Bank Organization, Market Structure and Risk Taking: Evidence and Theory from U.S. Commercial Banks

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Abstract

This paper starts by documenting that the removal of regulatory impediments to bank expansion in the United States decreased risk taking only for banks that did not diversify their operations geographically. Because existing theories of diversification, competition and bank risk taking are unable to explain this finding, I propose an explanation by showing that a bank's organizational structure affects not only its risk taking behavior, but also the risk taking of competing banks. The model further provides additional hypotheses, which I test empirically using two identification strategies and data from U.S. commercial banks. My findings support the hypothesized relationship between organizational structure and risk, and show that a bank's geographic diversification affects the risk taking behavior of competing banks.

JEL Classification: G21, G32, L22

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1 Introduction

In this paper, I address one of the most basic questions in banking: Are banks with lending activities in several banking markets safer than banks that focus their operations on a single market? Expanding lending operations into more markets allows banks to diversify risk across regions, and if loan returns across regions are not perfectly correlated, geographically diversified banks are safer because they are less exposed to shocks that hit individual areas (Diamond (1984); Demsetz and Strahan (1997); Morgan et al. (2004)). Banks' risk taking is also related to market structure, and risk taking could change because diversification across markets affects competition in banking markets. Competition for borrowers might intensify as banks expand their operations, which decreases a bank's rents, erodes its charter value, and therefore provides incentives for banks to take on more risk (Keeley (1990)). However, greater competition might also lead to lower loan rates, which reduces the extent of borrowers' risk shifting incentives and thus reduces a bank's exposure to risk of failure (Boyd and de Nicolo (2005)).

While many researchers examine the connection between bank diversification and risk taking, none consider how the interactions between banks that diversify and banks that focus their operations affect the fragility of these different banks. This omission turns out to be of first-order importance both conceptually and empirically. By exploiting cross-bank heterogeneity in their response to regulatory changes that removed impediments to commercial banks' expansion within state lines in the United States, I find that diversifying banks did not experience a decrease in their risk taking. Non-expanding banks, on the other hand, decreased risk taking once states removed regulatory barriers to expansion. This finding cannot be attributed to risk-reducing effects due to greater diversification because non-expanding banks did not diversify their operations across markets. Alternative theories focusing on the effect of market competition on bank risk taking cannot explain this pattern either as earlier findings indicate that the removal of intrastate branching restrictions did not alter the local market structure (Rhoades (2000); Dick (2006)).

This paper provides more information on the relationship between bank diversification and risk by explicitly modeling the interactions between banks that diversify geographically and those that focus their operations, and testing the model's predictions empirically using information from the U.S. banking sector. The theoretical framework incorporates theories of market structure and risk taking (Boyd and de Nicolo (2005); Martinez-Miera and Repullo (2010)) and theories of organizational structure and firm behavior (Stein (2002); Acharya et al. (2011)) to study the effect of banks' diversification on risk taking. The model shows that a bank's geographic diversification not only affects its own risk taking, but also shapes the risk taking behavior of other banks due to competition in the banking market. Furthermore, the model also shows that the relationship between organizational structure and bank risk taking depends on market characteristics, such as borrowers' ability to provide collateral. Hence, this model adds to the debate on diversification, market structure and risk by proposing an additional channel that affects banks' risk taking, namely a bank's organizational structure.

I test the model's predictions by employing two empirical strategies based on (1) the timing of intrastate branching deregulation and (2) a gravity model, which explains a bank's expansion behavior within a state (Goetz et al. (2011)). Each identification strategy thereby utilizes the state specific timing of a removal of intrastate branching restrictions to determine an exogenous change in banks' organizational structure to pin down the causal effect of changes in a bank's organizational structure on its risk taking behavior and the risk taking behavior of competitors.

The theoretical mechanism between organizational structure and risk is related to Stein

(2002), who shows that the organizational structure of banks affects their lending to certain borrower groups. By characterizing the relationship between bank manager and loan officer similar to Acharya et al. (2011), I show that loan officers have an incentive to shift lending towards borrowers with collateral when banks expand their branch network. Because of competition for borrowers, a shift in lending affects market loan interest rates and changes a bank's loan portfolio risk, which determines a bank's exposure to risk of failure. Furthermore, it also impacts the behavior and risk of competitors, and loan officers in competing banks increase lending to borrowers without collateral. This then affects competing banks' exposure to risk of failure.

The empirical identification of a causal relationship between banks' organizational form and their exposure to risk of failure is difficult. Causality might run the other way and a bank's risk taking determines its organizational structure. Moreover, omitted variables, such as, for instance, a bank's efficiency, might exert an influence on its organizational scope and risk, thereby affecting the estimation.

To estimate the causal effect of a bank's organizational structure on competing banks' risk taking, the first empirical strategy uses heterogeneity in the timing of intrastate branching deregulation across states as an instrument for the average bank's organizational form. I find robust evidence that the failure risk of a bank decreases when competitors change their organizational structure and diversify operations across banking markets. Moreover, this effect is also economically significant: a bank's annual risk of failure decreases by approximately 20 percent if competitors increase the number of markets they are active in by one standard deviation. These findings are also not sensitive to the definition of risk and organizational structure.

To further strengthen my results, I combine the timing of intrastate branching deregulation with a gravity model of bank's expansion within a state in the second identification strategy, and construct an instrumental variable at the bank level.[1] By imbedding the timing of intrastate branching deregulation within a gravity model, I determine for each bank and year its projected organizational form using this gravity-deregulation model (Goetz et al. (2011)). In a second step, I then use this instrumental variable to estimate the effect of organizational form on risk taking.

Because the gravity-deregulation model explains expansion at the bank level for each year, I account for a bank's endogenous decision to expand, and I include a set of state specific time fixed effects in the regression model to capture unobservable state specific time-varying influences. Using this identification strategy, I test whether the impact of a bank's expansion on its own risk of failure is different than the impact on competitors' risk taking, as predicted by the model. Results from the gravity-deregulation model confirm the earlier findings and support the theorized relationship between organizational structure and risk taking.

To further test whether the relationship between organizational scope and failure risk differs across banking markets, I determine for each banking market the average level of collateral, and analyze whether the relationship between organizational structure and risk is different in markets where borrowers have more collateral. My findings suggest that the effect between organizational structure and risk taking is less pronounced in these markets, as hypothesized by the model.

The main contribution of this paper is the theoretical and empirical identification of a relationship between banks' organizational structure and risk taking. This adds to the debate on bank risk taking, market structure and organizational form, as my empirical results do not reject earlier theories and findings, but rather complement existing studies

[1] I follow the methodology from Frankel and Romer (1999) who analyze whether and how international trade flows affect economic growth.

by identifying a further channel that affects bank risk taking. Although the theoretical framework incorporates findings on the relationship between organizational structure and individual loan officers' behavior (Liberti and Mian (2009), Hertzberg et al. (2010)), I do not examine the impact of organizational structure on individual loan officers' risk taking behavior within a bank. In this paper, I focus on the firm-wide effects of changes in a bank's organizational structure on its risk taking and the risk taking of competitors. Moreover, this paper is also related to studies of market structure and bank risk taking, based on regression results from cross-country analysis (de Nicolo (2000), Boyd et al. (2007)), and evidence from the Great Depression (Calomiris and Mason (2000), Mitchener (2005)). My findings also contribute to the literature on the effects of branching deregulation on the banking sector in the U.S. (Jayaratne and Strahan (1996); Stiroh and Strahan (2003)) by examining how risk taking changes following the liberalization of intrastate branching restrictions.

The remainder of this paper is organized as follows: in Section 2, I estimate the effect of intrastate branching deregulation and banks' exposure to risk of failure. Following this, I provide a theoretical framework highlighting the relationship between banks' organizational structure and risk taking in Section 3. I present the empirical strategy and results on the causal relationship between banks' organizational structure and risk taking, as well as the role of borrower information for this relationship in Section 4. Section 5 concludes the paper.

2 Intrastate Branching Deregulation and Risk

Banks in the United States were restricted in their branching decision within and across states for many decades. Limits on the location of branch offices were imposed in the 19th century, and were supported by the argument that allowing banks to expand freely could lead to a monopolistic banking system. The granting of bank charters was also a profitable income source for states, increasing incentives for states to enact regulatory policies.[2] These regulations led to a banking system that was characterized by local monopolies within states since geographical restrictions prohibited other banks from entering a market. Because banks were beneficiaries of this regulation, they also had an incentive to preserve the status quo (Kroszner and Strahan (1999)).

With the emergence of new technologies - such as the Automated Teller Machines (ATMs) and more advanced credit scoring techniques - banks' benefits from regulation declined. Eventually intrastate branching restrictions were lifted in states, and banks were allowed to branch freely within a state. The passage of the Riegle-Neal Act in 1994 by U.S. Congress finally removed all remaining barriers by the middle of the 1990s. [3]

2.1 Empirical Strategy and Data

2.1.1 Empirical Strategy

To identify how the removal of intrastate branching restrictions affects banks' exposure to risk of failure, I exploit heterogeneity in the timing of deregulation across states and estimate:

$$R_{i,s,t} = \beta B_{s,t} + \mathbf{X'}_{i,s,t}\rho + \alpha_i + \delta_t + \varepsilon_{i,s,t} \tag{1}$$

where $R_{i,s,t}$ is bank i's risk, located in state s at time t; $B_{s,t}$ is an indicator taking on the value of one whether state s removed its intrastate branching restrictions, or zero otherwise;

[2]How severe these restrictions were shows the case of Illinois: before the removal of these restrictions, the state allowed banks to only open two branches within 3,500 yards of its main office (Amel and Liang (1992)).

[3]Previous research on intrastate branching deregulation suggests that the removal of branching restrictions had significant effects on the real activity and economic development. See among others Jayaratne and Strahan (1996), Beck et al. (2010).

$\mathbf{X}'$ is a matrix of bank- and/or state-specific controls, and α_i (δ_t) are bank (year) fixed effects. The parameter of interest is β which shows the relationship between intrastate branching deregulation and bank risk.

2.1.2 Data Sources

I use accounting data from commercial banks in the United States. These data come from Reports of Condition and Income data ('Call Reports'), which all banking institutions regulated by the Federal Deposit Insurance Corporation (FDIC), the Federal Reserve, or the Office of the Comptroller of the Currency need to file on a regular basis. I use semiannual data from the years 1976 to 2007 and only consider commercial banks in the 50 states of the U.S. and the District of Columbia.

The geographical location of bank branches is recorded in the 'Summary of Deposits' which contains deposit data for branches and offices of all FDIC-insured institutions. Dates of intrastate branching deregulation are collected by Amel and Liang (1992). Aggregate state and county level data are from the Bureau of Economic Analysis.

2.1.3 Variable Definitions

To measure a bank's probability of default I use *Inverse Z-Score*. By assuming that bank profits are normally distributed (Roy (1952)), a bank's probability of default can be approximated by:[4]

$$\text{Inverse Z-Score} = \frac{\text{Standard Deviation of Return on Assets(ROA)}}{\text{ROA} + \text{Capital-Asset-Ratio}}$$

[4] Boyd and Graham (1996), Laeven and Levine (2009), and Jimenez et al. (2010)

Z-Score can be interpreted as the number of standard deviations profit can fall before the bank is bankrupt. Hence, Inverse Z-Score is a risk measure, where higher values indicate greater bankruptcy risk. I use a five semi-annual moving average to estimate the volatility of profits using balance sheet information. In addition to this variable, I also construct a Distress indicator which takes on the value of one whether a bank's capital-asset ratio drops by more than 1 percentage point in two consecutive years (Boyd et al. (2009)).[5] Aside from this, I also use balance sheet information and follow Laeven et al. (2002) to construct a 'CAMEL' rating for each bank and year.[6] U.S. bank regulators evaluate the stability of banks using balance sheet information and on-site inspections, and combine their assessment in 'CAMEL' ratings, which range from 1 to 5, with higher ratings indicating weaker banks.[7]

To account for bank specific effects, I include the ratio of total loans to total assets, the log of total assets, a dummy variable indicating whether the bank is part of a bank holding company, and the capital-asset-ratio as control variables. These variables are computed from balance sheet information for every bank and year. State specific business cycle fluctuations are captured by the annual growth of state personal income as well as a lag thereof. Further, I account for banking market effects by including the log number of branches in market, log number of banks in market, the concentration of deposits across banks in a market (Herfindahl Index) and population per branch in market. Aside from intrastate branching deregulation, states also relaxed their restrictions on branching across state lines (interstate branching deregulation) over time. I include a dummy variable taking on the value of one whether banks from other states are allowed to enter a state, and zero otherwise to account

[5] I use the 1 percentage point threshold because it is the 10th percentile of the annual change in capital-asset ratio in my sample.

[6] CAMEL stands for Capital adequacy, Asset quality, Management quality, Earnings and Liquidity

[7] Because CAMEL ratings are not publicly available, I follow the methodology of Laeven et al. (2002) to construct them using balance sheet information only.

for this. To examine the impact of intrastate branching deregulation on risk, I only focus on banks that are active in only one single state, and existed at least one year before and one year after the removal of intrastate branching restrictions. Further details, regarding the construction of variables and the sample, are given in the appendix.

Summary statistics are reported in Table I. The sample consists of 10,585 banks and spans the years 1977 to 2006. The average bank size is $125 million , reflecting the fact that the U.S. banking sector consists of many small banks and a few larger institutions. While the average Return on Assets for banks in the sample is 0.58 percent, banks are well capitalized as the average capital-asset ratio of 9.45 percent shows.

2.2 Results

Regression results are presented in Table 2 and indicate that the liberalization of intrastate branching restrictions is associated with a decrease in bank risk even without conditioning on bank or macroeconomic controls.[8] The effect of intrastate branching deregulation on risk is significant at the 1 percent level and becomes larger in magnitude once I include bank and macroeconomic controls (columns 2 and 3). To gauge the economic magnitude of the effect of intrastate deregulation on risk, I compute that the removal of intrastate branching restriction is followed by a decrease in risk of approximately four percent of its standard deviation.

