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

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Abstract: This paper examines (1) the change in commercial banks' risk taking as states in the United States removed restrictions on bank branching within state borders and (2) the channels through which the removal of these restrictions affect bank risk taking. I find that, after the liberalization of branching restrictions, banks that do not expand their branch network into other markets decrease risk taking, while expanding banks do not change risk taking. Existing theories, which focus on the importance of market structure on risk taking, are not able to explain this pattern. Therefore I provide a theoretical framework, building on theories from organizational economics, which can account for this by showing that non-expanding banks have a comparative advantage in lending to informationally difficult borrowers, which induces them to lower risk taking as competitors expand. Empirical evidence supports this channel and highlights the importance of borrower information, since nonexpanding banks decrease risk taking more as competitors expand if they operate in a county with more informationally difficult borrowers.

About the Author: **Martin Goetz** is a Financial Economist at the Federal Reserve Bank of Boston. His research examines how banks' organizational structure affects their market behavior. In particular, he studies how banks' geographic diversification across several markets affects their risk taking behavior and market value. Moreover, he analyzes how small commercial banks played a role for the transmission of the financial crisis of 2007-09 to the local economic activity in the United States due to their reliance on wholesale funding markets. He earned undergraduate and postgraduate degrees from the University of Erlangen-Nuremberg and the University of London. In May 2010 he obtained a Ph.D. in Economics from Brown University.

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1 Introduction

This paper analyzes how the organizational scope of banks and the structure of local banking markets affect bank risk taking. In particular, I examine (1) if regulatory changes that removed impediments to bank expansion and that fostered consolidation of the banking industry in the United States increased, decreased, or had no effect on bank risk taking, and (2) identify the mechanisms through which the geographic expansion of banks affects individual bank risk taking by exploiting cross-bank heterogeneity in their response to the regulatory changes.

For many decades, commercial banks in the United States were prohibited from expanding their branch network within a state into other counties without regulatory approval. Over a period of almost 40 years, starting in 1960, each state in the U.S. lifted these restrictions at different years and allowed banks to expand their branch network freely across counties within a state.[1] Previous work identifies the real effects of this regulatory change and presents evidence that, for instance, following the liberalization of branching restrictions, states experienced an increase in the entry of new firms (Jayaratne and Strahan (1997)) and a decrease in income inequality (Beck et al. (2010)). However, the effects of these changes on bank risk taking have not been explored so far in the literature and this paper tries to fill that gap.

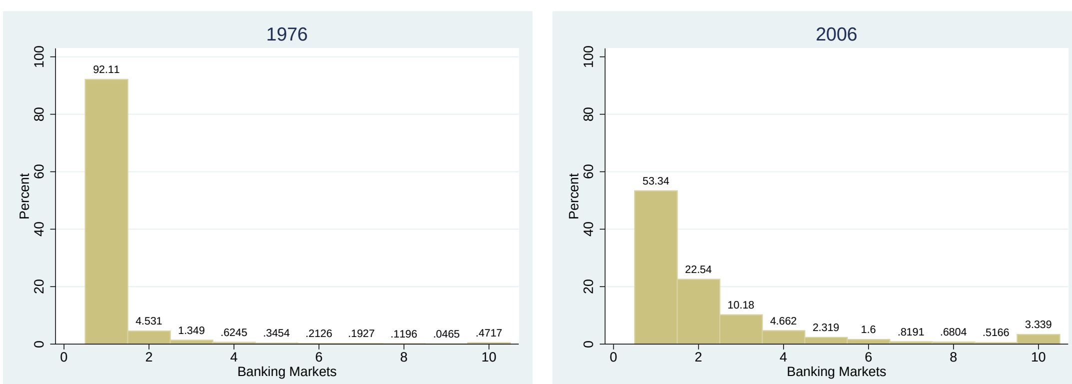
Whether a removal of geographic restrictions on banking activity decreases or increases bank risk taking is an open debate in economic research. Regulatory impediments to bank expansion into other counties are barriers to entry into local banking markets for commercial banks (Hannan and Prager (2004)), and once states remove these barriers, new competitors might enter and change the competitive structure of the county. Economic models argue that bank risk taking can increase or decrease as the competitive structure of the banking market changes. If competition among banks decreases, then banks reduce risk taking according to Keeley (1990) and Allen and Gale (2000), because banks in less competitive markets earn higher rents and therefore will not imperil their position by taking on more risk. Boyd and de Nicolo (2005), on the other hand, argue that less competition among banks increases banks' risk taking because borrowers in less competitive banking markets face higher loan interest rates, therefore take on more risk, which leads to a riskier loan portfolio for banks.[2]

[1] Iowa was the last state that abolished restrictions on intrastate branching in 1999 (Amel and Liang (1992)). Table C.I shows the years of liberalization for all states of the U.S.

