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Evidence from Geographic Bank Deregulation

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Competition and Bank Risk: Evidence from Geographic Bank Deregulation

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Abstract

We examine the effects of competition on bank risk. We find strong evidence that interstate banking deregulation—which generally increases bank competition—is associated with lower bank risk and some evidence intrastate branching increases bank risk. Further, interstate banking reduces bank risk more in sparsely populated states. Additional analyses suggest that in contrast to previous studies that focus on large banks, the impact of interstate banking deregulation on bank risk is driven by small banks, with strong small banks having lower risk after interstate banking. However, intrastate branching deregulation is associated with higher risk for small and medium banks.

JEL Classification Codes: G21, G28, D22

Keywords: Deregulation, Risk, Intrastate Branching, Interstate Banking, Interstate Branching, Diversification, Competition.

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"… we have deregulated the financial services sector, and we face another crisis."
Barack Obama, the U.S. President 2009–2017, *Renewing the American Economy*,
Presidential campaign speech at The Cooper Union, New York City, March 27, 2008.

"More than 30 years of deregulation and reliance on self-regulation by financial institutions … stripped away key safeguards, which could have helped avoid catastrophe."
The U.S. Financial Crisis Inquiry Commission, *Final Report of the National Commission on the Causes of the Financial and Economic Crisis in the United States*,
The Financial Crisis Inquiry Report, January 2011, p. xviii.

1. Introduction

Between the late 1970s and the mid-1990s, U.S. states significantly relaxed restrictions on the geographic expansion of banks. Whether such deregulation is socially beneficial is an open question. Deregulation allows banks to diversify their assets and extend their depositor bases, which can increase credit supply and extend the coverage of banking services. Deregulation also increases competition in local markets. Traditional economic literature suggests that increased competition benefits society by encouraging firms to innovate and provide better services at lower prices (e.g., Kovacic and Shapiro 2000; Aghion, Bloom, Blundell, Griffith, and Howitt 2005). In line with this view, extant empirical studies find a positive relation between banking deregulation and economic activity in the form of higher real per capita income growth (Jayaratne and Strahan 1996; Clarke 2004; Huang 2008), smaller fluctuations in economic growth (Morgan, Rime, and Strahan 2004), higher interstate trade (Michalski and Ors, 2012), more entrepreneurial activity (Black and Strahan 2002; Strahan 2003; Cetorelli and Strahan, 2006), increased credit supply to businesses (Rice and Strahan 2010; Chu 2018) and households (Dick and Lehnert 2010), improved resource allocation efficiency (Bai, Carvalho, and Phillips 2015), greater firm productivity (Krishnan, Nandy, and Puri 2015), and greater access to external financing to fund firm growth, at least for some firms (Berger, Chen, El Ghoul, and Guedhami, 2019).

However, as the quotes at the start of the paper indicate, deregulation might increase bank risk. In this paper we examine the effects of geographic banking deregulation—intrastate branching deregulation, interstate banking deregulation, and interstate branching deregulation—by U.S. states on bank risk, and how such effects vary with state population density and bank size. Intrastate branching deregulation allows banks to open branches statewide, while interstate banking deregulation allows banks to be acquired by out-of-state banks. Interstate branching deregulation started after the passage of the Riegle-Neal Act by removing restrictions on out-of-state banks to establish branches in a given state. The different types of deregulation and the variation in the timing of bank deregulation across states provides an ideal setting to conduct a quasi-natural experiment study of the effect of geographic deregulation on bank risk.

The very few existing studies on how deregulation of bank geographic expansion affects bank risk provide mixed results. Using state-level data for all commercial banks from 1976 to 1992, Jayaratne and Strahan (1996, 1998) find that intrastate branching deregulation and interstate banking deregulation are associated with lower credit risk, though the former to a lesser extent. Similarly, using a sample of 218 BHCs over the 1988 to 1991 period, Rivard and Thomas (1997) find that interstate BHCs have higher profitability, lower earnings volatility, and lower insolvency risk compared to strictly intrastate banks. In contrast, for a sample of 84 large U.S. BHCs from 1980 to 1992, Rose (1996) shows that interstate banking expansion leads to higher risk, but also finds evidence that diversification gains start to emerge when banks expand to at least four states, and Dick (2006) shows that deregulation associated with the Riegle-Niel Act leads to higher credit portfolio risk over the 1993 to 1999 period. Subramanian and Yadav (2012) examine the impact of intrastate branching and interstate banking deregulation on bank failures from 1976 to 1994 and find that intrastate branching deregulation leads to fewer bank failures due to increased portfolio diversification, improved operating efficiency, and reduced loan losses, but find no evidence that interstate banking deregulation affects bank failures. Goetz, Laeven, and Levine (2016) develop a new instrument to identify exogenous sources of variation in geographic diversity at the BHC level and use it to examine the impact of geographic expansion (in response to interstate banking deregulation) on bank risk. Using data on listed BHCs from 1986:Q2 to 1997:Q4, they find that geographic expansion is associated with lower BHC risk but has no significant impact on BHC loan quality. More recently, Goetz (2018) shows that the process of interstate banking deregulation significantly improves bank stability by increasing profitability and loan quality.

Theoretically, there are at least three hypotheses predicting that geographic deregulation increases risk and at least two hypotheses predicting it reduces risk. Turning first to the risk-increasing hypotheses, under the *Hubris Hypothesis,* geographic expansion associated with deregulation provides bank managers more opportunities to extract private benefits by increasing the resources under their control (e.g., Jensen 1986; Servaes 1996; Denis, Denis, and Sarin 1997; Laeven and Levine 2007; Berger, El Ghoul, Guedhami, and Roman 2017). Under the *Diversification Monitoring Hypothesis,* geographic diversification increases the cost of monitoring bank loans and in turn the cost of managing bank risk due to increased organizational complexity and increased distances between offices (e.g., Winton 1999; Brickley, Linck, and Smith 2003; Berger, Miller, Petersen, Rajan, and Stein 2005). Finally, under the *Competition Fragility Hypothesis*, deregulation leads to more competition in the local market, which may increase bank risk by eroding profit margins and in turn incentives for banks to control risk in an effort to protect their franchise value (e.g., Keeley 1990; Hellmann, Murdock, and Stiglitz 2000; Repullo 2004).

Turning to the two risk-reducing hypotheses, under the *Diversification Stability Hypothesis*, bank deregulation reduces bank risk by providing banks an opportunity to diversify their assets and widen their depositor base (e.g., Gart 1994; Hubbard 1994; Meslier-Crouzille, Morgan, Samolyk, and Tarazi 2016; Goetz, Laeven, and Levine 2016), which is an important part of banks' risk-transformation function (e.g., Diamond 1984; Boyd and Prescott 1986). Under the *Competition Stability Hypothesis,* bank deregulation intensifies competition in local markets (e.g., Jayaratne and Strahan 1996; Carlson and Mitchener 2006; Kerr and Nanda 2009; Beck, Levine, and Levkov 2010), which improves efficiency, reduces interest rates on loans and in turn borrower moral hazard and adverse selection problems (e.g., Jayaratne and Strahan 1998; Boyd and De Nicolo 2005; Boyd, De Nicolo, and Jalal 2006; Akins, Li, Ng, and Rusticus 2016).

To test which of the hypotheses empirically dominates, we examine the effects of intrastate branching and interstate banking deregulation by U.S. states between 1984:Q1 and 1994:Q3 on U.S. commercial banks. We end this sample period in 1994:Q3 to avoid confounding effects of the Riegle-Neal Interstate Banking and Branching Efficiency Act (hereafter, the Reigle-Neal Act), which became effective on September 29, 1994, and allowed interstate branch banking for the first time since the 1927 McFadden

Act. To test the relation between bank deregulation and risk prior to the Riegle-Neal Act, we estimate panel regression models using a generalized Difference-in-Differences (DiD) specification. The main dependent variable is the natural logarithm of a bank's *Z*-score (*Ln Z-Score*), which is an inverse indicator of bank insolvency risk. The explanatory variables are indicator variables for intrastate branching and interstate banking deregulation. We next consider the effect of interstate branching deregulation over the period 1994:Q4 to 2013:Q4. To test the relation between bank deregulation and risk following the Riegle-Neal Act, we regress *Ln Z-Score* on the interstate branching restriction index of Rice and Strahan (2010).

We find strong evidence that interstate banking deregulation is associated with lower bank risk. More specifically, on average, banks in states that allow bank acquisition by out-of-state banks have about 22% higher *Z*-scores than banks in states prohibiting such acquisitions. In contrast, we do not find significant evidence that interstate branching deregulation affects bank risk, which suggests that interstate merger and acquisition activities provide stronger incentives to decrease bank risk compared to interstate branching. With respect to intrastate branching activities, we find some evidence that banks in states that allow such geographic expansion have lower Z-scores than banks in states prohibiting it. To the extent that interstate banking deregulation decreased market power of local banks, while intrastate branching increased it (Chava, Oettl, Subramanian, and Subramanian 2013), these findings are consistent with the *Competition Stability Hypothesis*.

To mitigate endogeneity problems due to potential reverse causality between deregulation and bank risk, we run instrumental variables (IV) regressions using the deregulation variables of adjoining states as instruments. To address omitted variable bias, we first add controls for lagged state population density, bank size, bank holding company (BHC) membership, publicly listed status, local market concentration, asset diversification, overhead cost ratio, degree of internationalization, as well as time (quarter) and bank fixed effects to our main specification. We also conduct contiguous-county matching following Huang (2008). This matching procedure helps mitigate sample selection concerns. Our main results continue to hold. Because these analyses consistently suggest that interstate branching deregulation has no impact on bank risk, our remaining analyses focus on intrastate branching and interstate banking deregulation.

In additional sensitivity checks, we conduct placebo tests that show that randomly generated intrastate branching and interstate banking deregulation have no effect on bank risk. Further, we employ alternative measures of bank risk, exclude two states with very different banking regulations (Delaware and South Dakota), exclude too-big-to-fail banks, use bootstrapped standard errors, use a balanced sample that excludes new entrant banks and banks that exit the industry during the sample period, use standard errors clustered at the bank and quarter levels, and conduct our analysis at the BHC level instead of the bank level. Our main results continue to go through.