In column 4, I include a dummy variable indicating whether a bank expands into other markets following intrastate branching deregulation or not. A U.S. county is considered to be a distinct banking market for commercial banks (Berger and Hannan (1989)), and hence I focus on banks' expansion into other counties within the same state. The results show

[8] Since Inverse Z-Score is very small, I multiply it by 1,000 for my analysis.

that risk only decreases for banks that do not expand into other markets after intrastate branching deregulation, suggesting that diversification across markets does not decrease risk, since risk does not decline for banks that expand. While it is not possible to include state-year fixed effects, I account for time-variant unobservable effects at the regional level by including region specific time dummies in column 5.[9] As before, I find that the removal of branching restrictions is only associated with lower risk for banks that do not expand following intrastate branching deregulation. This result is also not sensitive to the definition of risk, as I find that the removal of branching restrictions is also associated with a decrease when I measure banks' exposure to risk of failure using CAMEL ratings (column 6) or the Distress indicator (column 7).

To translate these findings into a likelihood of failing, I estimate how a bank's probability of failing is related to Inverse Z-Score. Using information on the bankruptcy of 1,152 bank failures during the sample period, I estimate a state and year fixed effects logit regression and compute the average marginal effect of a one unit change in Inverse Z-Score on a bank's failure likelihood.[10] Estimations from this logit model suggest that a one unit increase in Inverse Z-score decreases the likelihood of failing by approximately 1.2 percentage-points. Using the coefficient from column 4 in Table 2, I find that intrastate branching deregulation decreases the probability of failure for banks by 1.6 basis points. During the sample period, on average three out of a thousand banks fail each year, and so intrastate branching deregulation reduces the average annual failure rate by approximately five percent.

Carlson and Mitchener (2009) argue that deregulation is associated with a weeding out

[9] The regions are Midwest (IA, IL, IN, KS, MI, MN, MO, ND, NE, OH, WI), Northeast (CT, MA, MD, ME , NH, NJ, NY, PA, RI, VT, WV), South (AL, AR, DC, FL, GA, KY, LA, MS, NC, OK, SC, TN, TX, VA) and West (AZ, CA, CO, ID, MT, NM, NV, OR, UT, WA, WY).

[10] Because it is not possible to compute Inverse Z-Score in the last year of a bank's existence, I determine for each bank whether it fails or not in the last period when Inverse Z-Score is available.

of risky banks, leading to a more stable banking system. During the sample period, many banks disappear because they fail, get acquired or merge with other institutions. Although I include bank fixed effects in the analysis, it is possible that the exiting of banks affects these findings. Therefore, I estimate the relationship where I exclude all banks that fail from the sample. Results from this subsample are given in Table III and are consistent with the earlier findings. Additionally, I exclude banks that are acquired, or merge during the sample period in column 2. Again, the findings are not sensitive to this. Because mergers and acquisitions impact bank's balance sheets and their risk, I exclude observations of acquiring banks once these banks engage in a merger or acquisitions in column 3. In column 4 I exclude observations around the year of mergers or acquisitions to limit the effect of mergers and acquisitions on the results. Overall my findings are robust to these exclusions.

By construction, Inverse Z-Score is correlated over time. Since I use a five semester moving average to estimate the volatility of profits, Inverse Z-Score in year t uses information on profits that are also used for the computation of Inverse Z-Score in year $t-1$. To address this, I limit the overlap of data for the construction of Inverse Z-Score by including only every other year for each bank in column 5. To virtually eliminate all autocorrelation due to construction, I only include every third year in the estimation in column 6. Results from these subsamples are similar to earlier findings and indicate that intrastate branching deregulation is associated with a significant decrease in bank risk, but only for banks that do not expand following deregulation.

I also explore whether the degree of expansion after the removal of branching restrictions is relevant. Specifically, I analyze whether the effect is different for banks that expand in only one, two, three or more than three markets by estimating the following regression model:

$$R_{i,s,t} = \beta_0 D_{i,s,t} + \sum_{e=1}^{e=4} \beta_1 D_{i,s,t} \times I_{i,e} + \alpha_i + \delta_t + \mathbf{X'}_{i,t}\rho + \varepsilon_{i,s,t} \tag{2}$$

where $I_{i,k}$ is a dummy variable that takes on the value of one if bank i expands into k markets following intrastate branching deregulation.[11] The total effect for each expansion category is plotted in Figure 1 which shows that the effect of intrastate branching deregulation on risk is increasing in banks' expansion following deregulation. Specifically, intrastate branching deregulation is associated with a larger increase in risk as banks expand into more markets. For banks that expand in one or two markets, however, the effect of intrastate branching deregulation on risk is not significantly different from zero at the one percent level.

3 Theoretical Framework

To explain this empirical pattern, I build on Stein (2002) to highlight (1) how a bank's organizational structure affects its risk taking and (2) the risk taking of competing banks. Stein (2002) and Berger et al. (2005) show that banks' organizational structure (decentralization versus hierarchy) determines their ability to produce and process information about borrowers. This has effects on banks' lending behavior as banks with a flatter organizational structure are better at lending to soft information borrowers. My theory is also related to models highlighting the relationship between bank competition and lending relationships (Petersen and Rajan (1995), Dell'Ariccia and Marquez (2004)), and theories regarding the structure of banks and their behavior (Dell'Ariccia and Marquez (2010), Boot and Schmeits

[11] The total effect of intrastate branching deregulation on risk for a bank that, say expands into one more market following deregulation is therefore given by $\beta_0 + \beta_1$.

(2000)).

3.1 Model

Borrowers Suppose there is a mass of entrepreneurs with access to a risky technology which yields R with probability $p(e)$. By increasing effort e at cost $\frac{1}{2}e^2$, an entrepreneur's likelihood of success $p(e)$ increases. Moreover, an entrepreneur's likelihood of success is independent of other entrepreneurs' success probabilities. For any given level of effort, the success probability is less than one, and concave in effort with $p(0) = 0.5$. Effort is unobservable and not verifiable to third parties. Entrepreneurs seek financing from banks, but differ in their level of collateral they can pledge when taking out a loan. Hard information borrowers can pledge collateral λ, while soft information borrowers have no collateral to pledge when taking out a loan. In case a hard information borrower is not successful (with probability $1-p$), the bank receives λ. Given loan rate r_L, a borrower chooses e to maximize his expected profit:

$$\max_{e} \quad E(\pi) = \begin{cases} p(e)\left[R - r_L\right] - (1-p(e))\lambda - \frac{1}{2}e^2 & \text{hard information} \\ p(e)\left[R - r_L\right] - \frac{1}{2}e^2 & \text{soft information} \end{cases}$$

Lemma 1 (Risk Shifting) *An increase in the loan interest rate r_L decreases the optimal level of effort e^*, and hence the probability of success.*

Similar to Boyd and de Nicolo (2005), borrowers in this model shift risk towards banks when banks increase the loan rate.

Entrepreneurs also differ in their unobservable outside option, denoted $\bar{\pi}$, which determines whether an entrepreneur will borrow or not. Suppose there is a continuum of borrowers in the market, defined by a continuous distribution of outside options with support $\mathbb{R}_+$. The measure of borrowers with an outside option of at most $\bar{\pi}$ is denoted as $F(\bar{\pi})$. Further, suppose that hard and soft information borrowers have different outside options, $\bar{\pi}^S = \bar{\pi}^H + \lambda$.[12] An entrepreneur takes out a loan at rate r_L if his expected profit is greater or equal than his outside option. The measure of borrowers at loan rate r_L is denoted $F(\pi(r_L))$, which yields loan demand D (Martinez-Miera and Repullo (2010)):

$$D(r_L) = F(\pi(r_L))$$

Loan demand is decreasing in the loan interest rate r_L, $D'(r_L) = F'(\pi(r_L))\pi'(r_L) < 0$. Inverse loan demand is then denoted by $r_L(D)$ with $r'_L(D) < 0$.

Banks Banks differ in their organizational structure which is characterized by a bank's number of branches. The number of branches also gives the number of distinct banking markets a bank is active in. Each branch consists of a loan officer that decides on lending to borrowers. Branches of the same bank do not compete for borrowers within the same market. Further, each bank also consists of a CEO (see below).

Loan officers make lending decision in bank branches. Their lending decision is shaped by (a) competition in the market for borrowers *(horizontal competition)*, and (b) the possibility to become the next CEO (Acharya et al. (2011)) *(vertical competition)*. Because borrower types are observable, loan officers face a loan demand D_S/D_H for soft/hard information borrowers. Loan officers in a market compete for borrowers a la Cournot and each loan officer has one unit of funding available, which he allocates between soft and hard information

[12] This is for simplicity only and ensures that the measure of borrowers demanding loans at a given level of outside option is not affected by the availability of collateral.

borrowers. Suppose the total supply of credit to hard information borrowers in a market is denoted by A.[13] Expected profits from lending to hard/soft information borrowers are given as μ_H/μ_S:

$$\begin{aligned}\mu_H &= p_H(A)(1+r_H(A)) + (1-p_H(A))\lambda \\ \mu_S &= p_S(A)(1+r_S(A))\end{aligned}$$

Loan officers choose a loan portfolio β (= share of loans to hard information borrowers) to maximize their expected profit.

A bank's CEO receives a fraction γ of every branch's expected profit, and his only role is to evaluate every loan officer and determine his successor. In particular, he observes each loan officers profit at cost c - where c is decreasing in a loan officer's choice of β[14] - and chooses the loan officer with the highest profit net of the evaluation cost to be the next CEO.[15]

Horizontal Competition (within markets) Each loan officer in a market chooses to lend a fraction of its funding to hard information borrowers in that market. Suppose there are two branches of competing banks in that market. Let the fraction of loan officer a be denoted by α, and the fraction of loan officer b by β. Total lending to hard information borrowers in this market is then $A = \alpha + \beta$. Without considering the effect of vertical

[13]Because the total amount of credit within a market is limited by the number of branches expected profits from lending to soft information borrowers are also determined by A.

[14]The rationale is that it is less costly for the CEO to evaluate a loan portfolio of hard information borrowers.

[15]A loan officer's choice of β also affects his chance of becoming the next CEO. If a bank has only one branch, the loan officer will become the next CEO with certainty. However, loan officers in banks with more than one branch compete with each other to become the next CEO if the banks has more than one bank branch.

competition within banks (see below), loan officers choose β to maximize their expected profits, $E(\pi) = [\beta\mu_H(A) + (1-\beta)\mu_S(A)] \times (1-\gamma)$.

Vertical Competition (within banks) Suppose a bank has two branches, and let loan officers in branches of this bank be labeled i and j. Each loan officer chooses a fraction β_i, β_j of lending to hard information borrowers in his respective banking market. Loan officer i will become the next CEO if his profit net of evaluation cost $(\pi_i - c_i)$ are larger than j's net profit $(\pi_j - c_j)$. Because evaluation costs are decreasing in the loan officer's share of hard information borrowers, the probability of becoming the next CEO for loan officer i (pr_i) increases in β_i (see appendix for details).[16]

3.2 Equilibrium and Comparative Statics

3.2.1 Equilibrium

In equilibrium, banks discriminate between hard and soft information borrowers, and offer a separate interest rate for each borrower type. Denote the CEO's equilibrium net profit from each branch as Π, and suppose there are two branches (i, j). Loan officer i then chooses β_i to maximize:

$$\max_{\beta_i} \quad (1-\gamma)\ E\left(\pi_i(\beta_i)\right) + pr_i(\beta_i, \beta_j) \times 2\frac{\gamma}{1+\rho}\left[\quad \bar{\Pi} \quad\right] \tag{3}$$

Lemma 2 *There exists a β_i^* which is a solution to 3.*

Since loan demand is supposed to be increasing in interest rates, there is an optimal allocation of lending between soft and hard information borrowers.[17]

[16]This approach is similar to a result from first priced sealed bid auction.
[17]see appendix for further details.

3.2.2 Comparative Statics

Competition within a market For simplicity, I focus on the case of two banks and two branches. Let the choice of loan officers' share of hard information loans in different banks be denoted by α and β, and the share of loan officers of the same bank be denoted by β_i and β_j. Because loan officers within a market compete for borrowers a la Cournot, loan officers have an incentive to differentiate themselves from each other:

Proposition 1 (Differentiation) *A loan officer's share of hard information borrowers is negatively related to its competitor's choice of hard information borrowers. This effect can be larger or smaller (in absolute value) than one.*

Suppose a competing branch increases lending to hard information borrowers ($\alpha \uparrow$). Because total credit supply in a banking market is limited and loan officers compete for borrowers a la Cournot, interest rates for hard information borrowers decrease, while interest rates for soft information borrowers increase. This makes lending to soft information borrowers more profitable, which induces a loan officer to increase lending to soft information borrowers ($\beta \downarrow$).

Proposition 2 (Effect of collateral) *Depending on the elasticity of the repayment probability for hard information borrowers with respect to loan supply for hard information borrowers, the optimal choice of β either increases or decreases in λ.*

An increase in collateral value increases a bank's payoff if a hard information borrower defaults, thus making lending to hard information borrowers more attractive. However, this is counteracted in two ways: increased lending leads to (1) lower loan rates, and (2) higher success probabilities of hard information borrowers. So, borrowers are more likely to repay, and a bank's expected profit could thus be lower due to lower loan rates and higher repayment probability.

Competition within banks It can be shown that loan officers in banks with more branches will choose a loan portfolio with a larger share of hard information borrowers.

Proposition 3 (Effect of hierarchy on β) *A loan officer in a bank with more branches chooses a larger β than a loan officer in a bank with less branches.*

This result is similar to Stein (2002). While Stein (2002) shows that internal capital markets in more hierarchical banks lead to a larger share of hard information borrowers, the mechanism here is the tournament between loan officers for the bank's CEO position Acharya et al. (2011)).

3.3 Risk

3.3.1 Loan Portfolio Risk

In equilibrium, branches lend to a continuum of soft and hard information borrowers. Repayment by each borrower is stochastic and independent within and across borrower types. Further, due to symmetry, each borrower type chooses the same level of effort and exhibits the same repayment probability. Suppose, a bank's loan portfolio consists of infinitely granular soft and hard information borrowers and is given by X. Because profit from lending to a borrower type is binomially distributed, X can be approximated by a normal distribution with mean μ_B and variance σ_B^2, where

$$\begin{aligned} \mu_B &= \beta\mu_H + (1-\beta)\mu_S \\ \sigma_B^2 &= \beta^2\sigma_H^2 + (1-\beta)^2\sigma_S^2 \end{aligned}$$

σ_H^2 and σ_S^2 is the variance of hard and soft information borrowers, respectively.