[2] Similarly, an increase in competition leads to the opposite conclusion regarding risk taking in both theories.

I find that only banks that do not expand their branch network after the removal of geographic restrictions decrease risk taking once states liberalize their branching restrictions. Expanding banks, on the other hand, do not experience a change in their risk taking. Existing theories are not able to explain why non-expanding banks decrease risk taking after deregulation: the decrease in bank risk taking cannot be attributed to gains from diversification across markets because non-expanding banks are not changing their diversification across markets. Furthermore, Rhoades (2000) and Dick (2006) show that the competitive structure of the local banking market remains unchanged after deregulation and hence, existing theories on the relation between market structure and bank risk taking can not account for this finding either.

I present a short theoretical model, which is consistent with this empirical pattern and emphasizes the role of soft and hard information in local lending markets following Stein (2002).[3] The model shows that a bank's organizational structure affects its risk taking behavior and the risk taking behavior of competing banks. Following earlier research on banks' organizational form, I model a bank's internal structure as a relationship between a bank manager (principal) and loan officers (agents), where loan officers choose a certain level of risk. An expansion of a bank's branch network into other markets is therefore an increase in its organizational form, because an increase in the number of branches increases the number of loan officers a bank manager needs to supervise.[4]



(a) 1976 (b) 2006

Figure 1: Distribution of Banks by Number of Counties Served

[3]Hard information is quantitative and verifiable, whereas soft information is qualitative and non verifiable (Petersen, 2004). An example of hard information is a balance sheet; soft information is, for instance, the product of a relationship between a bank and a borrower.

[4]Furthermore, I include features of the underlying market structure to account for interactions among banks.

Non-expanding commercial banks constitute the majority of chartered commercial banks in the U.S. and are therefore an important part of the U.S. banking sector. In 1976, nine out of ten commercial banks only operated branches in one single county (figure 1(a)). Even after the liberalization of branching restrictions, the majority of commercial banks still focus their operations on only one county (figure 1(b)). Despite some large banks that operate a regional or national branch network, more than half of all commercial banks in the U.S. are local banks.

My theoretical framework builds on Stein (2002), who argues that the organizational structure of banks affects their lending behavior. Soft information is not verifiable and harder to communicate between a loan officer and bank manager.[5] Because banks with less branches have a flatter organizational structure, soft information can be communicated easier between loan officers and bank managers. This gives banks with less branches a comparative advantage when lending to soft information borrowers. Banks with a more complex organizational structure, because of a larger branch network, on the other hand, are better at lending to borrowers characterized by hard information.[6]

I extend this model to also incorporate bank risk taking and features of the underlying market structure. First, I establish a link between lending, risk taking and a bank's organizational structure by analyzing how a bank's organizational structure affects loan officer's monitoring effort. By including aspects of competition among banks in the market, I show that risk taking of non-expanding banks decreases as competing banks enlarge their branch network into other markets: an expansion of banks increases the scope of their organization, intensifying the extent of the principal-agent problem and lowering loan officers' monitoring effort. Furthermore, they earn more profits by shifting lending away from informationally difficult borrowers. Competing non-expanding banks, on the other hand, increase lending to soft information borrowers, which raises their profits and induces them to exert more monitoring effort.

This effect of a bank's organizational structure on risk taking is consistent with the earlier findings and also provides several additional testable hypotheses: regarding risk taking, the model argues that banks decrease risk taking as competitors expand into other markets. Moreover, the theoretical framework shows that this effect depends on the type of borrower information in a market since banks will

[5]Soft information originates from a loan officer's interaction with a borrower (Cole et al. (2004)) and is qualitative.