To shed light on the hypotheses behind our main findings, we first run our main regressions separately on densely versus sparsely populated states, where we capture population density using population per square mile. We find that intrastate branching reduces bank risk in densely populated states, which are mainly served by large banks that have more diversification capacity than small banks (i.e., *Diversification Stability Hypothesis*). In contrast, in sparsely populated states where small banks dominate, statewide branching expansion is associated with higher risk**,** as small banks may face greater difficulty monitoring an expanded number of intrastate branches compared to large banks (i.e., *Diversification Monitoring Hypothesis*). We further find that interstate banking deregulation is associated with risk reduction in sparsely populated states but not in densely populated states. The threat of acquisition by an out-of-state bank increases the incentives of small banks, which dominate sparsely populated states, to operate more efficiently, which reduces risk (Jayaratne and Strahan 1998) (i.e., *Competition Stability Hypothesis*). In contrast, in densely populated states that have more large banks, this takeover threat is less effective because acquiring large banks is costlier than small banks.[2] We next estimate our regressions separately on subsamples of small, medium, and large banks. The results are consistent with those from the analysis of densely versus sparsely populated states. Thus, in contrast to previous studies that focus on large banks and BHCs, the impact of interstate banking deregulation on bank risk is driven by small banks. In

[2] As most intrastate branching deregulation occurred before interstate banking deregulation, large banks' statewide branching expansion may have further increased their size, allowing them to better defend themselves from takeover by out-of-state banks.

further analysis we find that strong small banks have lower risk following interstate banking deregulation, while weak small banks become riskier.

We organize the remainder of this paper as follows. Section 2 provides the hypotheses. Section 3 describes the data, variables, and summary statistics. Section 4 presents the main empirical results. Section 5 presents results of endogeneity checks, Section 6 provides results of additional robustness tests, and Section 7 presents results of additional tests on cross-sectional heterogeneity. Section 8 concludes the paper.

2. Hypotheses

The discussion in the introduction suggests the following competing hypotheses for the effects of deregulation of bank geographic expansion on bank risk:

H_{1a}: Fewer restrictions on bank geographic expansion result in higher risk for banks operating in these states.

H_{1b}: Fewer restrictions on bank geographic expansion result in lower risk for banks operating in these states.

A finding that supports Hypothesis **H_{1a}** would be consistent with the predictions of the *Hubris view*, the *Diversification Monitoring view*, or the *Competition Fragility view*. Empirical support for Hypothesis **H_{1b}** would be consistent with the predictions of the *Diversification Stability view* or the *Competition Stability view*.

3. Data, Variables, and Summary Statistics

3.1. Data and Sample

Our bank-level financial data come from quarterly Call Reports (*Reports of Condition and Income*) and cover all commercial banks in the U.S. from 1984:Q1 to 2013:Q4. The Call Reports start with 1976:Q1, but we begin the sample in 1984:Q1 as many banks' reports are semiannual rather than quarterly prior to this quarter; in particular, 215,182 of 485,146 bank-quarter observations (44.35%) have missing net income

(RIAD4340) in either Q1 or Q3 but not in Q2 and Q4 from 1976:Q1 through 1983:Q4.[3] Due to the lag structure of our baseline model, our main measure of bank risk starts with 1986:Q4. We divide our sample into two subsamples. The first subsample, which covers the 1984:Q1 to 1994:Q3 period, captures most of the intrastate branching and interstate banking deregulation that occurred at the state level. We end this subsample in 1994:Q3 to avoid confounding effects from the Riegle-Neal Act, which was enacted in 1994:Q4. The second subsample runs from 1994:Q4 to 2013:Q4. During this period, we focus the analysis on interstate branching deregulation following the Riegle-Neal Act.

The sample starts with 364,812 bank-quarter observations from the first subsample and 604,334 bank-quarter observations from the second subsample. We exclude non-commercial banks (RSSD9331 not equal to 1) as well as observations with zero or negative gross total assets (GTA),[4] total loans and leases, and total deposits. These filters result in 303,207 bank-quarter observations for 12,987 commercial banks for the first subsample, and 519,817 bank-quarter observations for 11,964 commercial banks across the 50 U.S. states and the District of Columbia (DC). We deflate all U.S. dollar-denominated variables using the 2010:Q4 GDP implicit price deflator[5] and winsorize all financial ratios at the 1% and 99% levels to mitigate the impact of outliers.[6]

3.2. Bank Risk Measure

Our main measure of bank risk is based on a bank's *Z*-score, which is an inverse measure of the bank's insolvency probability (e.g., Hannan and Hanweck 1988; Laeven and Levine 2009; Houston, Lin, Lin, and Ma 2010; Beltratti and Stulz 2012).[7] We first calculate a bank's *Z*-score according to

$$Z\text{-}Score_{i,t-k+1,t} = \frac{\mu_{i,t-k+1,t}(ROA)+\mu_{i,t-k+1,t}(Equity/GTA)}{\sigma_{i,t-k+1,t}(ROA)}, \tag{1}$$

[3] Bluedorn, Bowdler, and Koch (2013) also identify this irregularity in the Call Reports, though they do not provide further details on it.

[4] GTA adds back allowances for loan and lease losses (RCFD3123) and transfer risk reserves (RCFD3128) to total assets (RCFD2170) in order to capture the full value of the bank's financed assets. Hereafter, we use the terms "assets" and "GTA" interchangeably.

[5] The GDP implicit price deflator is downloaded from the Federal Reserve Bank of St. Louis' website: https://fred.stlouisfed.org/series/USAGDPDEFQISMEI.

[6] We find equivalent results when we winsorize the financial ratios at the top and bottom 3% rather than 1% level.

[7] A bank is considered insolvent when its losses exhaust its capital (Hannan and Hanweck 1988).

where $\mu_{t-k+1,t}(ROA)$ is bank i's mean return on assets, calculated as net income over GTA, $\mu_{t-k+1,t}(Equity/GTA)$ is bank i's mean capitalization ratio, and $\sigma_{t-k+1,t}(ROA)$ is the standard deviation of bank i's ROA. The mean and standard deviation are computed from time $t-k+1$ to time t. Following Berger, El Ghoul, Guedhami, and Roman (2017), we use $k = 12$ quarters. A higher *Z*-score indicates that the bank has lower insolvency risk.

Next, rather than use the level of *Z-Score*, we follow Laeven and Levine (2009), Houston, Lin, Lin, and Ma (2010), and Beck, Jonghe, and Schepens (2013) and use the natural logarithm of *Z-Score* to reduce skewness in the distribution.[8] Since *Z-Score* can take negative values, we employ the following *Ln* transformation to avoid truncations on negative values:

$$Ln\ Z\text{-}Score_{i,t-k+1,t} = \ln\left\{1 + \left|\min_{\forall i,t} Z_{i,t-k+1,t}\right| + Z_{i,t-k+1,t}\right\}, \quad (2)$$

where $\left|\min_{\forall i,t} Z_{i,t-k+1,t}\right|$ is the global minimum of *Z-Score* across all bank-quarter observations over the sample period. This transformation converts the global minimum (negative) value of *Z-Score* to zero.

3.3. Bank Deregulation Measures

Our key variables of interest in the first subsample period (i.e., 1984:Q1 to 1994:Q3) are indicator variables for intrastate branching deregulation ($Intra_{jt}$) and interstate banking deregulation ($Inter_{jt}$). $Intra_{jt}$ equals 1 if a bank is headquartered in a state j that has deregulated intrastate branching by time t, and 0 otherwise. $Inter_{jt}$ equals 1 if a bank is headquartered in a state j that has deregulated interstate banking by time t, and 0 otherwise. We include deregulation in all 50 U.S. states and DC in our analysis.[9]

[8] Table 4.1, Panels B and C show that the skewnesses of *Z-Score* are greatly reduced from 1.687 to -0.389 and from 1.284 to -0.575, respectively, when we use the natural logarithm transformation. Results are similar when we use the level rather than the ln-transformed *Z-Score*.

[9] Some previous studies on U.S. bank deregulation exclude Delaware and South Dakota from the analysis because banks in these states have special tax incentives for credit card business (e.g., Black and Strahan 2002; Dick and Lehnert 2010; Amore, Schneider, and Žaldokas 2013). Our results are robust to excluding these two states from the analysis (see Table 4, Panel B).

Dates for intrastate branching and interstate banking deregulation events come from Amel (1993), Berger, Kashyap, and Scalise (1995), and Francis, Hasan, and Wang (2014).

In the second subsample period (i.e., 1994:Q4 to 2013:Q4), our variable of interest is the interstate branching restrictiveness index (*RSI*) of Rice and Strahan (2010). This index is given as the sum of four indicator variables that are equal to 1 if a state imposes a minimum age of 3 or more years on target banks of interstate acquirers, does not permit de novo interstate branching, does not permit the acquisition of individual branches or portions of banks by an out-of-state bank, or imposes a deposit cap of less than 30%, and 0 otherwise. This index therefore ranges from 0 (no restriction) to 4 (fully restricted), and is an inverse measure of bank deregulation. In constructing this measure, we update the data from Rice and Strahan (2010) using the Profile of State-Chartered Banking (PSCB) and State Banking Laws.[10] We also update the index by assigning a value of 0 to the indicator for de novo interstate branching for all states as of 2010:Q4 onward to account for Section 613 of the Dodd-Frank Act, which effectively removed the restriction on de novo interstate branching.

3.4 Control Variables

To mitigate potential omitted variable bias, we control for state economic condition variables, bank-specific characteristics, as well as bank and time (quarter) fixed effects.[11] With respect to controls for a state's economic condition, we first include *Population Density*, which is equal to the ratio of a state's population to the state's area. We obtain data on a state's population and area from the U.S. Census Bureau. Prior economic literature documents a positive relation between population density and economic outcomes (e.g., McGranahan and Beale 2002; Walser and Anderlik 2004). Accordingly, we expect banks located largely in sparsely populated areas to be riskier, for at least three reasons: 1) it is difficult for these banks to achieve economies of scale due to a limited customer base, 2) these banks face more severe adverse

[10] These documents are available (by request) from the Conference of State Bank Supervisors and from http://law.justia.com/. If there is any difference in the interstate branching restriction recorded between these two sources and Rice and Strahan (2010), we follow Rice and Strahan.

[11] As we use a bank's capitalization ratio to construct our main risk measure, *Ln Z-Score*, we do not include this variable among our controls in the right-hand side of the regression.

selection problems due to smaller pools of potential borrowers, and 3) these banks may find it more difficult to diversify their loan portfolios due to a lack of business diversity in their service areas. We also proxy for the state's economic condition using the state's Housing Price Index, as measured by *Ln HPI*.

Turning to bank-level controls, we first include a proxy for bank size. Prior studies show that bank size can affect risk. On the one hand, larger banks have greater ability to diversify risks (e.g., Demsetz and Strahan 1997; Deng and Elyasiani 2008) and more stable earnings (De Haan and Poghosyan 2012a, b), and therefore are more financially stable. On the other hand, larger banks may take more risks to benefit from "too-big-to-fail" subsidies (e.g., O'Hara and Shaw 1990; Boyd and Gertler 1994; Laeven, Ratnovski, and Tong 2014). To capture a possibly nonlinear relation between bank size and risk (De Haan and Poghosyan 2012a), we employ both *Ln GTA* and its square as proxies for bank size.