3.3.2 Risk Taking

For simplicity, a bank holds no capital, and so a bank is bankrupt if the realization of its loan return is negative. A bank's probability of default (PD) is therefore given as:

$$PD = Pr(X < 0) = Pr\left(Z < -\frac{\mu_B}{\sigma_B}\right) = \Phi(-\frac{\mu_B}{\sigma_B}), \qquad \text{with } Z \equiv \frac{X - \mu_B}{\sigma_B}$$

Note that Z follows a standard normal distribution.[18]

Proposition 4 (Change in Loan Portfolio and Probability of Default)
Depending on the initial share of hard information borrowers, an increase in lending to hard information borrowers can either increase or decrease a bank's probability of default.

Consider again the case of two competing loan officers in two different banks where the loan officer's choice of lending to hard information borrowers is denoted by α/β. A loan officer's change of β has two effects. On the one hand, it directly affects the variance and expected value of a bank's loan portfolio. However, it also leads to a response by competing loan officers (Proposition 1):

$$\frac{\partial PD}{\partial \beta} \propto \frac{\partial \sigma_B}{\partial \beta}\left(1 + \frac{\partial \alpha}{\partial \beta}\right) \tag{4}$$

An increase in β will lower loan rates to hard information borrowers which lowers the variance of loans to hard information borrowers (σ_H^2). However, this increase also augments the variance of loans to soft information borrowers (σ_S^2). Because σ_S^2 (σ_H^2) is concave and increasing (convex and decreasing) in β, the marginal increase in σ_S^2 is larger than the

[18]This is also the definition of Z-Score used in the empirical analysis.

marginal decrease in σ_H^2 if β is small. Hence, a bank's PD increases when banks increase their share of loans to hard information borrowers.

Because of competition for borrowers in the market, competing loan officers respond to changes in β by also changing their loan portfolio (Proposition 1). This response alters the impact of changes in a bank's loan portfolio on a bank's risk. Depending on parameter values, the overall effect can also be inverted.[19]

3.3.3 Changes in Collateral

A change in the collateral value of hard information borrowers has a monotonic effect on the relationship between a bank's PD and β:

Proposition 5 (Collateral Value and $\frac{\partial PD}{\partial \beta}$) *A decrease in collateral values increases the effect of changes in a bank's loan portfolio its Probability of Default (PD).*

An increase in collateral values affects the relationship between β and PD in two ways: on the one hand, it increases a bank's payoff if hard information borrowers are not successful, thereby reducing the variance of hard information borrowers. On the other hand, it also affects a loan officer's choice of β (Proposition 2), where the effect of λ on β can be positive or negative. With respect to PD it can be shown that the first effect dominates, and a decrease in collateral value always increases the effect of changes in a bank's loan portfolio on bank's PD.

[19] This happens if the elasticity of lending to hard information borrowers across loan officers is less than -1.

3.4 Empirical Predictions

This model can explain the empirical pattern described in Section 2 (Proposition 1, 3 and 4) and also gives additional empirical hypotheses.

Bank Expansion and Probability of Default A change in a bank's organizational structure leads to changes in their lending behavior and the loan interest rate. This affects risk shifting of borrowers and impacts banks' probability of default.

Hypothesis 1 *As banks expand, their probability of default increases or decreases.*

Depending upon the initial level of a bank's share of hard information borrowers, a bank's expansion can increase or decrease a bank's PD. Because of competition for borrowers, the model also yields the following prediction for non-expanding banks:

Hypothesis 2 *If expanding banks increase their probability of default, then non-expanding banks decrease their probability of default (and vice-versa).*

Collateral Value and Probability of Default Proposition 5 shows that a change in the collateral value of borrowers affects the relationship between changes in a bank's loan portfolio and its probability of default. Instead of focusing on individual borrowers' collateral values, this proposition can be interpreted to consider the average collateral value within a banking market.

Hypothesis 3 *If there are more soft information borrowers in a market, non-expanding banks experience a stronger increase (or decrease) of their probability of default as competitors expand.*

4 The Effect of Organizational Structure on Risk

The theoretical framework provides an explanation for the decrease in non-expanding banks' risk taking after the removal of branching restrictions.

Ordinary-least squares estimation does not allow an identification of the causal relationship between organization and risk because of influences that jointly determine bank risk and a bank's organizational scope. To overcome this problem, I use two-stage-least squares (2SLS) estimation and employ two instrumental variable strategies. The first strategy uses the timing of deregulation at the state level as an excluded instrument for a bank's organizational structure. The second approach combines the timing of intrastate branching deregulation and bank specific characteristics in a gravity-deregulation model similar to Frankel and Romer (1999) to develop an instrumental variable at the bank level.

4.1 Empirical Strategy and Data

4.1.1 Empirical Strategy and Data

The theoretical framework relates risk of bank i to its organizational structure and also to its competitor's ($= j$'s) organizational scope. For bank i, I compute a variable that captures its own organizational structure and the average organizational scope of its competitors. The first stage regression model is given as:

$$D_{i,s,t} = \gamma Z_{i,s,t} + \mathbf{X'}_{i,s,t}\rho + \pi_i + \pi_t, \tag{5}$$

where $D_{i,s,t}$ captures the organizational form of bank i and/or of its competitors at time t; $Z_{i,s,t}$ is an instrumental variable, based on (1) the timing of intrastate branching deregulation, or on (2) a gravity-deregulation model; $\mathbf{X'}_{i,s,t}$ is a vector of bank-, and or state-specific control variables; π_i/π_t are bank and time fixed effects. In the second stage, I use the predicted value of organizational structure to determine how it impacts a banks' risk taking.

$$R_{i,s,t} = \beta \hat{D}_{i,s,t} + \mathbf{X'}_{i,s,t}\gamma + \tilde{\delta}_i + \tilde{\delta}_t + \eta_{i,s,t}, \tag{6}$$

where $\hat{D}_{ist}$ is the predicted value of organizational structure from the first stage regression. I use the same data sources as in the earlier analysis, and rely on 'Call Report' and 'Summary of Deposits' data to determine a bank's organizational structure and to construct bank specific controls.

4.1.2 Organizational Scope

I do not consider the expansion of banks within the same banking market, i.e. the opening of new branches in the same county, and capture a bank's organizational scope across markets for each year by two variables.[20] The first variable is the natural logarithm of banking markets, a bank has branches in, for each bank and year, where I simply count the number of counties a bank has branches in and take the natural logarithm. Lower values imply a flatter organizational form as they reflect that a bank is active in fewer markets. Second, I compute for each bank and year a Herfindahl Index of deposit concentration across markets by summing up the squared share of deposits a bank has in each market. This Herfindahl Index takes on values between zero and one, where larger values indicate that a bank has a flatter organizational structure as it focuses on fewer markets. To be consistent with the first variable, I subtract this Herfindahl Index from one, and hence smaller values of this

[20]The model assumes that each bank only has one branch in each market, and competition within the organization is only between loan officers, located in different markets.

variable indicate a flatter organizational scope.

For each bank and year, I determine the average of these two variables of all banks that are active in the same market. Then, I take the average of each measure in a county without including bank i and assign it to bank i, which yields for each bank an average measure of its competitors' organizational structure.

4.2 State-level instruments

4.2.1 Intrastate Branching Deregulation and Organizational Scope

Intrastate branching restrictions prohibited banks from expanding their branch network for many years. Figure 2 shows the dynamic effects of intrastate branching deregulation on the log number of markets a bank is active in.[21] The figure indicates that, following the removal of branching restrictions, banks continuously expand their branch network into more counties. Furthermore, a bank's expansion tendency is stronger in earlier years following intrastate branching deregulation, and then slows down.

The instrumental variables for the 2SLS analysis are motivated by this finding, and are therefore based on the following four sets of time-varying, state-level instruments. First, I use a dummy variable taking on the value of one once a state liberalized its branching restrictions, and zero otherwise. While this indicator captures the average effect of intrastate

[21] I estimate the following regression model:

$$ln(M_{i,s,t}) = \sum_{p=-10}^{15} \alpha_p Y_{p,s,t} + \tilde{\delta}_i + \tilde{\delta}_t + \tau_{i,s,t}$$

where $ln(M_{i,s,t})$ is the log number of banking markets bank i, located in state s, is active in during year t, $Y_{p,s,t}$ is a dummy variable that takes on the value of one if in year t, state s liberalizes its intrastate branching restriction in p years. The effect on organizational structure in the year of deregulation $D_{0,s}$ is dropped due to collinearity; the coefficients α_p are relative to the year of intrastate deregulation. Figure 2 plots the estimated coefficients α_p as well as the 95 percent confidence interval for these coefficients.

branching deregulation on a bank's organizational scope, it does not capture changes over time. Therefore, I also use the number of years since a state first started to remove its intrastate branching restrictions, and a square term to allow for a quadratic relationship.[22] Third, I employ a nonparametric specification that includes independent dummy variables for each year since a state removed its branching restrictions, taking a value of one all the way through the first ten years after deregulation, and zero otherwise. Lastly, I use the natural logarithm of one plus the number of years since a state removed its intrastate branching restrictions.

To link my empirical analysis to the earlier findings on intrastate branching deregulation, I first focus on the relationship between competitors' organizational structure and bank i's exposure to risk of failure. First stage regression results of these instruments on competitors' expansion across markets are presented in Panel B of Table IV. Similar to Figure 2, results in Table IV indicate that intrastate branching deregulation is associated with an increase in the organizational scope of banks as measured by the log number of markets a bank is active in (columns 1 to 4). This also holds when I define a bank's organizational structure as 1 - Herfindahl Index of deposits across banking markets (columns 5 to 8). The associated F-statistics support the use of these instruments as F-test results show that intrastate branching deregulation significantly impacts the expansion of banks.

4.2.2 Second-stage regression results

Panel A of Table IV reports the second stage results of a 2SLS regression of bank risk on the organizational structure of competing banks, as measured by the average number of markets a competitor is active in (columns 1 to 4), or the competitor's average dispersion across

[22]Since Figure 2 shows that banks' expansion decreases over time, I only allow for a linear and quadratic trend up to ten years after deregulation.

markets (columns 5 to 8).

The second stage results indicate that bank risk decreases significantly when competitors expand their organizational scope. Depending on the set of instrumental variables, the impact of competitors' organizational scope on bank risk is highly significant.[23] This finding is not sensitive to the definition of banks' organizational scope, since I also find a statistically significant relationship between organizational structure and risk when I use the dispersion across markets to capture competitors' organizational scope (columns 5 to 8).

Using the estimated coefficient reported in column 4 of Panel A of Table IV, I compute that if competitors increase their number of banking markets by one standard deviation, a bank's probability of failure decreases by 6 basis points. Since the average annual failure rate of banks is 30 basis points, this implies that a bank's annual risk of bankruptcy decreases by 20 percent.

I examine whether the relationship between a competitor's organizational scope and risk is sensitive to changes in the sample or the definition of risk in Table V. For all specifications in Table V, I use the log number of years since intrastate deregulation as exogenous instrument. The results show that a competitor's expansion into more markets significantly decreases a bank's risk, and is not sensitive to the exclusion of exiting banks (columns 1 and 2) or banks that merge and/or acquire other banks (columns 3 and 4) during the sample period. The relationship is also not sensitive to alternative definitions of risk as shown in columns 5 and 6. I also account for unobservable effects at the region level by including region-time fixed effects in these regressions.

[23]When using the nonparametric specification of intrastate branching deregulation as instrumental variables (columns 3 and 7), the effect of ln(Number of competitor's banking markets) significantly lowers bank risk at the 6 percent level.

4.3 Gravity-Deregulation Model

Instrumental variables at the state-level are not able to capture a bank's decision to expand into other markets, and hence only provide an instrument for the average expansion of banks within a state. Moreover, unobservable state specific time varying effects, such as changes in a state's overall level of bankruptcy risk, might influence my findings.

Therefore, I design a strategy to differentiate the effect of a removal of branching restrictions on banks' expansion, which allows me to account for the endogenous choice of banks to expand within a state, and include state specific time fixed effects to capture unobservable changes within a state. This approach incorporates (a) the timing of intrastate branching deregulation at states, (b) the distance and size of counties within a state, and (c) differences between banks regarding their regulatory charter and/or membership to the Federal Reserve System.

4.3.1 Gravity-Deregulation Model: Strategy

Frankel and Romer (1999) devise an identification strategy using a gravity model to analyze whether international trade causes economic growth. They determine the effect of several country specific variables on trade flows between countries and construct projected aggregate trade volumes at the country level. In a second step, they use these constructed trade volumes as instruments for actual trade to identify the causal impact of trade on economic growth. Goetz et al. (2011) modify this approach to pin down the causal relationship between a bank holding company's geographic diversification across states in the United States and its market valuation. To do so, they incorporate the state specific process of a removal of (bilateral) interstate banking restrictions in a gravity model to create an instrument that captures a bank holding company's level of geographic diversification.

Building upon their approach, I construct a bank-specific instrumental variable, based on the timing of intrastate branching deregulation, the distance and size of counties in a state, and bank specific characteristics. Specifically, I estimate the effect of distance and size of a bank's home county and another county on the degree of a bank's expansion into that county. Furthermore, I estimate how that effect changes once states remove their intrastate branching restrictions. Based on the gravity model, I hypothesize that a bank's share of deposits is larger (1) in counties that are closer to the bank's home county, and (2) in counties that are larger (in terms of population) than the bank's home county.

Additionally, I examine how the relationship between expansion, distance and size is different across bank types. In particular, I hypothesize that the link between expansion, distance and size differs by (1) a bank's charter authority (state or national charter) and (2) a bank's membership to the Federal Reserve System. Because of the McFadden Act of 1927 and the Banking Act of 1933, banks in the U.S. are subject to state specific banking laws irrespective of their charter type. Aside from smaller differences, a bank's charter choice determines its primary regulatory agency, which can be associated with additional costs: state chartered banks are supervised by state banking regulators and do not need to bear any costs due to supervision. National chartered banks, on the other hand, are supervised by the Office of the Comptroller of the Currency (OCC), which charges supervisory fees (Blair and Kushmeider (2006)). Anecdotal evidence also suggests, that banks choose state charters because state regulators, in contrast to national regulators, have a better understanding of a bank's business model in light of the local economy.[24] Hence, a bank's charter choice reflects its desire to expand within state borders, once states liberalize intrastate branching restrictions.

