169
Well-capitalized banks ($n = 142$)								
	Pre	0.6952	13.86***		−0.0062	−0.46		0.3933
	Post	0.5948	12.64***	2.13	−0.0125	−1.02	0.12	0.3511
Moderately-capitalized banks ($n = 142$)								
	Pre	0.6996	12.03***		0.0023	0.15		0.3277
	Post	0.6833	13.78***	0.05	−0.0196	−1.51	1.17	0.3927
Poorly-capitalized banks ($n = 141$)								
	Pre	1.0233	11.22***		−0.0100	−0.41		0.2984
	Post	0.9106	10.49***	0.80	0.0225	0.99	0.96	0.2723
High-credit-risk banks ($n = 142$)								
	Pre	0.8656	9.34***		−0.0088	−0.35		0.2276
	Post	0.7720	8.44***	0.55	0.0029	0.12	0.12	0.1936
Moderate-credit-risk banks ($n = 142$)								
	Pre	0.7162	12.89***		−0.0021	−0.14		0.3590
	Post	0.6007	13.40***	2.62	−0.0087	−0.74	0.12	0.3774
Low-credit-risk banks ($n = 141$)								
	Pre	0.8199	12.23***		−0.0014	−0.08		0.3351
	Post	0.7836	14.96***	0.18	−0.0073	−0.53	0.07	0.4301

This table shows changes in systematic and interest rate risks over the 300-day pre- and post-event period. The t-statistic is used to test whether the betas are significantly different from zero. F-statistics are calculated under the null hypothesis that the betas in the pre- and post-Riegle–Neal period are equal. F-statistics are calculated as follows: (Residual sum of squares restricted model − Residual sum of squares unrestricted model/q)/(Residual sum of squares unrestricted model/$n - k$) where q is the number of restrictions, n is the number of observations and k is the number of parameter estimates. Thus, the F-statistic has (1,594) degrees of freedom.

*Significance at 10% level.

**Significance at 5% level.

***Significance at 1% level.

Table 5
Changes in risk measures for portfolios based on the extent of interstate banking activity and the status of interstate banking laws

Portfolio	Interval	β_{mp}	F-statistic	Var(R_p)	F-statistic	Var(e_p)	F-statistic
Panel A: Bank portfolios based on extent of interstate activity							
Banks with assets in one state ($n = 316$)							
	Pre	0.7931		0.000025		0.000015	
	Post	0.6815	2.13	0.000020	1.24*	0.000012	1.19
Banks with assets in multiple states ($n = 109$)							
	Pre	0.8229		0.000041		0.000031	
	Post	0.8138	0.01	0.000029	1.44***	0.000019	1.69***
Panel B: Bank portfolios based on status of interstate banking laws							
No interstate banking permitted ($n = 29$)							
	Pre	0.7192***		0.000079		0.000071	
	Post	0.8704***	0.96	0.000052	1.52***	0.000040	1.77**
Reciprocal by state ($n = 83$)							
	Pre	0.6470***		0.000033		0.000026	
	Post	0.6544***	0.01	0.000019	1.66***	0.000013	2.05**
National with reciprocity ($n = 259$)							
	Pre	0.8264***		0.000027		0.000016	
	Post	0.6869***	3.58*	0.000017	1.60***	0.000009	1.76**
National without reciprocity ($n = 54$)							
	Pre	0.9443***		0.000071		0.000085	
	Post	0.9489***	0.00	0.000110	1.50***	0.000128	1.57**

This table shows changes in systematic (β_{mp}), total (Var(R_p)), and unsystematic (Var(e_p)) risks for portfolios based on the extent of interstate banking activity and the status of interstate banking laws in the state where each sample bank was headquartered at the time of Riegle–Neal's passage. The sample consists of large and medium-sized banks only. Reciprocal by state indicates states that had formed regional banking pacts permitting interstate banking activity within the region. National without reciprocity indicates nationwide entry permitted without requiring a reciprocal arrangement while national with reciprocity refers to states that permitted nationwide entry with reciprocal agreements. The change in risk is assessed using a 300-day pre- and post-event period. The t-statistic is used to test whether the betas are significantly different from zero. F-statistics for the betas are calculated under the null hypothesis that the betas in the pre- and post-Riegle–Neal period are equal and are calculated as follows: (Residual sum of squares restricted model − Residual sum of squares unrestricted model/q)/(Residual sum of squares unrestricted model/$n - k$) where q is the number of restrictions, n is the number of observations, and k is the number of parameter estimates. The F-statistic has (1594) degrees of freedom. F-statistics for the variances are calculated under the null hypothesis that the variances in the pre- and post-Riegle–Neal period are equal and are calculated as Var(Group A)/Var(Group B). In all instances Group A refers to the group with the larger variance and Group B refers to the group with the smaller variance. F-statistics for the variances are based on (299,299) degrees of freedom in the numerator and denominator respectively.
*Significance at 10% level.
**Significance at 5% level.
***Significance at 1% level.