Second, we control for membership in a BHC. Several studies show that banks benefit from the internal capital markets provided by their parent BHCs (e.g., Houston, James, and Marcus 1997; Ashcraft 2008; Haas and Lelyveld 2010). Other studies show that BHCs are associated with lower risk due to diversification benefits (e.g., Deng and Elyasiani 2008). However, Demsetz and Strahan (1997) document that the diversification benefits of large U.S. BHCs are offset by lower capital and riskier loan portfolios. Similarly, Laeven and Levine (2007) show that BHCs suffer from a diversification discount that is related to intensified agency problems within conglomerates. Following Berger, El Ghoul, Guedhami, and Roman (2017), we proxy for BHC membership using *BHC*, a dummy variable that equals 1 if a bank is part of a BHC, and 0 otherwise.

Our third bank-level control accounts for a bank's listing status. On the one hand, publicly listed banks may be less risky than privately owned banks because they are subject to greater market discipline (Barry, Lepetit, and Tarazi 2011), that is, to greater monitoring by investors, capital market regulators, and bank regulators. On the other hand, listed banks are generally larger and hence are more likely to be bailed out due to their importance to financial markets, which provides incentives for listed banks to take more risk. To capture the effect of listing status, we employ the dummy variable *Listing*, which equals 1 if a bank is publicly listed or is part of a publicly listed BHC and 0 otherwise.

We also control for a bank's local market concentration. The literature shows that market concentration can affect bank risk negatively or positively, depending on whether concentration stability (e.g., Allen and Gale 2000, 2004; Beck, Demirgüç-Kunt, and Levine 2006; Craig and Dinger 2013) or concentration fragility (e.g., Boyd and De Nicolo 2005; Boyd, De Nicolo, and Jalal 2006) holds.[12] Following Cetorelli and Strahan (2006), we use the Herfindahl-Hirschman Index of deposits (*Deposit HHI*) to proxy for local market concentration.[13] Following Berger, Klapper, and Turk-Ariss (2009), we also include the square of *Deposit HHI* to capture a possibly nonlinear relation between local market concentration and bank risk. We define local banking markets at the Metropolitan Statistical Area (MSA) or New England County Metropolitan Area (NECMA) level as applicable and at the county level for non-MSA/NECMA rural counties. For each MSA/NECMA and non-MSA/NECMA area, we calculate *Deposit HHI* as the sum of squared deposit shares of all banks and bank branches within the area for the given period. We collect bank deposit data from the *FDIC Summary of Deposits* (*SOD*).[14] To obtain the HHI at the bank level, we calculate a bank's HHI as the deposit-weighted average HHI across all of the local markets in which the bank operates. For example, if a bank operates in 5 MSAs and 5 non-MSA rural counties, then the bank's deposit-weighted HHI is the sum of the weighted HHIs for these 10 markets, where the weight factor used for each market is the bank's deposits in the given market divided by the bank's total deposits across all 10 markets.

Our fourth bank-level control focuses on diversification of banking activities. The literature provides conflicting predictions on how diversification of business activities affects bank risk. On the one hand, having two or more business activities that are not perfectly correlated may reduce the volatility of a

[12] Recent studies on bank competition such as Claessens and Laeven (2004), Beck, Demirgüç-Kunt, and Levine (2006), and Schaeck, Cihak, and Wolfe (2009) show that market concentration and competition are distinct banking market measures.

[13] The U.S. Department of Justice has long relied on the HHI measure as one of the main metrics used to evaluate bank merger proposals. For more details, see the *Horizontal Merger Guidelines* (U.S. Department of Justice and Federal Trade Commission 2010).

[14] Summary of Deposits (SOD) data for 1994 and thereafter are available from the FDIC's website at https://www5.fdic.gov/sod/dynaDownload.asp?barItem=6. We thank Christa Bouwman and Raluca Roman for sharing the SOD data prior to 1994. The FDIC gathers these data through annual surveys of branch office deposits as of June 30.

bank's cash flows, which can allow the bank to fund positive NPV projects regardless of the condition of the economy and therefore is associated with lower financial risk (e.g., Froot, Scharfstein, and Stein 1993; Froot and Stein 1998). On the other hand, more exposure to activities that generate noninterest income may increase bank risk due to increased monitoring complexity or agency problems (e.g., Acharya, Hasan, and Saunders 2006; Stiroh 2006; Stiroh and Rumble 2006; Laeven and Levine 2007). Following Laeven and Levine (2007), we measure diversification of banking activities using *Asset Diversification Ratio,* which is calculated as $1-\left|\frac{\text{Net loans-Other earning assets}}{\text{Total earning assets}}\right|$.[15]

Our next bank-level control is *Overhead Cost Ratio,* which measures a bank's operating cost structure. DeYoung and Roland (2001) show that reliance on noninterest income is associated with an increase in a bank's degree of operating leverage, which transforms revenue volatility into higher earnings volatility. Similarly, Demirgüç-Kunt and Huizinga (2010) find that banks with high overhead costs tend to have higher insolvency risk. Following Demirgüç-Kunt and Huizinga (2010), we measure *Overhead Cost Ratio* as the ratio of total overhead expenses to GTA, where total overhead expenses (RIAD4093) comprise personnel expenses (RIAD4135) and nonpersonnel expenses (RIAD4217 and RIAD4092).

Our last bank-level control is bank internationalization, which we capture using *Foreign Assets Ratio*, following Berger, El Ghoul, Guedhami, and Roman (2017). On the one hand, expansion of banking activities internationally may reduce bank risk because there is greater asset portfolio diversification (e.g., Laeven and Levine 2007). However, internationalization of banking activities can also increase bank risk because of differences in market-specific factors (Berger, El Ghoul, Guedhami, and Roman 2017) and in local cultures (Li and Guisinger 1992), as well as increased monitoring complexity (Berger, DeYoung, Genay, and Udell 2000).

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[15] The main results are robust to replacing *Asset Diversification Ratio* with *Income Diversification Ratio,* which is calculated as $1-\left|\frac{\text{Netinterest income-Other operating income}}{\text{Total operating income}}\right|$.

3.5 Summary Statistics

Table 1 presents variable definitions (Panel A) and summary statistics (Panels B and C). In the first subsample period, U.S. commercial banks have a mean *Ln Z-Score* of 3.0 and *Z-Score* of 26.3, indicating that on average the banks are fairly stable. In the second subsample period after the Riegle-Neal Act, the mean *Ln Z-Score* increases to 3.4 and the *Z-Score* increases to 39.7, which implies that, on average, U.S. banks have become more stable over time. Similarly, the mean *NPL/TL* (*SDROA*) decreases from 2.3% to 1.1% (from 0.8% to 0.6%) in the second subsample period compared to the first subsample period. In terms of loan concentration, the mean *LPC* is relatively stable across the Riegle-Neal Act at approximately 0.3. In contrast, the concentration of CRE loans increases almost two-fold after the Riegle-Neal Act, from 12.2% to 21%. Moreover, the mean banking cost efficiency, *CIR*, increases from 35% to 46.1%.

In terms of bank characteristics, before the Riegle-Neal Act, U.S. banks have a mean size (*Ln GTA*) of $441 million, *Deposit HHI* of 0.08, *Asset Diversification Ratio* of 28.3%, *Overhead Cost Ratio* of 3.3%, and *Foreign Assets Ratio* of 0.08%, about 68% of the banks are part of BHCs, and 6.9% are listed or part of listed BHCs. After the Riegle-Neal Act, U.S. banks have a mean size of $1 billion, *Deposit HHI* of 0.09, *Asset Diversification Ratio* of 54.6%, *Overhead Cost Ratio* of 3.2%, and *Foreign Assets Ratio* of 0.06%, about 79% of the banks are part of BHCs, and 12% are listed or part of listed BHCs. These results imply that after the Riegle-Neal Act, U.S. banks are relatively larger, have more diversified assets, demonstrate slightly better overhead cost management, and participate less in international banking activities. The banking market is also more consolidated, as the number of BHCs has increased and more banks participate in the stock market. However, local market concentration as measured by *Deposit HHI* does not seem to have changed substantially after the Riegle-Neal Act. This finding extends Black and Strahan (2002), who show that local banking markets' HHI remains relatively constant despite geographic deregulation of banking activities over the 1976 to 1994 period. This result is also in line with Dick (2006), who finds no evidence that interstate branching deregulation is associated with a change in HHI at the MSA level.

Turning to the states' economic condition, we find that state-level population density is relatively constant before and after the Riegle-Neal Act with a mean around 134 persons per square miles. We further find that bank risk increases following improvement of a state's economic condition, which we capture with *Ln HPI*. This finding suggests that asset bubbles in housing prices encourages banks to take more risk, betting on riskier real estate loans.

4. Main Empirical Results

4.1. Intrastate Branching and Interstate Banking

To test for the effects of intrastate branching and interstate banking on bank risk, we estimate the following empirical specification over the 1984:Q1 to 1994:Q3 sample period:

$$Risk_{i,j,t-k+1,t} = \alpha + \beta_1 \cdot Intra_{j,t} + \beta_2 \cdot Inter_{j,t} + \beta_3 \cdot Controls_{i,j,t-k} + \gamma_i + \delta_t + \varepsilon_{i,j,t-k+1,t}, \qquad (3)$$

where $i, j,$ and t index bank, state, and time, respectively, *Risk* is (inverse) bank risk as measured by *Ln Z-Score*, *Intra* is an intrastate branching deregulation indicator, *Inter* is an interstate banking deregulation indicator, *Controls* is the vector of control variables as discussed in Section 3.2, γ and δ are bank and time (quarter) fixed effects, respectively,[16] and ε denotes an error term. The risk variables are measured over k quarters from time $t-k+1$ to t, while the control variables are measured at time $t-k$ to ensure that they are predetermined relative to the risk variables.[17] The deregulation indicator variables are measured at time t so that our coefficients of interest, β_1 and β_2, can be interpreted as the treatment effects of a generalized DiD estimation.[18] Since risk variables are likely correlated within a bank over time, we cluster standard errors at the bank level.

Table 2, Panel A presents the results. We find that in all regression specifications except columns (1) and (2), which do not include the vector of control variables, *Intra* is negative and statistically significant at the 1% level. This result suggests that intrastate branching deregulation increased banks' overall risk. In

[16] In a robustness check, we control for state fixed effects instead of bank fixed effects. Our results continue to hold.