[24] See for instance *http://www.arkansas.gov/bank/benefits_why.html*

Aside from this, banks can also decide whether they want to become members of the Federal Reserve System. While national chartered banks are members of the Federal Reserve System by default, state chartered banks can apply for membership. The Federal Reserve bank of the bank's district decides whether to grant membership, and evaluates the bank's application based on factors such as, financial condition or general character of management. Membership to the Federal Reserve System provides banks with additional benefits. One of those benefits is, for instance, the privilege of voting for directors of the Federal Reserve bank. However, membership to the Federal Reserve System is also costly, as it requires banks to subscribe to the capital stock in the Federal Reserve bank of its district. Moreover, once state chartered banks are members of the Federal Reserve System, they are jointly supervised by the Federal Reserve and state banking regulators - although at no additional costs due to supervision.

Given these differences across bank types, I hypothesize that a removal of branching restrictions has different effects on banks' branching decisions. Compared to state chartered banks, I hypothesize that the effect of distance and size on expansion changes more for national chartered banks once states remove their branching restrictions. Similarly, I hypothesize that - compared to non-member banks - member banks of the Federal Reserve System have a greater incentive to expand once states liberalize their branching restrictions, implying that distance and size becomes less important once branching restrictions are removed.

4.3.2 Zero-Stage: Distance, Size and Intrastate Branching Deregulation

The following gravity-deregulation model estimates the effect of distance and size on the expansion of banks within state borders:

$$
\begin{aligned}
Share_{i,h,c,t} &= \alpha_1\, dist_{h,c} + \beta_1\, size_{h,c,t} + \alpha_2\, dist_{h,c} \times B_{i,t} + \beta_2\, size_{h,c} \times B_{i,t} + \\
&+ \alpha_3\, dist_{h,c} \times B_{i,t} \times I_i + \beta_3\, size_{h,c} \times B_{i,t} \times I_i + \\
&+ \alpha_4\, dist_{h,c} \times I_i + \beta_4\, size_{h,c} \times I_i + \Delta_{i,h,c,t} + \varepsilon_{i,h,c,t}
\end{aligned}
$$

$Share_{i,h,c,t}$ is the share of deposits bank i, headquartered in county h, holds in branches in county c in year t; $dist_{h,c}$ is the distance (in miles) between county h and county c; $size_{h,c,t}$ is the natural log of population in county h divided by population in county c; $B_{i,t}$ is a dummy variable taking on the value of one whether bank i's state removed its intrastate branching restrictions, or zero otherwise; I_i is an indicator variable taking on the value of one, (1) whether bank i had a national charter prior to intrastate branching deregulation, (2) and/or was a member of the Federal Reserve System prior to intrastate branching deregulation, or zero otherwise; $\Delta_{i,h,c,t}$ is a set of dummy variables accounting for fixed effects at the bank, county and year level.

The baseline effect of distance and size on banks' expansion is captured by the coefficients α_1 and β_1. Changes of this relationship due to a removal of intrastate branching restrictions are reflected in α_2 and β_2. Differential effects because of banks' charter type or their membership to the Federal Reserve System are captured by α_3 and β_3. As mentioned above, I hypothesize that banks have less deposits in branches that are further away, or branches that are located in relatively smaller counties, i.e. $\alpha_1 < 0$ and $\beta_1 < 0$. However, I expect this effect to be mitigated once states liberalize branching restrictions, i.e. $\alpha_2 > 0$ and $\beta_2 > 0$. Furthermore, I expect that the effect of distance and size on expansion decreases more for national banks or Federal Reserve member banks once states remove intrastate branching prohibitions.

Table VI presents results from an OLS estimation of the gravity-deregulation model where I use the share of deposits in percentage points as the dependent variable.[25] The results show that banks have a smaller share of deposits in counties that are (a) further away, and are (b) relatively smaller than their home county. The effect of distance and size on the share of deposits becomes smaller once states remove their branching restrictions. This also holds when I include bank fixed effects (column 2). In columns (3) to (5), I include the aforementioned bank specific variables, and results in Table VI suggest that distance is less important for a bank's expansion if the bank is a member of the Federal Reserve System and/or has a national charter.

The bank specific heterogeneity in the effect of distance on banks' intrastate expansion allows me to construct a projected expansion for each bank and year. To be consistent with my earlier analysis, I estimate the gravity-deregulation model where I use as dependent variable (1) an indicator taking on the value of one whether bank i has a branch in county c in year t, and (2) the squared share of deposits bank i holds in county c in year t. The projected variables are then aggregated at the bank-year level to construct instrumental variables for (1) a bank's number of active banking markets, and (2) a bank's deposit dispersion across markets. Similar to before, I construct instruments for competitors' expansion by taking the average of each variable in a county without including bank i and assigning it to bank i

[25] Due to the size of the data set, I demeaned the dependent and independent variables by hand to capture the reported fixed effects. Standard errors are robust and clustered at the bank level.

4.3.3 Second-stage regression results using instruments based on gravity-deregulation model

Table VII presents second stage regression results using instrumental variables based on the gravity-deregulation model. In particular, I use the gravity models of columns 3 and 5 in Table VI to construct instruments for a bank's organizational scope and the organizational scope of its competitors.[26]

Consistent with earlier findings, results in Table VII indicate that banks' risk taking decreases when competitor's expand (column 1), or when competitors increase their dispersion across markets (column 3). Because the gravity-deregulation model provides an instrumental variable at the *bank* level, I can also account for a bank's own change in its organizational structure in Table VII. The findings suggest that risk taking *increases* when a bank expands into more markets, consistent with the model. Furthermore, this pattern is consistent with hypothesis 2, which states that if a bank's expansion leads to an increase in risk, then it should also lead to a decrease in risk for competing banks.

In addition to earlier 2SLS results, I also include state-year fixed effects in Table VII. These fixed effects capture unobservable, time-varying changes at the state level and hence account for other confounding effect, such as changes in overall bankruptcy risk at the state.

4.4 Role of Information: Soft versus Hard Information

The model shows that the effect of (competitors') organizational structure on risk is stronger if borrowers in a market have less collateral to pledge, i.e. if borrowers are characterized by a larger degree of soft information. To analyze this, I use three variables to capture the degree of borrowers' information within a market, and test whether the effect of organizational

[26] Results from using instruments from other models are similar.

structure on risk taking is different in counties with more soft information borrowers.

4.4.1 Measures of Information

Opaqueness Morgan (2002) finds that some industries are more informational opaque than others.[27] For each industry, Morgan (2002) provides a statistic 'Kappa' characterizing informational asymmetries, where higher values of Kappa indicate less opaque industries. Using information provided by the U.S. Census in its 'County Business Patterns' (CBP), I first determine for each county and year the share of establishments at the two digit Standard Industry Classification (SIC) code, where I exclude the financial sector. I then aggregate this information at the county level by multiplying this share with Kappa to measure the informational content of borrowers in a market. Higher values indicate markets with more hard information borrowers.

Average Establishment Size Larger firms tend to be organized as corporations, which implies that they compile and report balance sheet information (= hard information). Because larger firms can be seen as hard information borrowers, markets with larger firms can be seen as markets with a more hard information borrowers. To capture this, I compute the average establishment size (= average number of employees per establishments) in a county using information from the CBP for each county and year.

Share of Nonproprietors' Income Proprietors' income is the current-production income of sole proprietorships, partnerships, and tax-exempt cooperatives.[28] Compared to businesses that are structured as legal entities, proprietorships are more opaque as their

[27]By comparing bond issues in several industries (Bank, Manufacturing, Mining, Trade, Services, Transportation, Public utilities, Insurance, Other finance and Real Estate), he finds that the financial sector is characterized by a greater degree of informational asymmetries since bond rating agencies disagree more often about their assessment of bond issues by financial institutions than about their assessment of other industries.

[28]A sole proprietorship is a business entity with no legal distinction between the owner and the business.

ability to provide hard information depends on the owner. Thus, a larger share of nonproprietors' income in a county's total earnings indicates that the county has more hard information borrowers. For each county, I determine the share of nonproprietors' income in 'Earnings by place of work' as reported by the Bureau of Economic Analysis in its Local Area Personal Income Statistic.[29]

The correlation of the information measures at a county level shows that all proxies are positively correlated. The pairwise correlation coefficient between Kappa and the share of nonproprietors' income is 0.39. Counties with a higher share of nonproprietor's income in total personal income also tend to have - on average - larger firms, as the correlation coefficient (0.69) between these two variables shows.

4.4.2 Second stage results

For each county, I first compute the level of information before states liberalize their intrastate branching restrictions, and then interact this variable with the measure of organizational form.

Table VIII presents regression results from a 2SLS regression where I first use the state level instruments (natural logarithm of the number of years since intrastate branching deregulation) and then instruments based on the gravity-deregulation model (gravity-model from column 6 in Table VI). Consistent with the theoretical framework, I find that the effect of competing banks' organizational structure on risk is smaller in counties with a larger share of hard information borrowers. This finding is also not sensitive to the definition of borrower information. In columns 4 to 6, I use instrumental variables based on the gravity-deregulation model. Again, the results indicate that a bank's expansion increases its risk and decreases

[29]'Earnings by place of work' is the sum of wage and salary disbursements, supplements to wages and salaries, and proprietors' income.

risk of competing banks, but this risk-reducing effect is less pronounced in counties with more hard information borrowers.

5 Conclusion

I find that the removal of intrastate branching restrictions in the United States is associated with a decrease in commercial banks' risk taking, but risk taking only decrease at banks that do not expand their geographic scope once states liberalize their branching restrictions. This finding cannot be attributed to risk-reducing benefits due to greater geographic diversification. Furthermore, this pattern can also not be explained by theories focusing on the interplay between market structure and bank risk, because the market structure of local banking markets did not change following the removal of branching restrictions.

I present a theoretical model building on earlier work from Stein (2002) and Acharya et al. (2011), to show how a bank's organizational structure, particularly its branch network across markets, affects its risk taking and also the risk taking of competing banks. The model argues that the organizational structure of banks has an effect on banks' lending behavior, which then determines their exposure to risk of failure. Because of competition for borrowers, there is also an effect on competing bank's risk taking. The model is not only able to explain the empirical pattern, but also yields additional hypotheses which I test empirically using instrumental variables technique and data from U.S. commercial banks.

By using the staggered timing of intrastate branching deregulation, and a gravity-deregulation model, I pin down the causal relationship of banks' organizational structure on risk taking of competing banks. In particular, I find that banks decrease risk taking when competitors increase their organizational structure, measured by the number of markets a bank is active in or its dispersion of deposits across markets. Moreover, my findings also suggest that a bank's own risk taking increases when it expands. The model and empirical findings also highlight the importance of borrower information since I find that the link between organizational scope and bank risk taking is more pronounced in markets where borrowers are less able to provide collateral.

References

Acharya, V. V., S. C. Myers, and R. G. Rajan (2011): "The Internal Governance of Firms," *Journal of Finance*, 66, 689–720.

Amel, D. and N. Liang (1992): "The Relationship between Entry into Banking Markets and Changes in Legal Restrictions on Entry," *Antitrust Bulletin*, 631 – 649.

Beck, T., R. Levine, and A. Levkov (2010): "Big Bad Banks: The Winners and Losers from Bank Deregulation in the United States," *Journal of Finance*, 65, 1637 – 1667.

Berger, A. N. and T. H. Hannan (1989): "The Price-Concentration Relationship in Banking," *The Review of Economics and Statistics*, 291 – 299.

Berger, A. N., N. H. Miller, M. A. Petersen, R. G. Rajan, and J. C. Stein (2005): "Does function follow organizational form? Evidence from the lending practices of large and small banks," *Journal of Financial Economics*, 76, 237–269.

Blair, C. E. and R. M. Kushmeider (2006): "Challenges to the Dual Banking System: The Funding of Bank Supervision," *FDIC Banking Review*, 18, 1 – 22.

Boot, A. W. A. and A. Schmeits (2000): "Market Discipline and Incentive Problems in Conglomerate Firms with Applications to Banking," *Journal of Financial Intermediation*, 9, 240 – 273.

Boyd, J. H. and G. de Nicolo (2005): "The Theory of Bank Risk Taking and Competition Revisited," *Journal of Finance*, 60, 1329–1343.

Boyd, J. H., G. de Nicolo, and A. M. Jalal (2007): "Bank Risk-Taking and Competition Revisited: New Theory and New Evidence," IMF working paper WP/06/297.

Boyd, J. H., G. de Nicolo, and E. Loukoianova (2009): "Banking Crises and Crisis Dating: Theory and Evidence," IMF working paper WP/09/141.

Boyd, J. H. and S. L. Graham (1996): "Consolidation in U.S. banking: implications for efficiency and risk," Federal Reserve Bank of Minneapolis Working Paper, no. 572.

Calomiris, C. W. and J. R. Mason (2000): "Causes of U.S. Bank Distress during the depression," NBER working paper 7919.

Carlson, M. and K. J. Mitchener (2009): "Branch Banking as a Device for Discipline: Competition and Bank Survivorship during the Great Depression," *Journal of Political Economy*, 117, 165–210.

de Nicolo, G. (2000): "Size, charter value and risk in banking: an international perspective," Board of Governors of the Federal Reserve System, International Finance Discussion Paper No.689.

Dell'Ariccia, G. and R. Marquez (2004): "Information and bank credit allocation," *Journal of Financial Economics*, 72, 185–214.

——— (2010): "Risk and the Corporate Structure of Banks," *Journal of Finance*, 65, 1075–1096.

Demsetz, R. S. and P. E. Strahan (1997): "Diversification, Size, and Risk at Bank Holding Companies," *Journal of Money, Credit, and Banking*, 29, 300–313.

Diamond, D. (1984): "Financial intermediation and delegated monitoring," *Review of Economic Studies*, 51, 393–414.

Dick, A. A. (2006): "Nationwide Branching and Its Impact on Market Structure, Quality and Bank Performance," *Journal of Business*, 79, 567–591.

Frankel, J. A. and D. Romer (1999): "Does Trade Cause Growth?" *American Economic Review*, 89, 379–399.

Goetz, M., L. Laeven, and R. Levine (2011): "The Valuation Effects of Geographically Diversified Bank Holding Companies," Mimeo.