[6]Specifically, larger banks have a size advantage when generating funds which they then lend to hard information borrowers.

decrease risk taking more as competitors expand if they operate in counties with a larger share of informationally difficult borrowers. Aside from risk taking, the model shows that, once states liberalize their branching restrictions, non-expanding banks increase lending to informationally difficult borrowers, whereas expanding banks shift lending towards borrowers with hard, verifiable information.

Armed with this framework, I turn to data to test these theoretical predictions. When examining banks' loan portfolios, I find that non-expanding banks increase their share of loans to individuals, whereas expanding banks increase their share of loans secured by real estate. Under the assumption that lending to individuals is based primarily on soft information and real estate loans use hard information (Zarutskie (2007), Berger and Black (2008)), this pattern is consistent with the predictions derived from the model.

To pin down the causal relationship between a bank's risk taking and competitors' expansion, and test the other hypotheses derived from the model, I use two-stage-least-squares estimation. Thereby, I assume that the removal of branching restrictions only affects a bank's risk taking through the aforementioned mechanism. Using the exogenous variation of a bank's expansion due to the removal of branching restrictions, I estimate how an expansion into other markets by competitors is related to risk taking.

The two-stage-least-squares results show that banks decrease risk taking as competitors expand their geographical scope into other markets. This finding is consistent with the theoretical prediction, and the effect is economically significant: I estimate that, if competing banks increase the number of markets they are active in by one standard deviation, a bank's annual risk of failure decreases by approximately 17 percent. Furthermore, these findings are robust to other additional influences and not sensitive to measures of bank risk taking and organizational structure.[7]

As a further examination of my model, I test the additional hypothesis that the effect on risk taking is larger if banks operate in counties with more informationally difficult borrowers. Following earlier research (Morgan (2002), Claessens and Laeven (2003)), I determine for each industry in a county its relative level of opaqueness and aggregate this information at the county level. My findings indicate that non-expanding banks decrease risk taking more as competitors expand if they are located in a county with a larger share of informationally difficult borrowers. This finding supports the mechanism provided in the theoretical framework.

The main contribution of this paper is the theoretical and empirical identifica-

[7] Specifically, I account for endogeneity and selection biases using additional instruments and an "Identification at Infinity" approach (Chamberlain (1986)).

tion of a relationship between a bank's organizational structure and risk taking. This relationship is - to my knowledge - not documented in the theoretical and empirical literature and thereby contributes to the debate on bank risk taking, market structure and banks' organizational form. From an empirical point of view, I present evidence that the deregulation of branching restrictions affects bank risk taking only through changes in the organizational structure of banks.

My findings do not reject earlier research on bank risk taking but rather complement theoretical and empirical studies by identifying a further channel regarding banks' risk taking behavior. Additionally to earlier work, which focuses on the relationship between market structure and bank risk taking, I contribute by showing that a bank's organizational structure also has an impact on bank risk taking. Because a bank's organizational structure does not need to be related to the underlying market structure, my framework complements earlier theoretical work.[8] In addition to earlier research, my paper highlights the importance of borrower information for the analysis of bank risk taking, as a change in banks' organizational form has stronger effects on risk taking if banks operate in markets with a larger share of informationally difficult borrowers.

My empirical analysis complements studies of market structure and bank risk taking based on regression results from cross-country analysis (de Nicolo (2000), Berger et al. (2009)), and evidence from the Great Depression (Calomiris and Mason (2000), Carlson and Mitchener (2009)). Furthermore, I analyze the effects on bank risk taking at the county level, which has been argued to be the relevant market for commercial banks in the U.S. (Hannan and Prager (2004)). In addition to these earlier studies, I can also identify a causal relationship between a removal of entry barriers and risk taking because my results indicate that the timing of of branching deregulation is not correlated with prior bank risk taking.

Besides, this paper also contributes to the literature on effects of branching deregulation in the U.S. on the banking sector (Jayaratne and Strahan (1997) and Stiroh and Strahan (2003)) by examining how bank risk taking changes after the liberalization of branching restrictions. Even though this work is related to the literature regarding the real effects of branching deregulation in the U.S. (Jayaratne and Strahan (1996), Levine et al. (2009), and Morgan et al. (2004)), I do not address the effects of bank risk taking or bank failures on the performance of the real economy (Cetorelli and Strahan (2006), Dell'Ariccia et al. (2008)) in my paper.