reduction. These results are presented in Panel A. Banks with assets in one state experience a marginally significant change in total risk but no significant change in unsystematic risk following the law's passage. However, banks with assets in multiple

states experience a significant reduction in total risk (0.000041–0.000029), a decline of 29%. The banks also experience a significant decline in unsystematic risk (0.000031–0.000019), a decline of 39%. In both instances, the decline is significant at the 1% level. This is consistent with the hypothesis that banks with existing interstate activity are more likely to expand and, therefore, experience the greatest risk reduction.

Panel B shows changes in the risk measures for portfolios formed on the basis of the interstate banking laws in existence in each state at the time of Riegle–Neal's passage. Banks in states that did not permit interstate banking experience a decline of 34% and 43% in total and unsystematic risks respectively. Similar results are observed for banks in states with reciprocal agreements by state and for banks in states that permitted national interstate banking with reciprocity. In contrast, banks in states that permitted national interstate banking without reciprocity experience a significant increase in both total and unsystematic risks. Unsystematic risk increases from 0.000085 to 0.000128, an increase of 51% significant at the 1% level. The total risk also increases from 0.000071 to 0.000110, an increase of 55% significant at the 1% level. This suggests that banks in states with the most liberal interstate banking provisions (which permit out-of-state-banks to enter the state without requiring a reciprocal agreement) may operate in a more competitive environment than their counterparts in other states with more restrictive provisions. This difference in the competitive environment appears to be an important factor driving the change in risk.

We also conduct the analysis for portfolios which control for both the extent of interstate banking activity and the status of interstate banking laws. The results of this analysis revealed that all portfolios experienced a significant decrease in both total and unsystematic risks with the exception of banks operating in one state which also permitted national interstate banking without requiring reciprocity. These banks experience a significant increase in risk suggesting that the competitive environment in states with liberal interstate banking provisions places banks with assets in just one state at a competitive disadvantage. In the interest of brevity, these results are not tabulated.

Recognizing that size and interstate activity are highly correlated, we also form portfolios that control for both size and interstate activity. [9] All the portfolios experience a significant decline in both total and unsystematic risks with the exception of small banks operating in one state which experience only a marginally significant decline in risk. [10] These results should be interpreted with caution since small banks with assets in one state represented 312 of the 316 banks which had assets in just one state. However, the fact that small banks with assets in multiple states experience a significant decline in risk suggests that the primary factor contributing to the risk reduction is the extent of interstate activity.

[9] We examine six portfolios; large banks with assets in one state ($n = 1$), large banks with assets in multiple states ($n = 13$), medium-sized banks with assets in one state ($n = 3$), medium-sized banks with assets in multiple states ($n = 43$), small banks with assets in one state ($n = 312$), and small banks with assets in multiple states ($n = 53$).

[10] In the interest of brevity, these results are not tabulated.

Taken collectively, the results provide evidence that bank risk has fallen significantly since Riegle–Neal's passage for most banks. The results reject the null hypotheses of no significant change in total (H1) and unsystematic (H2) risks in the wake of Riegle–Neal's passage. However, the results fail to reject the null hypotheses regarding systematic (H3) and interest rate (H4) risks. The findings are consistent with the hypothesis that the potential for geographic diversification resulting from Riegle–Neal's passage has reduced the diversifiable portion of risk for most banks.

6. Conclusions

This study examines changes in capital market measures of bank risk following the Riegle–Neal of 1994. The changes in risk are examined for all banks and portfolios based on size, capitalization, credit risk, the extent of interstate activity, and the status of interstate banking laws in the respective states at the time of Riegle–Neal's passage. The results provide evidence that both total and unsystematic bank risks have fallen significantly since Riegle–Neal's passage. In contrast, systematic risk is largely unaffected by Riegle–Neal's passage. Our results suggest that the observed decline in risk is not related to a reduction in market-wide risk because market risk does not change significantly over the sample period. Furthermore, the results do not appear to be driven by the record profitability that banks experienced in the mid-1990s. In fact, when we control for factors related to geographic diversification we find significant differences across the bank portfolios that are consistent with the implications of these factors for changes in bank risk following Riegle–Neal.

We find that the extent of interstate banking activity and the status of state-level interstate banking laws are important in explaining the extent of the risk reduction. Banks with assets in multiple states experience a significant reduction in risk whereas banks with assets in one state experience no significant change in risk. Further, banks in states with the most restrictive interstate banking provisions experience a significant decrease in risk whereas banks in states with the most liberal interstate banking provisions experience a significant increase in risk. This suggests that the competitive environment in each state is a major factor driving the results.