Hertzberg, A., J. M. Liberti, and D. Paravisini (2010): "Information and Incentives Inside the Firm: Evidence from Loan Officer Rotation," *Journal of Finance*, 65, 795–828.

Jayaratne, J. and P. E. Strahan (1996): "The Finance-Growth Nexus: Evidence from Bank Branch Deregulation," *Quarterly Journal of Economics*, 111, 639–670.

Jimenez, G., J. A. Lopez, and J. Saurina (2010): "How does Competition Impact Bank Risk-Taking?" Mimeo, Banco de Espana.

Keeley, M. C. (1990): "Deposit Insurance, Risk, and Market Power in Banking," *American Economic Review*, 80, 1183–1199.

Kroszner, R. S. and P. E. Strahan (1999): "What Drives Deregulation? Economics and Politics of the Relaxation of Bank Branching Restrictions," *Quarterly Journal of Economics*, 114, 1437–1467.

Laeven, L., P. Bongini, and G. Majnoni (2002): "How Good is the Market at Assessing Bank Fragility? A Horse Race Between Different Indicators," *Journal of Banking and Finance*, 26, 1011–1028.

Laeven, L. and R. Levine (2009): "Bank governance, regulation and risk taking," *Journal of Financial Economics*, 93, 259–275.

Liberti, J. M. and A. R. Mian (2009): "Estimating the Effect of Hierarchies on Information Use," *The Review of Financial Studies*, 22, 4057–4090.

Martinez-Miera, D. and R. Repullo (2010): "Does Competition Reduce the Risk of Bank Failure?" *Review of Financial Studies*, 23, 3638–3664.

Mitchener, K. J. (2005): "Bank Supervision, Regulation, and Instability During the Great Depression," *The Journal of Economic History*, 65, 152–185.

Morgan, D. P. (2002): "Rating Banks: Risk and Uncertainty in an Opaque Industry," *American Economic Review*, 92, 874–888.

Morgan, D. P., B. Rime, and P. E. Strahan (2004): "Bank Integration and State Business Cycles," *Quarterly Journal of Economics*, 1555–1584.

Petersen, M. A. and R. G. Rajan (1995): "The Effect of Credit Market Competition on Lending Relationships," *Quarterly Journal of Economics*, 110, 407–443.

Rhoades, S. A. (2000): "Bank Mergers and Banking Structure in the United States 1980 - 1998," Federal Reserve Board - Staff Study 174.

Roy, A. (1952): "Safety First and the Holding of Assets," *Econometrica*, 431–449.

Stein, J. C. (2002): "Information Production and Capital Allocation: Decentralized versus Hierarchical Firms," *Journal of Finance*, 57, 1891–1921.

Stiroh, K. J. and P. E. Strahan (2003): "Competitive Dynamics of Deregulation: Evidence from U.S. Banking," *Journal of Money, Credit, and Banking*, 35, 801–828.

Figures

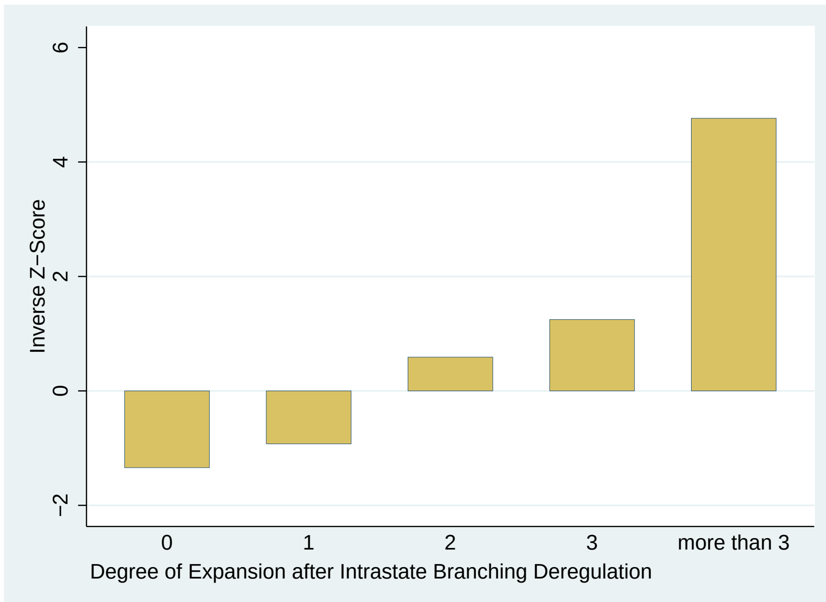


Figure 1: Change in risk taking by degree of expansion
Note: Figure 1 plots the estimated coefficients from regression of model 2 with inverse Z-Score as dependent variable. The regression model controls for bank and county specific variables.

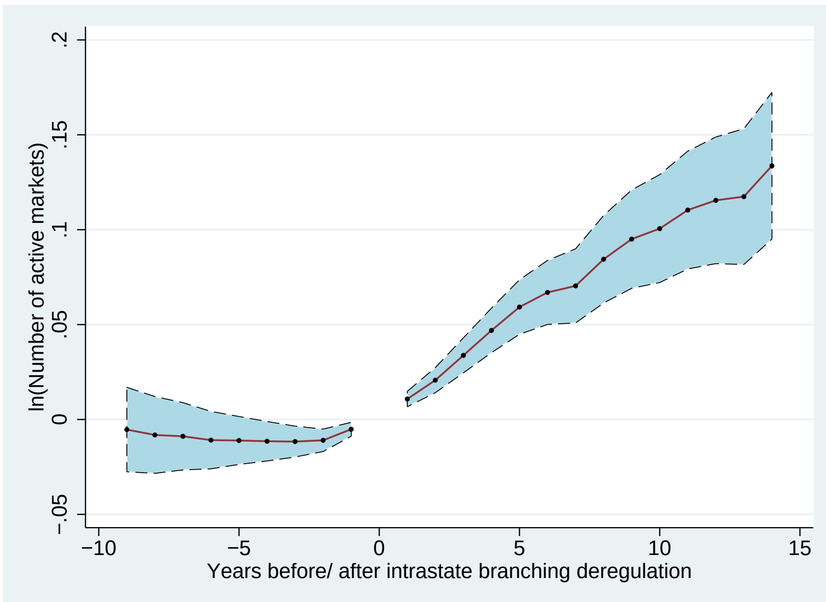


Figure 2: Effects of intrastate branching deregulation on organizational structure

Note: This figure illustrates the dynamic effects of intrastate branching deregulation on the natural log of banking markets. The regression model is given as $ln(M_{i,s,t}) = \sum_{p=-10}^{15} \alpha_p Y_{p,s,t} + \tilde{\delta_i} + \tilde{\delta_t} + \tau_{i,s,t}$ where $ln(M_{i,s,t})$ is the log number of banking markets bank i, located in state s, is active in during year t, $Y_{p,s,t}$ is a dummy variable that takes on the value of one if in year t deregulation in a state s is in p years. The figure plots the estimates on the dummy variables (α_p) as well as the 95 percent confidence interval for these estimates. The regression adjusts for bank-level clustering and centers around the year of deregulation.

Tables

Table I: Summary Statistics

Variable	N	Mean	Std.Dev.	Min	Max	Median
Inverse Z-Score	185075	21.555	18.739	2.802	119.146	15.395
Distress Indicator	198632	.014	.117	0	1	0
CAMEL-Indicator	146135	.846	.896	0	4	1
Return on Assets (in %)	218579	.575	.386	-2.329	1.708	.584
Standard Deviation (ROA)	189548	20.682	17.593	2.273	101.433	14.772
=1 if bank part of Bank Holding Company	221882	.592	.491	0	1	1
Capital-Asset-Ratio (in %)	219561	9.45	3.068	4.007	32.424	8.756
Total Loans / Total Assets	221880	.549	.142	0	1.124	.563
Total Assets (in 1,000 $)	221880	124994	716144	144	$5.26*10^7$	38187
ln(Number banking markets)	221882	.159	.411	0	4.060	0
Herfindahl Index of deposits across counties	221882	.095	.242	0	1	0
ln(Number of competitor's banking markets)	210443	.205	.361	0	3.611	0
1 - Competitor's Herfindahl Index of deposits across counties	210443	.096	.174	0	1	0
Average Kappa in County	220561	.314	.032	0	.57	.320
Share of Proprietor's Income (in %)	219651	16.860	10.361	.020	83.891	13.869
Growth of county personal income	220483	0.072	0.068	-0.682	2.641	0.066
Growth of county personal income (lag)	220483	0.073	0.067	-0.682	2.641	0.067
ln(Number of Branches in County)	221882	2.672	1.196	0	6.472	2.485
ln(Number of Banks in County)	221882	1.767	0.976	0	5.598	1.609
Population per branch in county (in 1,000s)	220489	3.752	2.788	.281	160.136	3.132
Herfindahl Index of deposits in county	221882	0.114	0.137	0	1	0.084

Table II: Intrastate Branching Deregulation and Bank Risk

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent Variable:	Inverse Z-Score	Inverse Z-Score	Inverse Z-Score	Inverse Z-Score	Inverse Z-Score	CAMEL Rating	Distress Indicator
=1 if Intrastate Branching Deregulation	-0.416*	-0.701***	-0.742***	-1.306***	-0.923***	-0.030**	-0.012***
	(0.253)	(0.249)	(0.252)	(0.274)	(0.280)	(0.012)	(0.001)
(=1 if Intrastate Branching Deregulation) * (Expansion after Intrastate Branching Deregulation)				1.662***	1.524***	0.075***	0.014***
				(0.314)	(0.314)	(0.016)	(0.002)
=1 if Interstate Branching Deregulation		-2.801***	-2.639***	-2.666***	-3.271***	-0.047***	-0.008***
		(0.334)	(0.336)	(0.336)	(0.348)	(0.014)	(0.002)
Capital-Asset-Ratio		-1.723***	-1.728***	-1.726***	-1.720***	-0.047***	0.008***
		(0.037)	(0.038)	(0.038)	(0.037)	(0.002)	(0.000)
Total Loans / Total Assets		6.014***	5.981***	5.917***	6.205***	0.875***	0.037***
		(0.712)	(0.713)	(0.712)	(0.718)	(0.034)	(0.005)
=1 if bank part of Bank Holding Company		-2.207***	-2.226***	-2.246***	-2.358***	-0.015	0.003**
		(0.220)	(0.220)	(0.220)	(0.220)	(0.012)	(0.001)
ln(Total Assets)		-2.380***	-2.835***	-3.095***	-3.291***	-0.063***	-0.034***
		(0.248)	(0.254)	(0.256)	(0.255)	(0.013)	(0.002)
Growth of county personal income			-5.362***	-5.343***	-4.693***	-0.123***	0.011**
			(0.763)	(0.763)	(0.760)	(0.046)	(0.005)
Growth of county personal income (lag)			-4.403***	-4.340***	-4.003***	-0.214***	0.005
			(0.721)	(0.720)	(0.723)	(0.047)	(0.005)
ln(Number of Branches in County)			3.568***	3.561***	3.387***	0.136***	0.004
			(0.560)	(0.559)	(0.563)	(0.032)	(0.004)
ln(Number of Banks in County)			-0.673**	-0.665**	-0.584*	0.001	0.005***
			(0.320)	(0.319)	(0.319)	(0.015)	(0.002)
Population per branch in county			-0.003	-0.009	0.012	0.022***	0.001
			(0.114)	(0.113)	(0.113)	(0.008)	(0.001)
Herfindahl Index of deposits in county			4.111***	4.076***	4.096***	0.087*	0.035***
			(1.048)	(1.050)	(1.051)	(0.049)	(0.006)
Bank fixed effects	✓	✓	✓	✓	✓	✓	✓
Year fixed Effects	✓	✓	✓	✓			
Region-Year fixed effects					✓	✓	✓
Observations	192,986	185,075	184,016	184,016	184,016	144,025	197,488
Number of Banks	10,585	10,571	10,467	10,467	10,467	10,302	10,512

This table reports regression results from a bank and year/region-year fixed effects OLS analysis. The dependent variable given in the first row. Inverse Z-Score is (Standard Deviation of ROA)/(ROA + Capital-Asset-Ratio)*1000; CAMEL-Rating are constructed following Laeven et al. (2002); Distress Indicator takes on a value of one if a bank's capital-asset ratio drop by more than 1 percentage point on two consecutive years. '=1 if Interstate Branching Deregulation' is a dummy taking on the value of one the year after a state deregulates its interstate branching restrictions. Growth of personal income in year t is given as (personal income in year t - personal income in year t-1)/(personal income in year t-1). Total Loans / Total Assets is defined as (Total Loans)/(Total Assets); ln(total assets) = natural log of total assets; Capital-Asset-Ratio is defined as (Bank Capital)/(Total Assets). '=1 if bank part of Bank Holding Company' is equal to one if the bank is part of a bank holding company; 'Ln(Number of Banks in County)' is the natural logarithm of chartered banks in the banking market; 'Ln(Number of Branches in County)' is the natural logarithm of all branches in the banking market, 'Population per branch' is the number of county population (in 1000) per bank branches; 'Herfindahl Index of deposits in county' is the Herfindahl Index of deposits across competitors in a banking market. The constant is not reported. Standard errors are robust, clustered at the bank level and reported in parentheses below. Significance stars are: * $p<0.10$, ** $p<0.05$, *** $p<0.01$.