[17] Several researchers argue that simultaneity between a dependent variable and an endogenous independent variable can be mitigated by replacing the independent variable with its lagged value. See, for example, Gupta (2005), Duchin, Ozbas, and Sensoy (2010), and Buch, Koch, and Koetter (2013). For the main specification, we use $k = 12$.

[18] Jayaratne and Strahan (1996) drop deregulation-year observations from their DiD specification. In unreported tests we find that our results are robust to conducting this treatment.

contrast, in all of the regression specifications, *Inter* is positive and statistically significant at the 1% level, which suggests that interstate banking deregulation decreased banks' overall risk. In terms of economic importance, the coefficient on *Intra* (*Inter*) indicates that the *Z-score* of banks in states allowing intrastate branching (interstate banking) is 2.96% lower (22.14% higher) than that of banks in states prohibiting intrastate branching (interstate banking), holding all else equal.[19]

Given that intrastate branching increased the market power of local banks while interstate banking deregulation decreased it (Chava, Oettl, Subramanian, and Subramanian 2013), our results above support the *Competition Stability Hypothesis*. However, the coefficient magnitudes suggest that the effect of interstate banking deregulation on bank risk is much more material than that of intrastate branching deregulation. These findings are in line with previous studies such as Rivard and Thomas (1997) and Goetz, Laeven, and Levine (2016), who find BHCs had lower risk following interstate banking deregulation. However, those studies focus only on BHCs, while our study covers all commercial banks—BHCs and non-BHCs, from small banks to large money center banks.

4.2. Interstate Branching

To test for the relation between interstate branching and bank risk, we estimate the following empirical specification over the post–Riegle-Neal Act 1994:Q4 to 2013:Q4 sample period:

$$Risk_{i,j,t-k+1,t} = \alpha + \beta_1 \cdot RSI_{j,t} + \beta_2 \cdot Controls_{i,j,t-k} + \gamma_i + \delta_t + \varepsilon_{i,j,t-k+1,t}, \quad (4)$$

where *RSI* is the interstate branching restrictiveness index based on Rice and Strahan (2010). All control variables and standard error adjustments are as in equation (3). Note that *RSI* is not an indicator variable, and hence equation (4) is not a DiD estimation.

Table 2, Panel B presents the results. We find positive coefficients on *RSI* in all specifications, with the coefficients statistically significant at the 10% level in all specifications except column (1). These results imply that interstate branching deregulation increased banks' overall risk. However, similar to the case of

[19] Halvorsen and Palmquist (1980) show that the coefficient on a dummy variable (β_j) in a semilogarithmic regression equation should be interpreted as the $100(\exp\{\beta_j\} - 1)$ percentage change in Y in response to a discrete change in the dummy from 0 to 1.

intrastate branching deregulation, the effect of interstate branching deregulation on bank risk is much weaker compared to that of interstate banking deregulation. In particular, the magnitude of the coefficient on *RSI* is about 0.006, which means that the *Z-score* of banks in states with no restrictions on intrastate branching (RSI equal to 0) is 2.4% lower than that of banks in states with maximum restrictions (RSI equal to 4), holding all else equal. This finding is consistent with Dick (2006), who documents an increase in loan charge-offs following interstate branching deregulation. However, Dick (2006) does not consider variation in states' provisions related to defense from nationwide branching expansion. Our paper is the first to our knowledge to consider this variation in state provisions using the interstate branching restrictiveness index of Rice and Strahan (2010).

5. Endogeneity

Our main results above may be subject to endogeneity concerns such as reverse causality or omitted variables bias. We address these concerns using several approaches. We discuss each of these concerns and the approaches we employ to address them in turn.

5.1 Instrumental Variables Regression

It is possible that our results above are subject to reverse causality between bank risk and deregulation. For example, a state with relatively risky banks may deregulate to incentivize the banks to reduce their risk by diversifying, in particular, by opening new branches in the state, by acquiring out-of-state banks, or by opening out-of-state branches. Alternatively, a state may choose to postpone deregulation until its banks are financially strong, so they are less susceptible to distress following the deregulation-induced increase in competition. To address this concern, we isolate the exogenous component of bank deregulation using instrumental variables (IV) analysis. In doing so we follow Berger, Klapper, and Turk-Ariss (2009) and use IV with a Generalized Method of Moments (GMM) estimator to mitigate heteroscedasticity problems. Further, as in our regression models above, we cluster standard errors at the bank level.

We construct our instruments based on the deregulation variables of adjoining states.[20] A large strand of literature on state policy diffusion finds that policy adoption in one U.S. state affects policy adoption in adjoining U.S. states, that is, states tend to follow neighboring states in adopting new laws (e.g., Berry and Berry 1990; Mooney 2001; Shipan and Volden 2008; Gillardi 2010).[21] There are at least two reasons a state may follow its adjoining states in adopting a policy. First, adopting a policy that has already been adopted by adjoining states reduces the political risk associated with the policy: if the policy fails, the state's politicians can blame it on systematic factors affecting various states in the region. Second, states in the same region often compete to attract new investment and hence may adopt the same policies as adjoining states to stay competitive. Since our analysis is at the bank level for each state, we do not expect the deregulation of adjoining states to directly affect our dependent variable.

Table 3, Panel A reports the first- and second-stage IV regression estimates for the subsample prior to the Riegle-Neal Act. Since two endogenous variables are estimated in the second stage, namely, *Intra* and *Inter,* we use two instruments in the first stage. The first of these instruments, *Intrastate Branching in Adjoining States,* is calculated as the weighted average of the *Intra* indicator variables of adjoining states, where the weights correspond to a given adjoining state's area. Similarly, the instrument *Interstate Banking in Adjoining States* is the area-weighted average of the *Inter* indicator variables of adjoining states. Columns (2) and (3) of Panel A show that the *F*-statistics for our instruments in the first-stage IV estimation are statistically significant at the 1% level and far above the threshold of 10, which suggests that the instruments are strongly correlated with both of the deregulation variables.[22] Moreover, the Kleibergen-Paap *rk LM* statistics for our instruments reject the null hypothesis at 1% level, which suggests that our IV regression

[20] We follow Berger and Sedunov (2017) to determine the adjoining states of Alaska and Hawaii. Alaska's adjoining states are Hawaii, Oregon, Washington, and California; the adjoining states for Hawaii are Alaska, Oregon, Washington, and California.

[21] For a literature review on state policy diffusion, see, for example, Mooney (2001).

[22] Staiger and Stock (1997) suggest that the problem of weak instruments is less likely if the *F*-statistics for excluded instruments are greater than 10. In (unreported) robustness tests, we also compute Cragg-Donald Wald *F*-statistics, Anderson-Rubin Wald statistics, and Stock-Wright *LM S*-statistics. Almost all of these tests reject the null hypothesis of weak instruments at the 5% level.

is well identified. When we examine the coefficients on our instruments, we find that they are both positive and statistically significant at 1% level, consistent with the state policy diffusion literature. In particular, the results show that a state is more likely to allow intrastate branching or interstate banking activities if its adjoining states have already done so, holding all else equal. In column (4), which reports results from the second-stage IV estimation, we find that the sign and statistical significance of the coefficients on *Intra* and *Inter* are consistent with the OLS results reported in column (1) (i.e., the OLS results from column (6) of Table 2, Panel A).[23]

Panel B of Table 3 reports the IV regression results for the subsample following the Riegle-Neal Act. Similar to *Intra* and *Inter*, we instrument *RSI* with the area-weighted average *RSI* from adjoining states. Column (2) presents results from the first-stage regression. Both the *F*-statistic and Kleibergen-Paap *rk LM* statistic for the instrument are statistically significant at 1% level, which suggests that the instrument is relevant and the IV model is well identified. Further, consistent with the state policy diffusion literature, the coefficient estimate on the instrument is positive and statistically significant at 1% level, which suggests that a state is more likely to relax restrictions on interstate branching by out-of-state banks if its adjoining states have already done so, holding all else equal. In column (3), which reports results of the second-stage regression, we do not find significant evidence that interstate branching is associated with bank risk. This result is consistent with our finding from the OLS model.

5.2 Contiguous-County Matching

Another potential source of endogeneity is omitted variable bias. To address this concern, we first control for state- and bank-specific variables that prior literature shows can affect bank risk as discussed in Section 3.4. We also follow Huang (2008) and run OLS regressions on contiguous-county matching (CCM) samples. In particular, we run OLS regressions of equations (3) and (4) on the subsample of banks that are

[23] Finding larger coefficient estimates from the IV regression than from the OLS regression is consistent with, for example, Levitt (1996) and Berger, El Ghoul, Guedhami, and Roman (2017).

located in contiguous counties separated by state borders.[24] As contiguous counties are more likely to have similar characteristics, this approach helps address bias from factors that we cannot observe.

The results are reported in Panel C of Table 3. Looking first at the pre–Riegle-Neal Act period, we find that the coefficient on *Inter* is positive and statistically significant at the 1% level, which is consistent with the OLS and IV results above. The magnitude of the coefficient on *Inter* is about 0.15, which is economically material. In contrast, the coefficient on *Intra* is not statistically significant. Turning to the post–Riegle-Neal Act period, the coefficient on *RSI* is also statistically insignificant, consistent with the results of the previous endogeneity tests.

Since our OLS results show negligible evidence that interstate branching affects bank risk, and no significant evidence of this relation using IV or CCM, in the remaining analyses we focus attention on intrastate branching and interstate banking deregulation.

5.3 Placebo Regression

We next conduct placebo (falsification) tests on the impact of intrastate branching and interstate banking deregulation on bank risk. This analysis checks the internal validity of our research design, that is, whether our main analysis based on equation (3) does indeed capture the effect of intrastate branching and interstate banking deregulation on bank risk.

We start by generating 500 random sets of intrastate branching and interstate banking deregulation years for each state using a uniform distribution. The random years generated for intrastate branching are between 1970, the earliest year in which intrastate branching was permitted, and 1999, the latest year in which intrastate branching was permitted, where we follow Kroszner and Strahan (1999) and Francis, Hasan, and Wang (2014) and use 1970 as the year in which intrastate branching was permitted if a state deregulated intrastate branching before 1970. The random years generated for interstate banking are between 1978, the earliest year in which interstate banking was permitted, and 1997, the latest year in which interstate banking was permitted. We then run 500 OLS regressions using equation (3), with standard errors

[24] County adjacency data are available at https://www.census.gov/geo/reference/county-adjacency.html.

clustered at the bank level using the *Intra* and *Inter* generated using the random deregulation years. Finally, we calculate the mean of the *Intra* and *Inter* coefficient estimates from the 500 placebo regressions and test whether they are significantly different from zero.