The remainder of this paper is organized as follows: in the following section I

[8] Furthermore, I do not consider other changes of the market structure in my model.

briefly review existing theories and empirical evidence that help in understanding the relationship between geographic restrictions and bank risk. Then, I provide an overview of the U.S. banking sector with a focus on the restrictions on geographic activity. In section four, I present a short theoretical framework that relates a bank's organizational structure to risk of failing. In sections five and six, I present the econometric methodology, data sources, and the implementation of the econometric design. Reduced form results are presented in section seven, followed by two-stage-least squares results analyzing the relevance of bank's organizational structure and bank risk in section eight. Section nine concludes.

2 Related Literature

2.1 Market Structure and Risk

Allen and Gale (2000) provide a framework that highlights the importance of a bank's charter value in shaping its risk taking. By regulation banks need a charter to operate in a market. If banks enjoy monopoly rents, their charter is valuable and they are induced to reduce their risk taking in order to preserve their status as monopolists. Competition, on the other hand, erodes the value of their charter, increasing risk taking by banks. Keeley (1990) shows, using data from U.S. banks, that a monopolistic banking sector is more stable than a competitive one. He finds that a decline in bank charter value due to higher competition is associated with an increase in bank's risk of failing. More recently, Jimenez et al. (2007) present evidence for the Spanish banking market which supports this view: higher market power in the loan market is associated with lower bank risk. Further, Berger et al. (2009) find evidence that is consistent with this theory. However, Berger et al. (2009) also present evidence that is consistent with the alternative theory that a competitive banking system is associated with lower bank risk taking. This argument is brought forward by Boyd and de Nicolo (2005): a monopolistic banking system implies high loan interest rates for borrowers. If borrowers face high loan rates, they will increase their risk in order to fulfill their repayment obligations. This increases the probability of loan defaults, resulting in a higher risk of failing for banks. Competition among banks lowers loan interest rates, reducing the probability of loan defaults. Evidence supporting this link is found in cross-country studies by Boyd et al. (2007) and de Nicolo (2000).

Martinez-Miera and Repullo (2010) argue that the truth lies somewhere in between these two contrasting theories. They show that the effect of bank competition on bank risk is ambiguous if loan defaults are imperfectly correlated. This may result in a U-shaped relationship between competition and bank risk.

2.2 Diversification

This paper is also related to theoretical and empirical work that studies the effect of bank diversification. Earlier research focuses on the impact of diversification across markets on deposit rates (Radecki (1998), Barros (1999)) or value (Deng and Elyasiani (2008)). Deng and Elyasiani (2008) find that geographic diversification is associated with value enhancement for bank holding companies in the U.S. Further, they provide evidence that geographically diversified bank holding companies experience a smaller standard deviation of stock returns than undiversified banks. Hence, they conclude that diversification is risk reducing. In contrast to that, Demsetz and Strahan (1997) find that geographically diversified bank holding companies in the U.S. are not necessarily less risky than their undiversified counterparts. They find that - even though banks are better diversified across regions - banks increase their leverage following mergers or acquisition. Therefore diversification is not necessarily associated with a decrease in risk as banks finance themselves with less equity and hold riskier portfolios. Muñoz et al. (2008) focus on the expansion pattern and risk taking of Spanish Savings Banks. Their results suggest that corporate governance plays an important role in the expansion of banks: banks in which the regional government has a stake tend to expand more into areas that are politically ”close”. Further they find that banks tend to take more risk as they expand geographically. Again, banks in which the regional government has a stake take on more risk than banks that are not politically connected.

Overall, empirical evidence is mixed when analyzing the gains from diversification. Even though some studies find that diversification is associated with less risk, others find that diversification leads to an increase in banks' bankruptcy risk.