Table III: Intrastate Branching Deregulation and Bank Risk - Robustness

	(1)	(2)	(3)	(4)	(5)	(6)
Exclude...	...failing banks	...fail and/or acquired banks	...+/-1 year around acquisition	...once a bank acquires another bank	...every other year	...every third year
=1 if Intrastate Branching Deregulation	-0.916***	-1.243***	-0.820***	-1.030***	-1.076***	-0.768**
	(0.281)	(0.369)	(0.292)	(0.300)	(0.303)	(0.366)
(=1 if Intrastate Branching Deregulation) * (Expansion after Intrastate Branching Deregulation)	1.621***	2.004***	0.893***	0.870**	1.378***	1.228***
	(0.314)	(0.400)	(0.338)	(0.349)	(0.340)	(0.381)
=1 if Interstate Branching Deregulation	-3.131***	-3.740***	-3.268***	-3.326***	-3.905***	-1.917***
	(0.350)	(0.445)	(0.362)	(0.364)	(0.388)	(0.456)
Capital-Asset-Ratio	-1.698***	-1.530***	-1.784***	-1.876***	-1.792***	-1.828***
	(0.037)	(0.047)	(0.040)	(0.044)	(0.044)	(0.051)
Total Loans / Total Assets	6.130***	6.820***	6.349***	5.951***	5.888***	6.468***
	(0.722)	(0.923)	(0.756)	(0.794)	(0.816)	(0.957)
=1 if bank part of Bank Holding Company	-2.345***	-1.778***	-2.007***	-2.049***	-1.997***	-2.393***
	(0.222)	(0.291)	(0.227)	(0.234)	(0.248)	(0.282)
ln(Total Assets)	-3.331***	-3.370***	-4.410***	-3.600***	-2.699***	-3.155***
	(0.256)	(0.324)	(0.294)	(0.305)	(0.291)	(0.327)
Growth of county personal income	-4.299***	-2.333***	-4.619***	-4.673***	-4.649***	-4.182**
	(0.757)	(0.890)	(0.773)	(0.837)	(1.103)	(1.632)
Growth of county personal income (lag)	-3.902***	-2.217**	-3.853***	-4.028***	-4.517***	2.841**
	(0.725)	(0.862)	(0.735)	(0.782)	(1.101)	(1.317)
ln(Number of Branches in County)	3.377***	2.600***	3.722***	4.291***	3.203***	4.353***
	(0.564)	(0.775)	(0.595)	(0.672)	(0.637)	(0.740)
ln(Number of Banks in County)	-0.651**	-0.953**	-0.417	-0.642*	-0.322	-1.162***
	(0.320)	(0.388)	(0.348)	(0.358)	(0.352)	(0.412)
Population per branch in county	0.025	-0.076	0.153	0.324**	-0.059	0.087
	(0.113)	(0.184)	(0.120)	(0.147)	(0.133)	(0.154)
Herfindahl Index of deposits in county	4.118***	3.537***	3.119***	3.095***	3.367***	2.502*
	(1.051)	(1.197)	(1.127)	(1.146)	(1.115)	(1.408)
Bank fixed effects	✓	✓	✓	✓	✓	✓
Region-Year fixed effects	✓	✓	✓	✓	✓	✓
Observations	181,501	105,398	169,852	154,200	88,633	57,079
Number of Banks	10,137	4,527	10,357	10,325	10,405	10,265

This table reports regression results from a bank and region-year fixed effects OLS analysis using different subsamples. The sample selection criteria given in the first row. The dependent variable is Inverse Z-Score, which is defined as (Standard Deviation of ROA)/(ROA + Capital-Asset-Ratio)*1000. '=1 if Interstate Branching Deregulation' is a dummy taking on the value of one the year after a state deregulates its interstate branching restrictions. Growth of personal income in year t is given as (personal income in year t - personal income in year t-1)/(personal income in year t-1). Total Loans / Total Assets is defined as (Total Loans)/(Total Assets); ln(total assets) = natural log of total assets; Capital-Asset-Ratio is defined as (Bank Capital)/(Total Assets). '=1 if bank part of Bank Holding Company' is equal to one if the bank is part of a bank holding company; 'Ln(Number of Banks in County)' is the natural logarithm of chartered banks in the banking market; 'Ln(Number of Branches in County)' is the natural logarithm of all branches in the banking market, 'Population per branch' is the number of county population (in 1000) per bank branches; 'Herfindahl Index of deposits in county' is the Herfindahl Index of deposits across competitors in a banking market. The constant is not reported. Standard errors are robust, clustered at the bank level and reported in parentheses below. Significance stars are: * p<0.10, ** p<0.05, *** p<0.01.

Table IV: The impact of Competitor's Organizational Structure on Bank Risk - Instruments based on Intrastate Branching Deregulation

Panel A: Second Stage

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ln(Number of competitor's banking markets)	-21.030**	-12.013**	-9.624*	-13.967***				
	(9.348)	(5.191)	(4.999)	(5.098)				
1 - Competitor's Herfindahl Index of deposits across counties					-54.243**	-50.798***	-38.241**	-41.495***
					(25.189)	(16.739)	(15.188)	(15.710)
Bank and Macro Controls	✓	✓	✓	✓	✓	✓	✓	✓
Bank fixed effects	✓	✓	✓	✓	✓	✓	✓	✓
Year fixed Effects	✓	✓	✓	✓	✓	✓	✓	✓
Observations	174,735	183,375	183,375	183,375	174,735	183,375	183,375	183,375
F Test of instruments' joint significance	51.85	54.58	16.22	115.3	26.29	21.50	7.758	43.86
Number of Banks	10,161	10,205	10,205	10,205	10,161	10,205	10,205	10,205
Excluded Instrument:								
=1 if Intrastate Branching Deregulation	✓				✓			
Years since Intrastate Branching Deregulation		✓				✓		
(Years since Intrastate Branching Deregulation)^2		✓				✓		
Years since Intrastate Branching Deregulation[nonparametric]			✓				✓	
ln(Years since Intrastate Branching Deregulation +1)				✓				✓

This panel reports regression results from a bank and year fixed effects 2SLS. The dependent variable is Inverse Z-Score, which is defined as (Standard Deviation of ROA)/(ROA + Capital-Asset-Ratio)*1000. The endogenous variable 'ln(Number of competitor's banking markets)' is the natural logarithm of the number of counties a bank's competitor has branches in, and '1- Competitor's Herfindahl Index of deposits across counties' is the average sum of squared deposit shares across counties for a bank's competitors. The excluded instruments are '=1 if Intrastate Branching Deregulation' which is a dummy variable taking on the value of one after states liberalized their intrastate branching restrictions, 'Years since Intrastate Branching Deregulation' is the number of years since the liberalization of intrastate branching deregulation (up to ten years), 'Years since Intrastate Branching Deregulation [nonparametric]' is a set of independent dummy variables for each year since a state removed its branching restrictions, taking a value of one all the way through the first ten years after deregulation, and zero otherwise. All regressions include the set of bank and macro control variables: Total Loans / Total Assets, Ln(total assets), Capital-Asset-Ratio, =1 if bank part of Bank Holding Company, Growth of personal income, and a lag thereof, Ln(Number of Banks in County),Ln(Number of Branches in County), Population per branch, Herfindahl Index of deposits in county. The constant is not reported. Standard errors are robust, clustered at the bank level and reported in parentheses below. Significance stars are: * p<0.10, ** p<0.05, *** p<0.01.

Panel B: First Stage

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
=1 if Intrastate Branching Deregulation	2.887***				1.119***			
	(0.401)				(0.218)			
Years since intrastate branching deregulation		1.535***				0.566***		
		(0.170)				(0.093)		
(Years since intrastate branching deregulation)2		-0.071***				-0.032***		
		(0.016)				(0.009)		
ln(Years since intrastate branching deregulation)				3.493***				1.176***
				(0.325)				(0.178)
=1 if one year after intrastate branching deregulation, 0 otherwise			2.542***				0.981***	
			(0.265)				(0.144)	
=1 if two years after intrastate branching deregulation, 0 otherwise			3.967***				1.514***	
			(0.336)				(0.183)	
=1 if three years after intrastate branching deregulation, 0 otherwise			4.658***				1.623***	
			(0.420)				(0.228)	
=1 if four years after intrastate branching deregulation, 0 otherwise			5.012***				1.952***	
			(0.517)				(0.281)	
=1 if five years after intrastate branching deregulation, 0 otherwise			5.981***				2.229***	
			(0.556)				(0.304)	
=1 if six years after intrastate branching deregulation, 0 otherwise			6.512***				2.214***	
			(0.654)				(0.361)	
=1 if seven years after intrastate branching deregulation, 0 otherwise			7.463***				2.418***	
			(0.750)				(0.405)	
=1 if eight years after intrastate branching deregulation, 0 otherwise			8.261***				2.539***	
			(0.838)				(0.446)	
=1 if nine years after intrastate branching deregulation, 0 otherwise			8.379***				2.609***	
			(0.905)				(0.488)	
=1 if more than 10 years after intrastate branching deregulation, 0 otherwise			8.991***				2.888***	
			(1.024)				(0.563)	
Bank and Macro Controls	✓	✓	✓	✓	✓	✓	✓	✓
Bank fixed effects	✓	✓	✓	✓	✓	✓	✓	✓
Year fixed Effects	✓	✓	✓	✓				
Observations	174,735	183,375	183,375	183,375	174,735	183,375	183,375	183,375
F Test of instruments' joint significance	51.85	54.58	16.22	115.3	26.29	21.50	7.758	43.86
Number of Banks	10,161	10,205	10,205	10,205	10,161	10,205	10,205	10,205

Table V: The impact of Competitor's Organizational Structure on Bank Risk - Instruments based on Intrastate Branching Deregulation - Robustness

	(1)	(2)	(3)	(4)	(5)	(6)
Exclude...	...failing banks	...fail and/or acquired banks	...once a bank acquires another bank	...+/-1 year around acquisition		
Dependent Variable:	Inverse Z-Score	Inverse Z-Score	Inverse Z-Score	Inverse Z-Score	CAMEL Rating	Distress Indicator
ln(Number of competitor's banking markets)	-25.867***	-30.205***	-39.928***	-37.861***	-1.095**	-0.097***
	(5.793)	(10.322)	(8.107)	(8.114)	(0.446)	(0.029)
Bank and Macro Controls	✓	✓	✓	✓	✓	✓
Bank fixed effects	✓	✓	✓	✓	✓	✓
Region-Year fixed effects	✓	✓	✓	✓	✓	✓
Observations	180,796	102,886	169,356	153,411	106,269	152,983
F Test of instruments' joint significance	100.9	30.48	69.83	71.16	26.81	71.20
Number of Banks	9,898	4,422	10,061	9,944	9,160	9,933

This panel reports regression results from a 2SLS analysis using different subsamples and fixed effects. The sample selection criteria given in the first row. The dependent variables are: Inverse Z-Score, defined as (Standard Deviation of ROA)/(ROA + Capital-Asset-Ratio)*1000, CAMEL-Rating are constructed following Laeven et al. (2002), Distress Indicator takes on a value of one if a bank's capital-asset ratio drop by more than 1 percentage point on two consecutive years. The endogenous variable 'ln(Number of competitor's banking markets)' is the natural logarithm of the number of counties a bank's competitor has branches in. The excluded instruments are '=1 if Intrastate Branching Deregulation' which is a dummy variable taking on the value of one after states liberalized their intrastate branching restrictions, 'Years since Intrastate Branching Deregulation' is the number of years since the liberalization of intrastate branching deregulation (up to ten years), 'Years since Intrastate Branching Deregulation [nonparametric]' is a set of independent dummy variables for each year since a state removed its branching restrictions, taking a value of one all the way through the first ten years after deregulation, and zero otherwise. All regressions include the set of bank and macro control variables: Total Loans / Total Assets, Ln(total assets), Capital-Asset-Ratio, =1 if bank part of Bank Holding Company, Growth of personal income, and a lag thereof, Ln(Number of Banks in County),Ln(Number of Branches in County), Population per branch, Herfindahl Index of deposits in county. The constant is not reported. Standard errors are robust, clustered at the bank level and reported in parentheses below. Significance stars are: * $p<0.10$, ** $p<0.05$, *** $p<0.01$.

Table VI: The relationship between population, distance and banks' deposit holdings: Zero-Stage

		(1)	(2)	(3)	(4)	(5)
	ln(Distance in miles)	-8.199***	-8.200***	-8.294***	-8.294***	-8.294***
		(0.0437)	(0.0437)	(0.0559)	(0.0559)	(0.0559)
	ln(Population-ratio)	-0.222***	-0.244***	-0.267***	-0.267***	-0.267***
		(0.0283)	(0.0308)	(0.0389)	(0.0389)	(0.0389)
	(=1 if Intrastate Branching Deregulation) * ln(Distance (in miles))	0.0129***	0.0136***	0.00924***	0.00924***	0.00924***
		(0.00106)	(0.00110)	(0.00126)	(0.00126)	(0.00126)
	(=1 if Intrastate Branching Deregulation) * ln(Population-ratio))	0.00472**	0.00598**	0.00831**	0.00831**	0.00831**
		(0.00238)	(0.00249)	(0.00333)	(0.00333)	(0.00333)
(=1 if bank was member of Federal Reserve System prior to Branching Deregulation)	* (=1 if Intrastate Branching Deregulation) * ln(Distance (in miles))			0.00961***		0.00639***
				(0.00230)		(0.00248)
	* (=1 if Intrastate Branching Deregulation) * ln(Population-ratio))			-0.00599		-0.00567
				(0.00503)		(0.00535)
(=1 if bank held Federal Banking Charter prior to Branching Deregulation) *	* (=1 if Intrastate Branching Deregulation) * ln(Distance (in miles))				0.00639***	
					(0.00248)	
	* (=1 if Intrastate Branching Deregulation) * ln(Population-ratio))				-0.00567	
					(0.00535)	
(=1 if bank was member of Federal Reserve System AND holds State charter prior to Branching Deregulation)	* (=1 if Intrastate Branching Deregulation) * ln(Distance (in miles))				0.0142***	0.00781*
					(0.00439)	(0.00472)
	* (=1 if Intrastate Branching Deregulation) * ln(Population-ratio))				-0.00424	0.00143
					(0.00872)	(0.00908)
	County fixed effects	✓	✓	✓	✓	✓
	Bank fixed effects		✓	✓	✓	✓
	Group specific distance and population effect			✓	✓	✓
	Observations	24,130,604	24,130,604	24,130,604	24,130,604	24,130,604

This table reports regression results from a fixed effects OLS analysis. The dependent variable is the share of deposits (in %) a bank holds in county A. 'ln(Distance in miles)' is the natural logarithm of the distance between a bank's home county and county A, 'Population ratio' is the population in a bank's home county divided by the population in county A. Standard errors are robust, clustered at the bank level and reported in parentheses below. Significance stars are: * $p<0.10$, ** $p<0.05$, *** $p<0.01$.