The results, which are reported in Panel D of Table 3, show that the mean *Intra* and *Inter* coefficient estimates from the placebo regressions are statistically insignificant. This finding suggests that our main research design is not likely to suffer from weak internal validity.

6. Additional Robustness Tests

6.1. Alternative Measures of Bank Risk

In our first set of additional robustness tests, we employ six alternative measures of risk. First, we use *Ln Sharpe* ratio, which measures risk-adjusted return, calculated as μ(*ROE*)/σ(*ROE*). Second, we use the standard deviation of bank ROE (*SDROE*), which measures bank profit's volatility. Third, we use the standard deviation of ROA (*SDROA)*, an alternative measure of bank profit's volatility. Fourth, we use the ratio of bank total equity to GTA (*EQTA*), which measures bank capitalization. A higher value of *SDROE* or *SDROA* implies greater risk. Fifth, we use a bank's loan portfolio concentration (*LPC*). Following Demsetz and Strahan (1997), we calculate *LPC* as $\sum_{n=1}^{5} LS_{nit}^2$, where LS_{nit} is bank i's ratio of category-n loans to total loans at time t. The five loan categories include commercial and industrial loans, personal loans, commercial real estate loans, residential real estate loans, and other loans. A more concentrated loan portfolio, that is, a higher *LPC* value, indicates greater bank risk. Finally, we consider a bank's ratio of nonperforming loans to total loans (*NPL/TL*). This measure captures a bank's credit risk.[25] Greater credit risk indicates greater insolvency risk.

The results are reported in Panel Z1 of the Online Appendix to save space. To facilitate comparison, column (1) repeats our main results using *Ln Z-Score* as the risk measure (i.e., column (6) from Table 2, Panel A). We find that interstate banking deregulation is associated with higher *Ln Sharpe,* lower *SDROE*,

[25] Nonperforming loans are loans that are past due 90 days or more or that are in nonaccrual status (RCFD1403 + RCFD1407).

lower *SDROA*, higher *EQTA*, lower *LPC*, and lower *NPL*/*TL*, while intrastate branching deregulation is associated with higher *SDROE*, higher *SDROA*, and lower *EQTA*. These results are consistent with our main findings.

6.2. Other Robustness Checks

Panel Z2 of the Online Appendix reports results of additional robustness tests. In column (1), we re-run our main regression after excluding banks in South Dakota and Delaware because in the 1980s these states passed unique usury laws that resulted in a significant presence of credit card banks in their banking systems (Jayaratne and Strahan 1996; Black and Strahan 2002; Beck, Levine, and Levkov 2010; Subramanian and Yadav 2012; Francis, Haan, and Wang 2014; Goetz, Laeven, and Levine 2016). In columns (2) to (3), we exclude large banks that are too-big-to-fail (TBTF) using two definitions, 1) the Dodd-Frank Act's threshold of total assets larger than $50 billion, and 2) banks that are subject to the Supervisory Capital Assessment Program (SCAP) and Comprehensive Capital Analysis and Review (CCAR), respectively. In column (4), we re-run our main analysis using a block bootstrap technique to address concerns about inconsistent standard errors from a DiD regression, as suggested by Bertrand, Duflo, and Mullainathan (2004);[26] to account for possible serial correlation in the data, we use bank-level blocks (clusters). The results for these specifications are consistent with our main findings. In particular, interstate banking deregulation is associated with a higher *Ln Z-Score*, while intrastate branching deregulation is associated with a lower *Ln Z-Score*.

Another concern with our main results is that they may be affected by entry and exit dynamics during our sample period. In particular, it could be the case that after bank deregulation, bad banks are acquired by good banks, which would leave the industry with relatively more stable banks. Indeed, Stiroh and Strahan (2003) show that after intrastate branching and interstate banking deregulation, there is a substantial reallocation of market share toward better banks. We address this concern in column (5) by excluding banks that exist during only part of our sample period, that is, by restricting the analysis to banks

[26] Following Bertrand Duflo, and Mullainathan (2004), the bootstrap resampling process uses 400 repetitions.

that are operational throughout our main sample period.[27] Next, in column (6) we re-run our main analysis with standard errors two-way clustered at the bank and quarter levels to test whether potential heteroskedasticity in smaller clusters affects our main results. Finally, in column (7), we conduct our analysis at the BHC level instead of the bank level. The results in columns (5) to (7) consistently show that interstate banking deregulation is positively associated with *Ln Z-Score*, while the coefficient on intrastate branching deregulation becomes statistically insignificant.

7. Additional Tests: Cross-Sectional Heterogeneity

7.1. Results based on State Population Density

Bank deregulation that allows banks to expand into new markets may enable them to access lower-cost funds, increase investment opportunities, and improve productive efficiency. Indeed, previous literature shows that banks observe diversification benefits when they expand their markets geographically (e.g., Akhigbe and Whyte 2003; Deng and Elyasiani 2008; Goetz, Laeven, and Levine 2016). Because intrastate branching deregulation enables banks to expand their deposit base and diversify their loan portfolio within the state, we expect the benefit of this type of deregulation to be more pronounced for states with a relatively dense population. In contrast, we expect the benefit of interstate banking deregulation to be more pronounced for states in which the population is sparse and banks have less opportunity to diversify geographically within the state.

Table 4 reports regression estimates based on state population density. We classify a state as sparsely populated if its population density is below the 25th percentile, as fairly populated if its population density is between the 25th and 75th percentiles, and as densely populated if its population density is above the 75th percentile. In line with our predictions, the results show that intrastate branching deregulation is associated with a higher *Ln Z-Score* for banks in densely populated states and a lower *Ln Z-Score* for banks

[27] In these regressions we exclude banks that enter or exit the industry during the sample period because such changes could be caused by M&A activities or bank defaults.

in fairly and sparsely populated states, while interstate banking deregulation is associated with a higher *Ln Z-Score* for banks in sparsely and fairly populated states.

7.2. Results based on Bank Size

Table 5 reports results on the impact of intrastate branching and interstate banking deregulation on bank risk based on bank size. Following Berger and Bouwman (2013), we define small, medium, and large banks as commercial banks with real GTA up to $1 billion, between $1 billion and $3 billion, and greater than $3 billion, respectively. The results show that the positive impact of interstate banking deregulation on *Ln Z-Score* is driven by small banks. This finding differs from previous literature that attributes the positive effect of interstate banking deregulation on bank stability to large banks, due to these banks' ability to take advantage of interstate diversification. The results further show that the positive effect of intrastate branching deregulation is driven by large banks. Indeed, we find that intrastate branching deregulation has a negative effect on small and medium-sized banks. These results imply that banks in different size groups respond differently to the deregulation.

In Table 6, we examine the relations between *Ln Z-score* and intrastate branching and interstate banking deregulation using a subsample of small banks that are unit banks, that is, that are not part of a BHC, between 1984:Q1 to 1994:Q3. We expect these banks to have less ability to take advantage of the diversification benefits of deregulation, and hence any positive impact of intrastate branching and interstate banking deregulation on these banks is likely to be due to improved efficiency induced by the resulting increase in competition (i.e., *Competition Stability Hypothesis*). The results in Panel A support this conjecture. The results in Panels B and C show that those in Panel A are driven by "strong" small unit banks.[28] In contrast, "weak" small unit banks become riskier following deregulation. These results suggest that the increase in competition due to geographic bank deregulation induces strong small banks to improve

[28] We define "weak" small unit banks as small unit banks that are included on the FDIC list of failed banks at some point over the full sample period, while "strong" small unit banks are small unit banks not included on this list over the sample period.

even more, which decreases their risk, but kills the weak small banks, in line with the creative destruction argument of Schumpeter (1942, pp. 81-86).

8. Conclusion

There has been a long-standing debate among economists, regulators, and politicians about the impact of geographic deregulation on bank risk. Deregulation allows banks to diversify their assets and extend their depositor base. It also increases competition in local markets. The literature shows that an increase in either diversification or competition has an ambiguous impact on bank risk. Therefore, whether bank deregulation increases or reduces risk is an open empirical question.

In this paper, we examine the impact of geographic bank deregulation on bank risk. Specifically, we study three types of geographic bank deregulation in the U.S. over last three decades—intrastate branching, interstate banking, and interstate branching. The different types of deregulation and the differential timing of deregulation events across U.S. states provides a unique empirical setting to test the impact of competition and diversification on bank risk.

We find that, on average, interstate banking deregulation is associated with about a 22% increase in *Z-score*, an inverse indicator of overall bank risk, while we find no evidence that interstate branching deregulation affects bank risk. In terms of intrastate branching, we find some evidence that this deregulation is associated with an increase in bank risk. These findings are robust to a variety of sensitivity checks, including those for endogeneity and sample selection bias, as well as to using alternative risk measures. We further find that interstate banking deregulation is associated with risk reduction in sparsely populated states but not in densely populated states. The threat of acquisition by an out-of-state bank increases the incentives of small banks, which dominate sparsely populated states, to operate more efficiently, which reduces risk. In contrast, in densely populated states that have more large banks, this takeover threat is less effective because acquiring large banks is costlier than small banks. Different than previous studies that focus on large banks and BHCs, our findings show that the favorable impact of interstate banking deregulation on bank risk is driven by small banks, which opposed such deregulation due to fears that an increase in competition from large banks would reduce their survival probability. Moreover, we find that strong small banks have lower risk following interstate banking deregulation, while weak small banks become riskier. With respect to intrastate branching deregulation, we find that it is associated with higher risk for small and medium banks but lower risk for large banks. Taken together, these findings suggest that the *Competition Stability Hypothesis* dominates for small and medium banks, while the *Diversification Stability Hypothesis* dominates for large banks.

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Table 1**: Variable Definitions and Summary Statistics**

Panel A presents definitions for all variables used in our analyses. **Panel B** reports summary statistics for all U.S. commercial banks before the Riegle-Neal Act (1984:Q1 to 1994:Q3). **Panel C** reports summary statistics for all U.S. commercial banks after the Riegle-Neal Act (1994:Q4 to 2013:Q4). We use 1994:Q4 as the start of the latter sample period as the Riegle-Neal Act was signed into law on September 29, 1994. All variables in dollar amounts are expressed in real terms using the 2010:Q4 implicit GDP price deflator. All financial ratios are winsorized at the top and bottom 1% of the distribution.