These findings have important implications for regulators and shareholders. From a regulatory perspective, the results suggest that the move toward unrestricted nationwide banking reduced risk for most banks which is consistent with the objective of promoting safety and soundness in the banking industry. From the perspective of stockholders who hold well-diversified portfolios and are primarily concerned with systematic risk, the results suggest that their required returns should not change significantly following Riegle–Neal's passage.

References

Aharony, J., Saunders, A., Swary, I., 1986. The effects of a shift in monetary policy regime on the profitability and risk of commercial banks. Journal of Monetary Economics 17, 363–377.

Aharony, J., Saunders, A., Swary, I., 1988. The effects of DIDMCA on bank stockholders' returns and risk. Journal of Banking and Finance 12, 317–331.

Allen, P.R., Wilhelm, W.J., 1988. The impact of the 1980 depository institutions deregulation and monetary control act on market value and risk: Evidence from the capital markets. Journal of Money, Credit and Banking 20, 364–380.

Bhargava, R., Fraser, D.R., 1998. On the wealth and risk effects of commercial bank expansion into securities underwriting: An analysis of Section 20 subsidiaries. Journal of Banking and Finance 22, 447–465.

Billingsley, R.S., Lamy, R.E., 1992. Regional reciprocal interstate banking: The Supreme Court and the resolution of uncertainty. Journal of Banking and Finance 16, 665–686.

Bundt, T.P., Cosimano, T.F., Halloran, J.A., 1992. DIDMCA and bank market risk: Theory and evidence. Journal of Banking and Finance 16, 1179–1193.

Carow, K.A., Heron, R.A., 1998. The interstate banking and branching efficiency act of 1994: A wealth event for acquisition targets. Journal of Banking and Finance 22, 175–196.

Carow, K.A., Lee, W., 1997. State passage of interstate banking legislation: An analysis of firm, legislative and economic characteristics. Journal of Banking and Finance 21, 1017–1043.

Chance, D.M., Lane, W.R., 1980. A re-examination of interest rate sensitivity in the common stocks of financial institutions. Journal of Financial Research 3, 49–55.

Chong, B.S., 1991. The effects of interstate banking on commercial banks' risk and profitability. Review of Economics and Statistics, 78–84.

Flannery, M.J., James, C.M., 1984a. The effect of interest rate changes on the common stock return of financial institutions. Journal of Finance 39, 1141–1153.

Flannery, M.J., James, C.M., 1984b. Market evidence on the effective maturity of bank assets and liabilities. Journal of Money, Credit and Banking 16, 435–445.

Fraser, D.R., Hooton, J.L., Kolari, J.W., Reising, J.J., 1997. The wealth effects of interstate branching. Journal of Banking and Finance 21, 589–611.

Giliberto, M., 1985. Interest rate sensitivity in the common stocks of financial intermediaries: A methodological note. Journal of Financial and Quantitative Analysis 20, 123–126.

Hughes, J.P., Lang, W., Mester, L.J., Moon, C., 1996. Efficient banking under interstate branching. Journal of Money, Credit and Banking 28, 1045–1071.

Kane, E.J., Unal, H., 1988. Changes in market assessments of deposit-institution riskiness. Journal of Financial Services Research 1, 207–229.

Koehn, M.F., Stangle, B.E., 1980. The effect of deposit-rate ceilings on bank risk: A comment. Journal of Banking and Finance 4, 381–386.

Liang, N., Rhoades, S.A., 1988. Geographic diversification and risk in banking. Journal of Economics and Business 40, 271–284.

Mingo, J.J., 1978. The effect of deposit rate ceilings on bank risk. Journal of Banking and Finance 2, 367–378.

Peltzman, S., 1976. Toward a more general theory of regulation. Journal of Law and Economics 19, 211–240.

Smirlock, M., 1984. An analysis of bank risk and deposit rate ceilings: Evidence from the capital markets. Journal of Monetary Economics 13, 195–210.

Sundaram, S., Rangan, N., Davidson III, W.N., 1992. The market valuation effects of the financial institutions reform, recovery, and enforcement act of 1989. Journal of Banking and Finance 16, 1097–1122.

Unal, H., Kane, E.J., 1988. Two approaches to assessing the interest rate sensitivity of deposit-institutions' equity returns. Research in Finance 7, 113–138.

Zellner, A., 1962. An efficient method of estimating seemingly unrelated regressions and tests for aggregation basis. Journal of American Statistical Association 57, 348–368.