Table VII: The impact of Competitor's Organizational Structure on Bank Risk - Instrumental Variables based on a Branching Deregulation-Gravity Model

Panel A: Second Stage

	(1)	(2)	(3)	(4))
ln(Number of competitor's banking markets)	-24.835***	-20.582***		
	(5.566)	(5.281)		
ln(Number banking markets)	22.604***	21.267***		
	(2.825)	(2.810)		
1 - Competitor's Herfindahl Index of deposits across counties			-119.860***	-57.428**
			(32.045)	(22.911)
1 - Herfindahl Index of deposits across counties			72.727***	53.418***
			(12.339)	(9.902)
Bank and Macro Controls	✓	✓	✓	✓
Bank fixed effects	✓	✓	✓	✓
State-Year fixed Effects	✓	✓	✓	✓
Observations	178,951	178,951	178,951	178,951
Number of Banks	10,009	10,009	10,009	10,009
Excluded Instrument:				
Number of banking markets (predicted)	✓	✓		
Herfindahl Index of assets across counties (predicted)			✓	✓
Variables in Zero Stage:				
ln(Distance)	✓	✓	✓	✓
ln(Population-ratio)	✓	✓	✓	✓
(=1 if bank was member of Federal Reserve System prior to Branching Deregulation) * ln(Distance)	✓	✓	✓	✓
(=1 if bank was member of Federal Reserve System prior to Branching Deregulation) * ln(Population-ratio)	✓	✓	✓	✓
(=1 if bank was member of Federal Reserve System AND holds State charter prior to Branching Deregulation) * ln(Distance)		✓		✓
(=1 if bank was member of Federal Reserve System AND holds State charter prior to Branching Deregulation) * ln(Population-ratio)		✓		✓

This panel reports 2nd stage regression results from a bank and state-year fixed effects 2SLS analysis. The dependent variable is Inverse Z-Score, defined as (Standard Deviation of ROA)/(ROA + Capital-Asset-Ratio)*1000. The endogenous variables are: ln(Number of banking markets), which is the natural logarithm of the number of counties a bank has branches in, ln(Number of competitor's banking markets) is the natural logarithm of a bank's competitors' average number of banking markets, 1 - Herfindahl index of deposits across counties is the sum of squared deposit shares across counties for each bank, 1 - Competitor's Herfindahl Index of deposits across counties is the bank's competitors' average concentration of deposits across counties. The excluded instruments are from a gravity-deregulation model (see Table VI). Variables used in the gravity deregulation model are reported in the table. Standard errors are robust, clustered at the bank level and reported in parentheses below. Significance stars are: * p<0.10, ** p<0.05, *** p<0.01.

Table VIII: The impact of Competitor's Organizational Structure on Bank Risk - Differential Effects across counties

	(1)	(2)	(3)	(4)	(5)	(6)
Information Index	Kappa	Average Establishment Size	Share of Non-proprietors' Income	Kappa	Average Establishment Size	Share of Non-proprietors' Income
Instrument based on:	Intrastate Branching Deregulation			Gravity-Branching Deregulation Model		
ln(Number of competitor's banking markets)	-26.721***	-27.586***	-35.704***	-31.896***	-40.091***	-27.360***
	(7.529)	(8.045)	(9.002)	(7.244)	(8.355)	(7.004)
ln(Number of competitor's banking markets) * Information Index	10.315***	15.356***	19.395***	20.771***	22.931***	19.885***
	(1.416)	(1.920)	(2.877)	(4.229)	(3.665)	(4.393)
ln(Number of banking markets)				18.104***	18.381***	21.572***
				(3.440)	(3.778)	(3.880)
ln(Number of banking markets) * Information Index				-5.238	-4.432	-4.216
				(3.947)	(2.922)	(4.076)
Bank and Macro Controls	✓	✓	✓	✓	✓	✓
Bank fixed effects	✓	✓	✓	✓	✓	✓
Year fixed effects	✓	✓	✓			
State-Year fixed effects				✓	✓	✓
Observations	154,844	154,239	155,080	178,644	177,438	178,951
Number of Banks	9,709	9,628	9,724	9,992	9,860	10,009
Excluded Instrument:						
ln(Years since Intrastate Branching Deregulation)	✓	✓	✓			
Number of banking markets (predicted)				✓	✓	✓

This panel reports 2nd stage regression results from a bank and state-year fixed effects 2SLS analysis. The dependent variable is Inverse Z-Score, defined as (Standard Deviation of ROA)/(ROA + Capital-Asset-Ratio)*1000. The endogenous variables are: ln(Number of banking markets), which is the natural logarithm of the number of counties a bank has branches in, and ln(Number of competitor's banking markets) is the natural logarithm of a bank's competitors' average number of banking markets. These variables are interacted with an Information Index (given in first row of table). Kappa is the average Kappa (Morgan, 2002 within a county, Average Establishment Size is the average employment size of an establishment within a county, Share of Nonproprietors' Income is the share of county earnings that are generated from nonproprietors. The excluded instruments are from the log number of years since the removal of branching restrictions, or come from a gravity-deregulation model ('Number of banking markets (predicted)'). Standard errors are robust, clustered at the bank level and reported in parentheses below. Significance stars are: * p¡0.10, ** p¡0.05, *** p¡0.01.

A Mathematical Appendix

1 Preliminaries

1.1 Probability of success $p(e)$ concave in e

$$p'(e) = \frac{\partial p}{\partial e} > 0 \quad p''(e) = \frac{\partial^2 p}{\partial e^2} < 0$$

1.2 Sufficient condition to ensure equilibrium

Suppsoe that:

$$\frac{\partial \mu_H}{\partial A} - \frac{\partial \mu_S}{\partial A} + \beta^2 \frac{\partial \mu_H^2}{\partial^2 A} + \beta(1-\beta)\frac{\partial \mu_S^2}{\partial^2 A} \leq 0 \quad \forall \beta \in [0,1]$$

1.3 Probability of becoming next CEO

Let two loan officers of the same bank be denoted by i and j. Loan officer i will become the next CEO is his expected profit $E(\pi_i)$ net of the CEO's evaluation cost are higher than j's expected profits net of evaluation cost, ie.

$$\begin{aligned} pr_i(i \text{ becomes next CEO}) &= pr(E(\pi_i) - c(\beta_i) > E(\pi_j) - c(\beta_j)) \\ &= pr\left(E(\pi_i) - E(\pi_j) > c(\beta_i) - c(\beta_j)\right) \end{aligned}$$

Because the payoff for each borrower type is binomially distributed, a loan officer's loan portfolio is also normally distributed. Let the difference between loan officers' profits be denoted as $X = E(\pi_i) - E(\pi_j)$. X is also normally distributed with mean $\hat{\mu}$ and variance $\hat{\sigma^2}$. Furthermore, let the cumulative distribution function of X be given by $F(X)$. Then the probability of loan officer i to become the next CEO is given by

$$\begin{aligned} pr_i(i \text{ becomes next CEO}) &= pr(X > c(\beta_i) - c(\beta_j)) \\ &= 1 - F(c(\beta_i) - c(\beta_j)) \end{aligned} \tag{A-1}$$

Taking the derivative of equation A-1 with respect to β_i yields:

$$\frac{\partial pr_i}{\partial \beta_i} = -f(c(\beta_i) - c(\beta_j)) \times \frac{\partial c}{\partial \beta_i} > 0 \tag{A-2}$$

Note that $f(\cdot) > 0$ is the pdf, and therefore positive. Evaluation costs are supposed to decrease in β which implies that $\frac{\partial pr_i}{\partial \beta_i} > 0$.

2 Proofs

2.1 Lemma 1: Risk-Shifting

The choice of effort by entrepreneurs is given by the following equation

$$p'(e)[R - r_L - \lambda] - e = 0 \tag{A-3}$$

This implicit function gives the optimal choice of effort (e^*) as a function of loan rates (r_L) and collateral (λ). Let (A-3) be denoted by the function $G(e, r_L)$. Applying the implicit function theorem shows that effort is decrease in the loan rate.

$$\frac{\partial e^*}{\partial r_L} = -\frac{G_{r_L}}{G_e} = \frac{p'^2}{p' - ep''} < 0$$

Because the success probability $p(e)$ is decreasing in effort it can be shown that it is also decreasing in the loan rate:

$$\frac{\partial p}{\partial r_L} = \frac{\partial p}{\partial e}\frac{\partial e}{\partial r_L} < 0$$

2.2 Proposition 1: Differentiation

Let the competing loan officer's choice of hard information borrowers be given by α. Total supply of credit to hard information borrowers is therefore $\alpha + \beta_i$. A loan officer's optimal choice of β is given by the following implicit function $H(\cdot)$:

$$H = (1-\gamma)\frac{\partial E(\pi_i)}{\partial A}\frac{\partial A}{\partial \beta_i} + \frac{\partial pr_i}{\partial \beta_i}\frac{2}{1+\rho}\bar{\Pi} = 0 \tag{A-4}$$

Because β_i^* maximizes a loan officer's expected profits, the second order condition is supposed to be negative at β^*, ie. $H_{\beta_i} < 0$. The derivative of a loan officer's expected profit with respect to β is given as

$$\frac{\partial E(\pi_i)}{\partial \beta_i} = \beta_i\frac{\partial \mu_H}{\partial \beta_i} + (1-\beta_i)\frac{\partial \mu_S}{\partial \beta_i} + \mu_H - \mu_S$$

where μ_H/μ_S is the expected payoff from borrowing to hard/ soft information borrowers with $\mu_H = p_H(A)(r_H(A)+1) + (1-p_H)\lambda$ and $\mu_S = p_S(A)(r_S+1)$.

Using the implicit function theorem, we get

$$\frac{\partial \beta_i}{\partial \alpha} = -\frac{H_\alpha}{H_{\beta_i}}$$

because the second order condition H_{β_i} is negative. Taking the partial derivative of (A-4) gives $H_\alpha = H_{\beta_i} - \frac{\mu_H}{\partial A} + \frac{\mu_S}{\partial A}$ and hence

$$\frac{\partial \beta_i}{\partial \alpha} = -\frac{H_\alpha}{H_{\beta_i}} = \frac{\frac{\partial \mu_H}{\partial A} - \frac{\partial \mu_S}{\partial A}}{H_{\beta_i}} - 1$$

2.3 Proposition 2: Effect of collateral

Using the implicit function theorom gives:

$$\frac{\partial \beta_i}{\partial \lambda} = -\frac{H_\lambda}{H_{\beta_i}} \tag{A-5}$$

where H is defined in equation (A-4). Because H_{β_i} is negative due to the second order condition, and $H_\lambda = (1-\gamma)\frac{\partial A}{\partial \beta}\left(1 - p_H - \beta\frac{\partial p_H}{\partial A}\right)$ we have

$$\frac{\partial \beta_i}{\partial \lambda} \propto 1 - p_H(A)(\varepsilon_{p_H,\beta} + 1)$$

where $\varepsilon_{p_H,\beta}$ is the elasticity of a hard information borrowers success probability with respect to β, ie. $\varepsilon_{p_H,\beta} = \dfrac{\partial p_H/p_H}{\partial \beta/\beta} > 0$. While this elasticity is always positive, the magnitude depends on parameter values.

2.4 Proposition 3: Effect of hierarchy on β

Suppose a bank consists of N branches. Then loan officer i's probability of becoming the next CEO is given by

$$pr_i(i \text{ becomes the next CEO}) = (1-F)^{N-1}$$

In the case of N branches, a loan officer's optimal choice of β is given by the following implicit function

$$H = (1-\gamma)\frac{\partial E(\pi_i)}{\partial A}\frac{\partial A}{\partial \beta_i} + \frac{\partial pr_i}{\partial \beta_i}\frac{N}{1+\rho}\bar{\Pi} = 0$$

Applying the implicit function yields

$$\frac{\partial \beta_i}{\partial N} = -\frac{H_N}{H_{\beta_i}} \propto H_N$$

Because $H_{\beta_i} < 0$ we have that the effect of N on β is proportional to H_N. Similar to before, we have that $\frac{\partial pr_i}{\partial \beta_i} > 0$. Furthermore changes in β have a higher effect on the probability of becoming the next CEO if the bank has more branches, ie.

$$\frac{\partial^2 pr_i}{\partial \beta \partial N} = \frac{\partial pr_i}{\partial \beta_i}[\frac{1}{N-1} + ln(\frac{N-1}{N})] > 0$$

and therefore H_N becomes

$$H_N = \frac{\partial^2 pr_i}{\partial \beta \partial N}\frac{N}{1+\rho}\bar{\Pi} + \frac{\partial pr_i}{\partial \beta}\frac{1}{1+\rho}\bar{\Pi} > 0$$

2.5 Proposition 4: Change in Loan Portfolio and Probability of Default

A bank's PD is given as

$$PD = Pr(X < 0) = \Phi(-\frac{\mu_B}{\sigma_B})$$

where X characterizes a bank's loan portfolio and $\mu_B/\ \sigma_B$ is the loan portfolio's mean and standard deviation respectively, and $\Phi(\cdot)$ is the cdf of the standard normal distribution. Suppose two loan officers compete for borrowers in the market, and let their choice of hard information borrowers be given by β and α. Taking the total differential of this equation yields

$$dPD = -\phi(-\frac{\mu_B}{\sigma_B})\frac{\sigma_B\left(\frac{\partial\mu_B}{\partial\alpha}d\alpha + \frac{\partial\mu_B}{\partial\beta}d\beta\right) - \mu_B\left(\frac{\partial\sigma_B}{\partial\alpha}d\alpha + \frac{\partial\sigma_B}{\partial\beta}d\beta\right)}{\sigma_B^2}(-1)$$

where ϕ is the standard normal pdf. Every loan officer optimally determines his choice of β. Because of symmetry, we have $\frac{\partial\mu_B}{\partial\alpha} = \frac{\partial\mu_B}{\partial\beta} = 0$:

$$\frac{dPD}{d\beta} = -\phi\left(-\frac{\mu_B}{\sigma_B}\right)\frac{\mu_B}{\sigma_B^2}\left(\frac{\partial\sigma_B}{\partial\alpha}\frac{d\alpha}{d\beta} + \frac{\partial\sigma_B}{\partial\beta}\right)$$

Note that $\phi\left(-\frac{\mu_B}{\sigma_B}\right)\frac{\mu_B}{\sigma_B^2} > 0$. Due to symmetry, we have $\frac{\partial\sigma_B}{\partial\alpha} = \frac{\partial\sigma_B}{\partial\beta}$ and hence

$$\frac{dPD}{d\beta} \propto \frac{\partial\sigma_B}{\partial\beta}\left(\frac{d\alpha}{d\beta} + 1\right) \tag{A-6}$$

The standard deviation of a bank's loan portfolio is given as $\sigma_B = [\beta^2\sigma_H^2 + (1-\beta)^2\sigma_S^2]^{\frac{1}{2}}$. The derivative of the loan portfolio's standard deviation with respect to β gives

$$\frac{\partial\sigma_B}{\partial\beta} = \frac{1}{\sigma_B}\left[\beta\sigma_H^2\left(1 + \varepsilon_{\sigma_H,\beta}\right) + (1-\beta)\sigma_S^2\left(\frac{1-\beta}{\beta}\varepsilon_{\sigma_S,\beta} - 1\right)\right]$$

where $\varepsilon_{\sigma_S,\beta}/\varepsilon_{\sigma_H,\beta}$ is the elasticity of soft/hard borrower's variance with respect to β. These elasticities are given as

$$\begin{aligned}
\varepsilon_{\sigma_H,\beta} &= \beta\frac{\partial r_H}{\partial\beta}\left(\frac{1}{1+r_H-\lambda} + \frac{1}{2}\frac{\partial p_H}{\partial r_H}\frac{1-2p_H}{(1-p_H)p_H}\right) < 0 \\
\varepsilon_{\sigma_S,\beta} &= \beta\frac{\partial r_S}{\partial\beta}\left(\frac{1}{1+r_S} + \frac{1}{2}\frac{\partial p_S}{\partial r_S}\frac{1-2p_S}{(1-p_S)p_S}\right) > 0
\end{aligned}$$

The partial derivative of σ_B with respect to β is continuous, monotone and defined for every β. Moreover, $\lim_{\beta \to 0} \frac{\partial \sigma_B}{\partial \beta} > 0$, and $\lim_{\beta \to 1} \frac{\partial \sigma_B}{\partial \beta} < 0$.