Panel A**: Variable Definitions**

Variable	Definition
Bank Risk Measures:	
Ln Z-Score	The main measure of bank risk calculated as $\ln(1+\lvert\min(Z\text{-}Score)\rvert+Z\text{-}Score)$. The *Z-Score* is calculated as $\left(\mu(ROA)+\mu\left(\frac{Equity}{GTA}\right)\right)/\sigma(ROA)$. A lower value indicates a higher financial risk. The mean (μ) and standard deviation (σ) are calculated over 12 quarters from time $t-11$ to time t. *Return on Assets* (ROA) is defined as the ratio of net income to *Gross Total Assets (GTA)*. GTA is defined as total assets + allowance for loan and lease losses + allocated transfer risk reserves.
Ln Sharpe	An alternative measure of bank risk calculated as $\ln(1+\lvert\min(Sharpe\ Ratio)\rvert+Sharpe\ Ratio)$. The *Sharpe Ratio* is defined as $\mu(ROE)/\sigma(ROE)$. ROE is defined as the ratio of net income to total equity. A lower value indicates a worse risk-adjusted return. The mean (μ) and standard deviation (σ) are calculated over 12 quarters from time $t-11$ to t.
SDROE	A measure of bank profit's volatility, defined as the standard deviation of *Return on Equity* (ROE). *ROE* is calculated as the ratio of net income to total equity. A higher value is associated with higher bank risk. This measure is calculated over 12 quarters from time $t-11$ to time t.
SDROA	A measure of bank profit's volatility, defined as the standard deviation of ROA. A higher value is associated with higher bank risk. This measure is calculated over 12 quarters from time $t-11$ to time t.
EQTA	A measure of bank capitalization that is calculated as *Total Equity/GTA*. This measure is averaged over 12 quarters from time $t-11$ to t.
LPC	A measure of bank loan portfolio concentration that is calculated as $\sum_{n=1}^{5} LS_{nit}^2$, following Demsetz and Strahan (1997). This measure lies between 0 and 1, where higher number shows higher concentration (lower diversification) in a bank's loans portfolio. LS_{nit} is the ratio of loan category n of bank i at time t to total loans. There are five loan categories (n) included, i.e. commercial and industrial loans, personal loans, commercial real estate loans, residential real estate loans, and other loans. This measure is averaged over 12 quarters from time $t-11$ to t.
NPL/TL	A measure of credit risk defined as the mean of nonperforming loans (past due at least 90 days or in nonaccrual status) to total loans. A higher value indicates a riskier loan portfolio. This measure is averaged over 12 quarters from time $t-11$ to t.

(Continued)

Table 1**: Variable Definitions and Summary Statistics**

Panel A**: Variable Definitions**

Variable	Definition
Bank Deregulation:	
Intrastate Branching (Intra)	An indicator variable equal to 1 if a state allows statewide branching via mergers and acquisitions in a given year and 0 otherwise. The timing of intrastate branching deregulation events comes from Amel (1993) and Kroszner and Strahan (1999).
Interstate Banking (Inter)	An indicator variable equal to 1 if a state allows bank acquisition by out-of-state banks and 0 otherwise. The timing of interstate banking deregulation events comes from Amel (1993) and Kroszner and Strahan (1999).
Interstate Branching (RSI)	An index measuring the degree of interstate branching restrictions by a state that ranges from 0 (no restriction) to 4 (fully restricted), based on Rice and Strahan (2010). This index is a sum of indicator variables on *Minimum Age Restriction*, *De Novo Branching Restriction*, *Branch Acquisition Restriction*, and *Deposit Cap Restriction* as explained below. We update the data using the Profile of State-Chartered Banking (PSCB) and State Banking Laws. If there is any difference on interstate branching restriction between the PSCB and Rice and Strahan (2010), we follow Rice and Strahan.
Minimum Age Restriction	An indicator variable equal to 1 if a state imposes a minimum age of 3 or more years on target banks of interstate acquirers and 0 otherwise, following Rice and Strahan (2010).
De Novo Branching Restriction	An indicator variable equal to 1 if a state does not permit de novo interstate branching and 0 otherwise, following Rice and Strahan (2010).
Branch Acquisition Restriction	An indicator variable equal to 1 if a state does not permit the acquisition of individual branches or portions of banks by an out-of-state bank and 0 otherwise, following Rice and Strahan (2010).
Deposit Cap Restriction	An indicator variable equal to 1 if a state imposes a deposit cap of less than 30% and 0 otherwise, following Rice and Strahan (2010).
Control Variables:	
Ln Gross Total Assets (GTA)	A measure of bank size calculated as the natural logarithm of gross total assets *(*GTA*)*.
Population Density	A measure of a state population density that is calculated as the state's total population (in 1,000 persons) divided by the state's area (in square miles).
Ln Housing Price Index	The natural log of a state's Housing Price Index. The index is available from the Federal Housing Finance Agency's website. Following Klarner (2013), we divide the index by 100.
BHC	An indicator variable equal to 1 if the bank is part of a bank holding company and 0 otherwise.
Listed	An indicator variable equal to 1 if the bank is listed on a stock exchange or is part of a BHC that is listed on a stock exchange and 0 otherwise.
Asset Diversification Ratio	A measure of diversification across different types of earning assets, calculated as $1-\left\|\frac{\text{Net loans-Other earning assets}}{\text{Total earning assets}}\right\|$, following Laeven and Levine (2007). This measure takes values between 0 and 1, with higher values indicating greater diversification.

(Continued)

Table 1**: Variable Definitions and Summary Statistics**

Panel A**: Variable Definitions**

Variable	Definition
Overhead Costs Ratio	A measure of bank overhead cost structure calculated as the ratio of overhead expenses to GTA.
Foreign Assets Ratio	A measure of bank internationalization defined as the ratio of a bank's foreign total assets to GTA, following Berger, El Ghoul, Guedhami, and Roman (2016); a higher value indicates a larger degree of internationalization whereas a ratio of 0 refers to purely domestic banks.
Deposit HHI	The Herfindahl-Hirschman Index (HHI) of bank deposits, which measures the degree of concentration of commercial banks at the local market level. This measure is defined as the weighted average HHI in the MSA/NECMA/county in which the bank operates. The MSA/NECMA/county-level HHI is calculated as the sum of squared market share of deposits for all commercial banks in the MSA/NECMA/county.

Panel B**: Summary Statistics Pre–Riegle-Neal Act (1984:Q1-1994:Q3)**

	N	Mean	St. Dev	Skewness	P25	P50	P75
Bank Risk Measures:							
Ln Z-Score	303,207	3.003	0.873	-0.389	2.448	3.102	3.634
Z-Score	303,207	26.349	22.937	1.687	9.754	20.420	36.048
Ln Sharpe	303,212	1.356	0.611	0.085	0.914	1.357	1.784
Sharpe	303,212	2.928	3.053	1.601	0.741	2.130	4.203
SDROE (%)	303,212	13.196	23.624	3.879	3.094	5.445	11.369
SDROA(%)	303,207	0.840	1.017	2.865	0.270	0.473	0.941
EQTA (%)	303,207	8.621	2.634	1.863	6.944	8.080	9.682
LPC	303,099	0.310	0.092	1.961	0.249	0.282	0.340
NPL/TL (%)	303,099	2.278	2.032	1.621	0.856	1.643	3.023
Bank Deregulation:							
Intrastate Branching	303,207	0.776	0.417	-1.323	1	1	1
Interstate Banking	303,207	0.908	0.289	-2.818	1	1	1
Control Variables:							
Ln Gross Total Assets (Ln GTA)	303,207	11.512	1.101	1.831	10.749	11.290	11.959
Gross Total Assets (GTA), in billion $	303,207	0.441	4.301	34.629	0.047	0.080	0.156
Population Density (1,000 persons/sq. miles)	303,207	0.134	0.412	20.209	0.049	0.074	0.168
Ln Housing Price Index (Ln HPI)	303,207	0.271	0.203	1.499	0.144	0.236	0.356
Housing Price Index (HPI)	303,207	1.342	0.324	2.439	1.155	1.266	1.428
Bank Holding Company (BHC)	303,207	0.680	0.467	-0.771	0	1	1

(Continued)

Table 1**: Variable Definitions and Summary Statistics**

Panel B**: Summary Statistics Pre–Riegle-Neal Act (1984:Q1-1994:Q3)**

	N	Mean	St. Dev	Skewness	P25	P50	P75
Listed	303,207	0.069	0.254	3.388	0	0	0
Assets Diversification Ratio (%)	303,207	28.329	21.743	1.037	11.881	23.310	39.728
Overhead Cost Ratio (%)	303,207	3.268	1.262	2.024	2.467	3.030	3.773
Foreign Assets Ratio (%)	303,207	0.075	0.594	8.098	0.000	0.000	0.000
Deposit HHI	303,207	0.080	0.080	1.671	0.018	0.051	0.118

Panel C**: Summary Statistics Post–Riegle-Neal Act (1994:Q4-2013:Q4)**

	N	Mean	St. Dev	Skewness	P25	P50	P75
Bank Risk Measures:							
Ln Z-Score	519,817	3.447	0.804	-0.575	2.971	3.532	4.018
Z-Score	519,817	39.676	29.898	1.284	17.700	32.384	53.765
Ln Sharpe	519,840	1.576	0.618	-0.243	1.175	1.608	2.013
Sharpe	519,840	4.040	3.503	1.203	1.485	3.240	5.730
SDROE (%)	519,840	6.770	12.859	6.600	2.096	3.481	6.317
SDROA (%)	519,817	0.590	0.798	4.018	0.205	0.338	0.618
EQTA (%)	519,829	10.214	3.161	2.018	8.165	9.431	11.360
LPC	519,411	0.320	0.094	1.918	0.256	0.293	0.353
NPL/TL (%)	519,363	1.167	1.303	2.772	0.360	0.772	1.482
Bank Deregulation:							
Interstate Branching (RS index)	519,817	2.456	1.470	-0.481	1	3	4
Control Variables:							
Ln Gross Total Assets (Ln GTA)	519,817	11.791	1.189	1.714	10.966	11.585	12.327
Gross Total Assets (GTA), in billion $	519,817	1.019	19.267	55.838	0.058	0.107	0.226
Population Density (1,000 persons/sq. miles)	519,817	0.134	0.275	24.111	0.052	0.083	0.189
Ln Housing Price Index (Ln HPI)	519,817	0.781	0.333	0.487	0.544	0.757	0.988
Housing Price Index (HPI)	519,817	2.315	0.863	1.700	1.722	2.131	2.686
Bank Holding Company	519,817	0.791	0.407	-1.432	1	1	1
Listed	519,817	0.119	0.323	2.358	0	0	0

(Continued)

Table 1**: Variable Definitions and Summary Statistics**

Panel C**: Summary Statistics Post–Riegle-Neal Act (1994:Q4-2013:Q4)**

	N	Mean	St. Dev	Skewness	P25	P50	P75
Assets Diversification Ratio (%)	519,817	54.577	26.340	-0.186	34.815	55.731	76.120
Overhead Cost Ratio (%)	519,817	3.212	1.282	2.710	2.476	2.990	3.626
Foreign Assets Ratio (%)	519,817	0.061	0.531	9.054	0.000	0.000	0.000
Deposit HHI	519,817	0.085	0.075	1.803	0.023	0.069	0.121

Table 2**: Main Regression Analysis**

This table reports our main OLS results. **Panel A** reports evidence on the impact of intrastate branching and interstate banking deregulation on bank risk prior to the Riegle-Neal Act (1984:Q1 to 1994:Q3). **Panel B** reports evidence on the impact of interstate branching deregulation on bank risk following the Riegle-Neal Act (1994:Q4 to 2013:Q4). The dependent variable in all panels is *Ln Z-Score*, an inverse measure of bank risk; a higher value indicates lower overall bank risk. The main explanatory variables in Panel A are *Intra* (indicator variable equal to 1 if a state allows statewide branching via mergers and acquisitions and 0 otherwise) and *Inter* (an indicator variable equal to 1 if a state allows bank acquisition by out-of-state banks and 0 otherwise). The main explanatory variable in Panel B is *RSI*, an index measuring the degree of interstate branching restrictions by a state that ranges from 0 (no restriction) to 4 (fully restricted), based on Rice and Strahan (2010). All regressions include bank and time (quarter) fixed effects (FE). All right-hand-side control variables are lagged 12 quarters. All financial variables in dollar amounts are expressed in real terms using the 2010:Q4 implicit GDP price deflator. All financial ratios are winsorized at top and bottom 1% of the distribution. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. Standard errors are clustered at the bank level. Numbers in parentheses are *t*-statistics.

Panel A**: Intrastate Branching, Interstate Banking, and Bank Risk**

	Dependent Variable: *Ln Z-Score*					
	(1)	(2)	(3)	(4)	(5)	(6)
Intrastate Branching (Intra)	-0.003		-0.030***	-0.031***	-0.032***	-0.032***
	(-0.293)		(-2.810)	(-2.826)	(-2.982)	(-2.939)
Interstate Banking (Inter)		0.292***	0.201***	0.200***	0.200***	0.201***
		(19.355)	(13.513)	(13.437)	(13.476)	(13.566)
Ln Gross Total Assets (Ln GTA)			0.435*	0.391	0.347	0.350
			(1.719)	(1.543)	(1.351)	(1.369)
Ln GTA Squared			-0.034***	-0.032***	-0.031***	-0.031***
			(-3.056)	(-2.880)	(-2.735)	(-2.780)
Inflection point of *Ln GTA*			6.397	6.109	5.597	5.645
Population Density			0.115	0.106	0.126	0.132
			(0.227)	(0.209)	(0.251)	(0.263)
Ln Housing Price Index (Ln HPI)			-0.533***	-0.531***	-0.484***	-0.470***
			(-11.242)	(-11.171)	(-10.120)	(-9.850)
BHC				0.016	0.022	0.021
				(1.131)	(1.499)	(1.485)
Listed				-0.038**	-0.036**	-0.035**
				(-2.167)	(-2.013)	(-1.973)
Asset Diversification Ratio					0.002***	0.002***
					(13.681)	(13.624)
Overhead Cost Ratio					-0.018***	-0.018***
					(-5.000)	(-5.014)
Foreign Assets Ratio					0.035*	0.035*
					(1.943)	(1.940)
HHI of Deposits						1.307***
						(2.898)
HHI of Deposits Squared						-3.404***
						(-2.623)
Inflection point of *HHI*						0.192

(Continued)

Table 2**: Main Regression Analysis**

Panel A**: Intrastate Branching, Interstate Banking, and Bank Risk**

	Dependent Variable: *Ln Z-Score*					
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	2.814***	2.589***	2.215	2.459*	2.789*	2.736*
	(353.420)	(193.582)	(1.535)	(1.700)	(1.903)	(1.870)
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Time (Quarter) FE	Yes	Yes	Yes	Yes	Yes	Yes
N	304,133	304,133	304,129	304,129	303,777	303,207
N-cluster	13,021	13,021	13,020	13,020	12,994	12,987
R-squared	0.701	0.705	0.715	0.716	0.717	0.717

Panel B**: Interstate Branching and Bank Risk**

	Dependent Variable: *Ln Z-Score*				
	(1)	(2)	(3)	(4)	(5)
Interstate Branching (RSI)	0.003	0.007*	0.007*	0.006*	0.006*
	(0.792)	(1.855)	(1.827)	(1.654)	(1.669)
Ln Gross Total Assets (Ln GTA)		0.477***	0.485***	0.388***	0.380***
		(4.581)	(4.606)	(3.711)	(3.633)
Ln GTA Squared		-0.022***	-0.022***	-0.020***	-0.019***
		(-5.117)	(-5.173)	(-4.663)	(-4.602)
Inflection point of *Ln GTA*		10.841	11.023	9.700	10.000
Population Density		-0.073	-0.073	-0.074	-0.074
		(-1.247)	(-1.266)	(-1.287)	(-1.283)
Ln Housing Price Index (Ln HPI)		-0.272***	-0.274***	-0.295***	-0.299***
		(-5.310)	(-5.337)	(-5.817)	(-5.892)
BHC			-0.016	-0.009	-0.009
			(-0.988)	(-0.575)	(-0.574)
Listed			0.093***	0.092***	0.092***
			(2.705)	(2.746)	(2.750)
Asset Diversification Ratio				0.001***	0.001***
				(8.589)	(8.592)
Overhead Cost Ratio				-0.061***	-0.061***
				(-16.510)	(-16.376)
Foreign Assets Ratio				-0.013	-0.012
				(-0.740)	(-0.708)
Deposit HHI					0.370
					(1.635)
Deposit HHI Squared					-1.142*
					(-1.827)
Inflection point of *HHI*					0.162
Constant	3.322***	0.817	0.791	1.759***	1.801***
	(190.031)	(1.278)	(1.226)	(2.713)	(2.773)
Bank FE	Yes	Yes	Yes	Yes	Yes
Time (Quarter) FE	Yes	Yes	Yes	Yes	Yes
N	520,669	520,667	520,667	520,110	519,817
N-cluster	11,983	11,983	11,983	11,974	11,964
R-squared	0.536	0.538	0.538	0.542	0.542

Table 3**: Endogeneity Tests**

This table reports results of endogeneity checks on the impact of bank deregulation on bank risk. The dependent variable in all panels is *Ln Z-Score*, an inverse measure of bank risk; a higher value indicates lower overall bank risk. **Panel A** reports IV regression estimates of the impact of intrastate branching and interstate banking deregulation on bank risk prior to the Riegle-Neal Act (1984:Q1 to 1994:Q3). The main explanatory variables are *Intra* (an indicator variable equal to 1 if a state allows statewide branching via mergers and acquisitions and 0 otherwise) and *Inter* (an indicator variable equal to 1 if a state allows bank acquisition by out-of-state banks and 0 otherwise). The instruments in Panel A are *Intrastate Branching of Adjoining States* and *Interstate Banking of Adjoining States*, which are weight-averaged by the adjoining states' areas. **Panel B** reports IV regression estimates of the impact of interstate branching deregulation on bank risk following the Riegle-Neal Act (1994:Q4 to 2013:Q4). The main explanatory variable in Panel B is *Interstate Branching Index* (RSI), which measures the degree of interstate branching restrictions by a state and ranges from 0 (no restriction) to 4 (fully restricted), based on Rice and Strahan (2010). The instrument in Panel B is *Interstate Branching Index (RSI) of Adjoining States*, is weight-averaged by the adjoining states' areas. **Panel C** presents OLS regression estimates using banks headquartered in contiguous counties separated by state borders, closely following Huang (2008). Column (1) reports results for the pre–Riegle-Neal Act period (1984:Q1 to 1994:Q3), and column (2) reports results for the post–Riegle-Neal Act period (1994:Q4 to 2013:Q4). **Panel D** reports Placebo regression results on the impact of intrastate branching and interstate banking on bank risk from 1984:Q1 to 1994:Q3. Details on the placebo test are provided in Section 5.3. All regressions include bank and time (quarter) fixed effects (FE). All right-hand-side control variables are lagged 12 quarters. Nonfinancial controls include *Population Density*, *Ln HPI*, *BHC*, *Listed*, *Deposit HHI*, and *Deposit HHI Squared*. Financial controls include *Ln GTA*, *Ln GTA Squared*, *Asset Diversification Ratio*, *Overhead Cost Ratio*, and *Foreign Assets Ratio*. All financial variables in dollar amounts are expressed in real terms using the 2010:Q4 implicit GDP price deflator. All financial ratios are winsorized at the top and bottom 1% of the distribution. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. Standard errors are clustered at the bank level. Numbers in parentheses are *t*-statistics.

(Continued)

Table 3: **Endogeneity Tests**

Panel A**: IV Regression—Intrastate Branching, Interstate Banking, and Bank Risk**

	Ln Z-Score	*Intrastate Branching*	*Interstate Banking*	*Ln Z-Score*
	OLS (Baseline)	IV GMM 1st stage		IV GMM 2nd stage
	(1)	(2)	(3)	(4)
Intrastate Branching (Intra)	-0.032***			-0.276***
	(-2.939)			(-5.178)
Interstate Banking (Inter)	0.201***			0.653***
	(13.566)			(5.797)
Intrastate Branching of Adjoining States		0.017***	0.183***	
		(2.678)	(22.17)	
Interstate Banking of Adjoining States		0.429***	0.0480***	
		(34.40)	(6.317)	
Nonfinancial controls	Yes	Yes	Yes	Yes
Financial controls	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes
Time (Quarter) FE	Yes	Yes	Yes	Yes
N	303,207	302,905	302,905	302,905
N-cluster	12,987	12,685	12,685	12,685
R-squared (centered)	0.111	0.375	0.199	0.061
F-statistic for excluded instruments		670.25***	263.36***	
Kleibergen-Paap *rk LM* statistic		489.97***		

(Continued)

Table 3**: Endogeneity Tests**

Panel B**: IV Regression—Interstate Branching and Bank Risk**

	Ln Z-Score	*Interstate Branching (RSI)*	*Ln Z-Score*
	OLS (Baseline)	IV GMM 1st stage	IV GMM 2nd stage
	(1)	(2)	(3)
Interstate Branching (RSI)	0.006*		-0.0323
	(1.669)		(-1.271)
Interstate Branching (RSI) of Adjoining States		0.276***	
		(26.18)	
Nonfinancial controls	Yes	Yes	Yes
Financial controls	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes
Time (Quarter) FE	Yes	Yes	Yes
N	519,817	509,276	509,276
N-cluster	11,964	11,581	11,581
R-squared (centered)	0.116	0.474	0.114
F-statistic for excluded instruments		685.25***	
Kleibergen-Paap *rk LM* statistic		701.04***	