B Data Appendix

1 Sample Construction

I compute Inverse Z-Score using semiannual information of profitability (Return on Assets) obtained from 'Call Reports'. In particular, I compute a 5 period moving average of the standard deviation of Return on Assets, where the computation of standard deviation for period t uses information for periods $t-2$ to $t+2$. Because of this, I am not able to compute it for the first and last two periods. I then merge this information with 'Summary of Deposits' data which are available on an annual basis until 2006. This step limits the sample to annual bank observations for the years 1977 to 2006. Following previous research on intrastate branching deregulation, I drop the states of Delaware and South Dakota from the sample since the structure of the banking system in these two states was heavily affected by other laws, and it is not possible to isolate the effect of intrastate branching deregulation. Inverse Z-Score also exhibits very large volatility within the sample, and therefore I trim the sample with respect to the 1^{st} and 99^{th} percentile of Inverse Z-Score. This eliminates all outliers from the sample. In all regressions I restrict attention to banks that are active in only one state and exist before and after intrastate branching deregulation. Focusing on banks with branches in only one state allows me to better identify the effect of intrastate branching deregulation on risk as these banks were restricted in their geographic expansion.

2 Variable Definitions

Distress indicator I compute for each bank the annual change in its capital-asset ratio, and construct an indicator variable that takes on the value of one if a bank's capital-asset ratio drops in two consecutive years by more than 1 percentage point in each year.

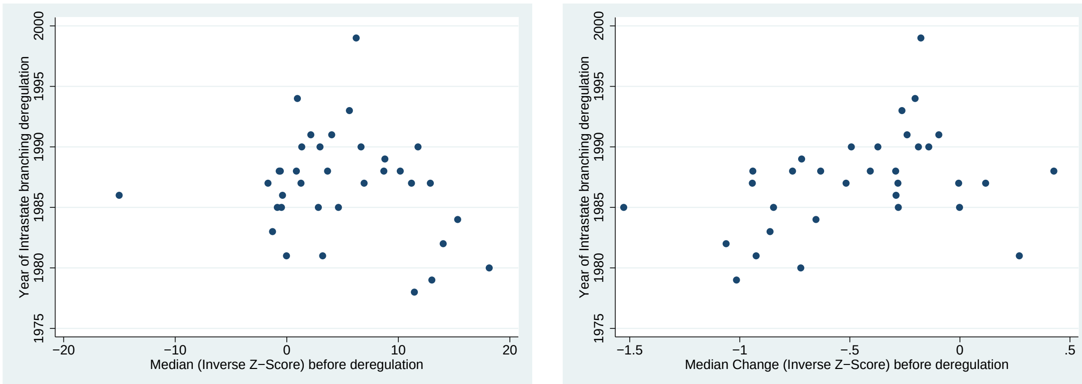
CAMEL-ratings Laeven et al. (2002) find that a higher ratio of loan loss reserves to capital, higher loan growth, lower net interest income to total income and lower return on assets are significantly correlated with bank failure. Following Laeven et al. (2002), I determine for each of these variables an indicator that takes on the value of one if the variable for a given bank is worse than that of 75% of all the sampled banks, and zero otherwise. For instance, if a bank's return on asset is lower than the 25th percentile, then this indicator is equal to one. Then, I sum these indicator variables and construct 'CAMEL'-ratings for each bank and year taking on values from 0 to 4, where higher values indicate higher failure risk.

3 Additional Analysis

3.1 Timing of Intrastate Branching Deregulation and Risk

The identification of the effect of intrastate branching deregulation on risk rests on the assumption that the timing of deregulation is not affected by bank risk. This implies that states did not deregulate because of a certain level of bank risk in a state. To examine this graphically, I plot the year of intrastate branching deregulation against (1) the median Inverse Z-Score and (2) the average change of median Inverse Z-Score in each state, where I also condition on the aforementioned control variables. Figures (Figure 1(b)) and (Figure 1(a)) are presented in the appendix and suggest that there is no relationship between the timing of deregulation and the level of bank risk in a state.

Kroszner and Strahan (1999) estimate an accelerated failure time model to identify forces of deregulation in each state. They measure the stability of a state's banking system by the share of assets held by failing banks and do not find evidence that the level of bank (in)stability in a state is correlated with the timing of deregulation. I extend their methodology using my risk variables and test whether the median Inverse Z-Score or the median



(a) Level of Bank Risk

(b) Change of Bank Risk

Figure B.I: Timing of Deregulation and Bank Risk
Note: This figure plots the year of intrastate deregulation against the level/change of bank risk. Bank risk at the state level is measured by the median Inverse Z-score in that state.

annual change in Inverse Z-Score in a state can predict the timing of deregulation (results available upon request).

3.2 Dynamic Analysis

To clarify the dynamic effects of deregulation, I include a series of dummy variables for each state to capture the effect on risk on every year before and after deregulation. In particular, I estimate the following regression model:

$$R_{i,s,t} = \sum_{p=-10}^{15} \alpha_p Y_{p,s,t} + \tilde{\delta}_i + \tilde{\delta}_t + \tau_{i,s,t} \tag{A-7}$$

where $Y_{p,s,t}$ is a dummy variable that takes on the value of one if in year t, state s liberalizes its intrastate branching restriction in p years. The effect on bank risk in the year of deregulation $D_{0,s}$ is dropped due to collinearity; the coefficients α_p are relative to the year of intrastate deregulation.[30]

[30]Consider the state of Massachusetts (MA) as an example where intrastate branching deregulation occurred in 1984: D_{-1MA} is equal to one only in 1983 and zero otherwise. Similarly, D_{1MA} is equal to one in

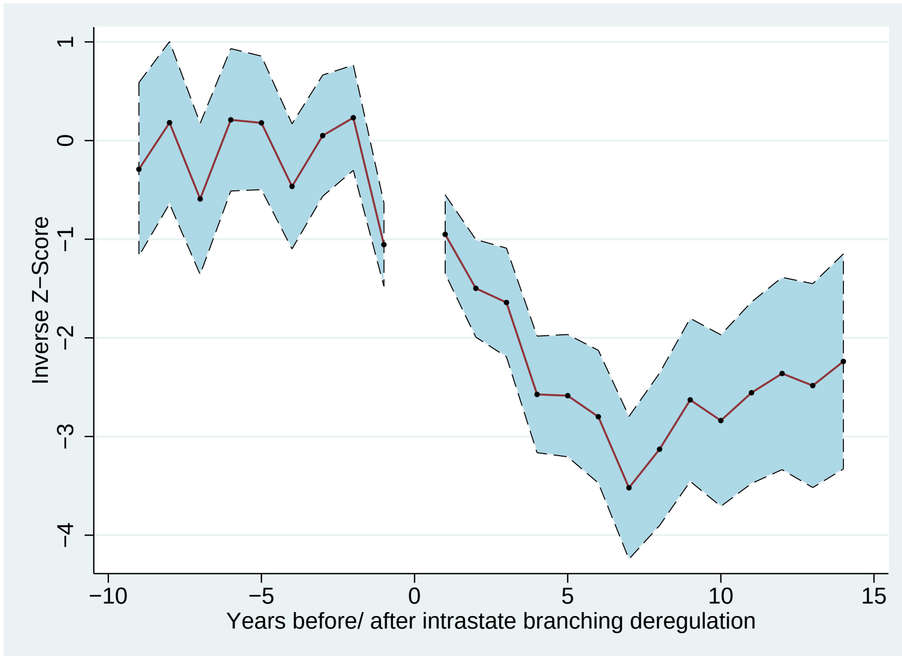


Figure B.II: Dynamic Effects of Intrastate Branching Deregulation
Note: This figure illustrates the dynamic effects of intrastate branching deregulation on Inverse Z-score. The regression model is given as $R_{ist} = \sum_{p=-10}^{15} \alpha_p Y_{pst} + \tilde{\delta_i} + \tilde{\delta_t} + \tau_{ist}$ where Y_{pst} is a dummy variable that takes on the value of one if in year t deregulation in a state s is in p years. The figure plots the estimates on the dummy variables (α_p) and the 95 percent confidence interval for these estimates. The standard errors are adjusted for bank-level clustering.

Figure B.II plots the estimated coefficients α_p as well as the 95 percent confidence interval for these coefficients. The results show that banks significantly decrease risk following intrastate branching deregulation, but risk does not change prior to the removal of branching restrictions. Further, the effect reaches a maximum approximately seven years after deregulation and remains significantly different from zero thereafter.

1985 and zero otherwise. I include dummy variables to capture the effects of more than ten years before or 15 years after deregulation. Hence, D_{15s} is equal to one for state s for all years that are at least 15 years after deregulation. Likewise, D_{-10s} is equal to one for state s for all years that are at most ten years before deregulation.

Table B.I: Variable Definitions

Variable	Description	Source
Bank		
Net Income (Loss)	RIAD4340	Call Reports
Total Assets	RCFD2170	Call Reports
Equity	1976 - 1989: RCFD3230 + RCFD3240 + RCFD3247 1990 - 1993: RCFD3230 + RCFD3839 + RCFD3632 - RCFD0297 1994 - 2006: RCFD3230 + RCFD3839 + RCFD3632 + RCFD8434	Call Reports
Total Loans	RCON1400 (1976 - 1984) RCON1400 - RCON2165 (1984 - 2006)	Call Reports Call Reports
Return on Assets	'Net Income (Loss)' divided by 'Total Assets'	
Capital-Asset-Ratio	'Equity' divided by 'Total Assets'	
Loans-Assets-Ratio	'Total Loans' divided by 'Total Assets'	
Inverse Z-score	Standard Deviation of Return on Assets divided by (Return on Assets + Capital-Asset-Ratio)	
Ln(number of banking markets)	Natural log of number of markets in which a bank operate branches	Summary of Deposits
1 - Herfindahl Index of deposits across counties	Sum of squared share of deposits for each bank in each county and year	Call Reports and Summary of Deposits
=1 if bank part of bank holding company	RSSD9347	Call Reports
=1 if bank was member of Federal Reserve System prior to Branching Deregulation	RSSD9422	Call Reports
=1 if bank held Federal Charter prior to Branching Deregulation	RSSD9347	Call Reports
Banking market		
Ln(number of banks in county)	Log of number of banking companies in county	Summary of Deposits
Ln(number of branches in county)	Log of total number of branches in county	Summary of Deposits
Herfindahl Index of deposits in county	Sum of squared share of deposits for each banking company in county	Summary of Deposits
Population per branch in county	County population estimates divided by number of branches in county	Summary of Deposits and Local Area Personal Income (BEA)
Growth of personal income in county	Change in Personal County Income divided by last year's Personal County Income	Local Area Personal Income (BEA)
Deregulation		
=1 if Intrastate Branching Deregulation	Indicator whether states allow in-state branching	Amel and Liang (1992)
=1 if Interstate Branching Deregulation	Indicator whether states allow out-of-state branching	Amel and Liang (1992)
Information		
Kappa	Agreement of rating agencies about bond issue ratings. Ranges from complete disagreement (=0) to complete agreement (=1)	Morgan (2002)
Average firm size	Number of employees per establishments in county	County business patterns (CENSUS)
Share of proprietors income	Share of proprietors income in Earnings by place of work	Local Area Personal Income (BEA)

Table B.II: Timing of Intrastate Branching Deregulation

State	**Name**	**Year of Deregulation**
AK	Alaska	1960
AL	Alabama	1981
AR	Arkansas	1994
CA	California	1960
CO	Colorado	1991
CT	Connecticut	1980
DC	District of Columbia	1960
FL	Florida	1988
GA	Georgia	1983
HI	Hawaii	1986
IA	Iowa	1999
ID	Idaho	1960
IL	Illinois	1988
IN	Indiana	1989
KS	Kansas	1987
KY	Kentucky	1990
LA	Louisiana	1988
MA	Massachusetts	1984
MD	Maryland	1960
ME	Maine	1975
MI	Michigan	1987
MN	Minnesota	1993
MO	Missouri	1990
MS	Mississippi	1986
MT	Montana	1990
NC	North Carolina	1960
ND	North Dakota	1987
NE	Nebraska	1985
NH	New Hampshire	1987
NJ	New Jersey	1977
NM	New Mexico	1991
NV	Nevada	1960
NY	New York	1976
OH	Ohio	1979
OK	Oklahoma	1988
OR	Oregon	1985
PA	Pennsylvania	1982
RI	Rhode Island	1960
SC	South Carolina	1960
TN	Tennessee	1985
TX	Texas	1988
UT	Utah	1981
VA	Virginia	1978
VT	Vermont	1970
WA	Washington	1985
WI	Wisconsin	1990
WV	West Virginia	1987
WY	Wyoming	1988