(Continued)

Table 3**: Endogeneity Tests**

Panel C**: Contiguous-County Matching**

	Dependent Variable: *Ln Z-Score*	
	Pre–Riegle-Neal Act (1984:Q1-1994:Q3)	Post–Riegle-Neal Act 1994:Q4-2013:Q4
	(1)	(2)
Intrastate Branching (Intra)	0.011	
	(0.602)	
Interstate Banking (Inter)	0.148***	
	(6.277)	
Interstate Branching (RSI)		-0.002
		(-0.266)
Nonfinancial controls	Yes	Yes
Financial controls	Yes	Yes
Bank FE	Yes	Yes
Time (Quarter) FE	Yes	Yes
N	112,662	191,305
N-cluster	4,678	4,534
R-squared	0.688	0.542

Panel D**: Placebo Regressions**

	The Average Regression Coefficients of *Ln Z-Score on:*
	(1)
Placebo Intrastate Branching (Intra)	0.006
	(1.488)
Placebo Interstate Banking (Inter)	-0.005
	(-1.437)
Nonfinancial controls	Yes
Financial controls	Yes
Bank FE	Yes
Time (Quarter) FE	Yes
Average N	303,207
Average N-cluster	12,987
Average R-squared	0.716

Table 4**: Regression Results based on State Population Density Grouping**

This table reports results on the impact of intrastate branching and interstate banking deregulation on bank risk between 1984:Q1 to 1994:Q3 based on state population density grouping. A state is defined as sparsely populated if its population density is below the 25th percentile, as fairly populated if its population density is between the 25th and 75th percentiles, and as densely populated if its population density is above the 75th percentile. The dependent variable in all panels is *Ln Z-Score,* an inverse measure of bank risk; a higher value indicates lower bank overall risk. All regressions include bank and time (quarter) fixed effects (FE). All right-hand-side control variables are lagged 12 quarters. Nonfinancial controls include *Population Density, Ln HPI*, *BHC, Listed*, *Deposit HHI*, and *Deposit HHI Squared*. Financial controls include *Ln GTA*, *Ln GTA Squared*, *Asset Diversification Ratio, Overhead Cost Ratio,* and *Foreign Assets Ratio.* All financial variables in dollar amounts are expressed in real terms using the 2010:Q4 implicit GDP price deflator. All financial ratios are winsorized at the top and bottom 1% of the distribution. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. Standard errors are clustered at the bank level. Numbers in parentheses are *t*-statistics.

	Dependent Variable: *Ln Z-Score*			
	Baseline	Sparsely Populated States	Fairly Populated States	Densely Populated States
	(1)	(2)	(3)	(4)
Intrastate Branching (Intra)	-0.032***	-0.183***	-0.052***	0.096***
	(-2.939)	(-7.298)	(-3.825)	(3.875)
Interstate Banking (Inter)	0.201***	0.047**	0.191***	0.119
	(13.566)	(2.269)	(7.842)	(0.908)
Nonfinancial controls	Yes	Yes	Yes	Yes
Financial controls	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes
Time (Quarter) FE	Yes	Yes	Yes	Yes
N	303,207	64,207	158,455	80,545
N-cluster	12,987	3096	6950	3404
R-squared	0.717	0.723	0.738	0.684

Table 5**: Regression Results based on Bank Size Grouping**

This table reports results on the impact of intrastate branching and interstate banking deregulation on bank risk between 1984:Q1 to 1994:Q3 based on bank size. Following Berger and Bouwman (2013), small, medium, and large banks are defined as commercial banks having real GTA up to $1 billion, between $1 billion and $3 billion, and greater than $3 billion, respectively. The dependent variable in all panels is *Ln Z-Score,* an inverse measure of bank risk; a higher value indicates lower bank overall risk. All regressions include bank and time (quarter) fixed effects (FE). All right-hand-side control variables are lagged 12 quarters. Nonfinancial controls include *Population Density, Ln HPI, BHC, Listed, Deposit HHI,* and *Deposit HHI Squared*. Financial controls include *Ln GTA, Ln GTA Squared, Asset Diversification Ratio, Overhead Cost Ratio,* and *Foreign Assets Ratio.* All financial variables in dollar amounts are expressed in real terms using the 2010:Q4 implicit GDP price deflator. All financial ratios are winsorized at the top and bottom 1% of the distribution. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. Standard errors are clustered at the bank level. Numbers in parentheses are *t*-statistics.

	Dependent Variable: *Ln Z-Score*			
	Baseline	Small Banks	Medium Banks	Large Banks
	(1)	(2)	(3)	(4)
Intrastate Branching (Intra)	-0.032***	-0.045***	-0.323***	0.261**
	(-2.939)	(-4.172)	(-2.978)	(2.152)
Interstate Banking (Inter)	0.201***	0.190***	-0.047	0.083
	(13.566)	(12.901)	(-0.335)	(0.500)
Nonfinancial controls	Yes	Yes	Yes	Yes
Financial controls	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes
Time (Quarter) FE	Yes	Yes	Yes	Yes
N	303,207	288,515	7,842	6,850
N-cluster	12,987	12,521	533	324
R-squared	0.717	0.728	0.717	0.669

Table 6**: The Competition Channel—Regression Results on Small Unit Banks Not Part of a BHC**

Panel A reports results on the impact of intrastate branching and interstate banking deregulation on bank risk using a sample of small banks that are unit banks (i.e., are not part of a BHC) over the 1984:Q1 to 1994:Q3 period. **Panel B** reruns the analysis in Panel A using "strong" small unit banks, while **Panel C** reruns the analysis in Panel A using "weak" small unit banks, where weak small unit banks are defined as small unit banks that are included on the FDIC list of failed banks at some point over our sample period. The dependent variable in columns (1) and (2) is *Ln Z-Score*, an inverse measure of bank risk; a higher value indicates lower overall bank risk. The dependent variables in the next four columns are mean nonperforming loans ratio (*NPL/TL*), mean return on assets (*ROA*), standard deviation of ROA (σ*(ROA)*), and mean equity to GTA ratio (*EQTA*), respectively. To be consistent with *Ln Z-Score*, all of these alternative risk measures are calculated over 12 quarters. Higher values of *NPL/TL* or *SDROA* indicate higher bank risk, while higher values of *ROA* and *EQTA* indicate lower bank risk. All regressions include bank and time (quarter) fixed effects (FE). All right-hand-side control variables are lagged 12 quarters. Nonfinancial controls include *Population Density*, *Ln HPI*, *BHC*, *Listed*, *Deposit HHI*, and *Deposit HHI Squared*. Financial controls include *Ln GTA*, *Ln GTA squared*, *Asset Diversification Ratio*, *Overhead Cost Ratio*, and *Foreign Assets Ratio*. All financial variables in dollar amounts are expressed in real terms using the 2010:Q4 implicit GDP price deflator. All financial ratios are winsorized at the top and bottom 1% of the distribution. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. Standard errors are clustered at the bank level. Numbers in parentheses are *t*-statistics.

Panel A**: All Small Unit Banks Not Part of a BHC**

	All Small Banks (Baseline)	Small Unit Banks				
	Ln Z-Score	*Ln Z-Score*	*NPL/TL(%)*	*ROA(%)*	SDROA(%)	*EQTA(%)*
	(1)	(2)	(3)	(4)	(5)	(6)
Intrastate Branching (Intra)	-0.045***	-0.016	-0.100	-0.095***	0.069	0.088
	(-4.172)	(-0.567)	(-1.128)	(-2.933)	(1.576)	(1.401)
Interstate Banking (Inter)	0.190***	0.123**	-0.544***	0.019	-0.104	0.404***
	(12.901)	(2.861)	(-3.514)	(0.391)	(-1.567)	(3.759)
Nonfinancial controls	Yes	Yes	Yes	Yes	Yes	Yes
Financial controls	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Time (Quarter) FE	Yes	Yes	Yes	Yes	Yes	Yes
N	288,515	29,356	29,345	29,356	29,356	29,356
N-cluster	12,521	1738	1736	1738	1738	1738
R-squared	0.728	0.836	0.800	0.809	0.767	0.946

(Continued)

Panel B**: Strong Small Unit Banks Not Part of a BHC**

	All Small Banks (Baseline)	Strong Small Unit Banks				
	Ln Z-Score	*Ln Z-Score*	*NPL/TL(%)*	*ROA(%)*	SDROA(%)	*EQTA(%)*
	(1)	(2)	(3)	(4)	(5)	(6)
Intrastate Branching (Intra)	-0.045***	-0.010	-0.178*	-0.084**	0.073*	0.149**
	(-4.172)	(-0.318)	(-1.945)	(-2.541)	(1.740)	(2.353)
Interstate Banking (Inter)	0.190***	0.128***	-0.592***	0.016	-0.110*	0.419***
	(12.901)	(2.979)	(-3.857)	(0.324)	(-1.660)	(3.905)
Nonfinancial controls	Yes	Yes	Yes	Yes	Yes	Yes
Financial controls	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Time (Quarter) FE	Yes	Yes	Yes	Yes	Yes	Yes
N	288,515	27,503	27,492	27,503	27,503	27,503
N-cluster	12,521	1510	1508	1510	1510	1510
R-squared	0.728	0.819	0.785	0.765	0.728	0.951

(Continued)

Panel C**: Weak Small Unit Banks Not Part of a BHC**

	All Small Banks (Baseline)	Weak Small Unit Banks				
	Ln Z-Score	*Ln Z-Score*	*NPL/TL(%)*	*ROA(%)*	SDROA(%)	*EQTA(%)*
	(1)	(2)	(3)	(4)	(5)	(6)
Intrastate Branching (Intra)	-0.045***	-0.043	1.023***	-0.175	-0.182	-0.642**
	(-4.172)	(-0.388)	(3.144)	(-1.113)	(-0.488)	(-2.189)
Interstate Banking (Inter)	0.190***	-0.260**	1.839**	0.062	0.582	-0.910
	(12.901)	(-2.487)	(2.320)	(0.233)	(1.436)	(-1.635)
Nonfinancial controls	Yes	Yes	Yes	Yes	Yes	Yes
Financial controls	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Time (Quarter) FE	Yes	Yes	Yes	Yes	Yes	Yes
N	288,515	1,853	1,853	1,853	1,853	1,853
N-cluster	12,521	228	228	228	228	228
R-squared	0.728	0.896	0.880	0.868	0.793	0.930