2.3 Historical Evidence: Branching Restrictions and Risk

Studies of the Great Depression investigate the role of (intrastate) branching restriction on bank risk. Thereby, researchers analyze whether states that had less restrictions on intrastate branching experienced less banking failures during this period and are therefore more stable. Calomiris and Mason (2000) find that banks with larger branch networks are more likely to fail than other banks. Similarly, Carlson (2004) analyzes whether unit or branch banks are more likely to fail during the Great Depression. He finds that banks with branches are more likely to fail since they are holding a riskier portfolio than other banks. Specifically, branch banks hold fewer reserves and more loans than other banks. This makes them more susceptible to bank runs as they occurred during the Great Depression. Carlson and Mitchener (2006) show that states without restrictions on intrastate branching experience lower failure rates during the Great Depression. They attribute their finding to selection: weak banks are not able to survive in a deregulated state which leads to a more stable banking system. During the Great Depression, this more stable banking system exhibits less failures. Support for this view is also found by Carlson and Mitchener (2009). They show that incumbent banks respond to increased competition from branch banks by changing their operations to become more efficient and profitable. Similarly, Ramirez (2003) investigates differences of bank failures in Virginia and West Virginia for the years 1925 to 1929. Virginia allowed banks to branch freely within a state whereas West Virginia did not. Using this, he finds that branching restrictions are associated with a higher incidence of bank failures. Further, he presents evidence that banks with branches in Virginia are bigger and enjoy a greater depository base. Combining this with his earlier findings he suggests that branching restrictions limit the size and depository base of banks and therefore decreases stability. Also, Wheelock (1995) finds that failure rates during the Great Depression are lower in states where banks have on average a larger branching network. He argues that a larger branching network is associated with larger bank size. Similar to Ramirez (2003), he supposes that this is the cause for lower failure rates in these states.

3 U.S. Banking Sector and Branching Restrictions

3.1 History of Deregulation

Across the United States, banks were restricted with respect to their choice of location of branch offices for many decades. Limits on the location of branch offices were imposed in the 19th century. These regulatory measures were supported by the argument that allowing banks to expand their operations freely could lead to a monopolistic banking system. Furthermore, the granting of bank charters was a profitable income source for states which increased the incentives for states to enact regulatory policies. How severe these restrictions were shows the case of Illinois:

before deregulation, the state only allowed banks to open up two branches within 3,500 yards of its main office (Amel and Liang (1992)). These regulations led to a banking system that was characterized by local monopolies since geographical restrictions also prohibited other banks from entering a certain market and banks in regulated states did not face competition. Because these banks were beneficiaries of regulation, they had an incentive to preserve the status quo (Kroszner and Strahan (1999)).

With the emergence of new technologies like Automated Teller Machines (ATMs) and more advanced credit scoring techniques, the 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. An overview of the timing of deregulation is given in table C.I in the appendix.

3.2 Effect of Deregulation

Previous research on intrastate branching deregulation has shown that it has significant effects on the real economy. Deregulation is associated with an increase in the number of new incorporations (Jayaratne and Strahan (1996)), a decrease in income inequality (Beck et al. (2010)) and personal income insurance (Demyanyk et al. (2007)). Jayaratne and Strahan (1997) provide evidence that lifting intrastate branching restrictions is associated with a decline in borrowing rates of banks. Additionally they argue that deregulation is followed by an increase in bank efficiency (Jayaratne and Strahan (1998)). Underlying market forces are studied by Stiroh and Strahan (2003). They show that following intrastate branching deregulation the market mechanism rewards profitable banks as banks with profits above average gain market share.

4 Model: Bank Organization and Risk

4.1 Preliminaries

Stein (2002) shows that the ability to produce and process information within firms depends upon their organizational form. He argues that single-managed banks are better at producing and processing soft information, whereas large, hierarchical banks have a comparative advantage when producing hard information. He links his theory to the ongoing consolidation in the U.S. banking sector and concludes that consolidation is associated with a decline in lending to small-businesses. This occurs because small businesses are only able to provide soft information, which is harder to process for banks if they consolidate into large, hierarchical firms. I extend Stein's model to link a bank's organizational form to lending and risk taking. First, I introduce competition among loan officers of separate banks for borrowers to capture features of the underlying market structure. Second, I introduce borrowers that differ with respect to the information they can provide (soft vs. hard information borrowers) and third, I model the risk of these borrowers to analyze bank's risk taking.

My theory is also related to models that highlight the relationship of bank competition on lending relationships (Petersen and Rajan (1995), Dell'Ariccia and Marquez (2004)) and theories regarding the relaxation of entry barriers in banking (Besanko and Thakor (1992)).

4.2 Set-up: Borrowers and Lenders

A banking market consists of borrowers and lenders. Borrowers differ with respect to the information (soft versus hard information) they can provide to lenders and each borrower seeks financing from a lender. Ex ante he will repay an uncertain amount $\tilde{y}$ to lenders. This loan return $\tilde{y}$ is normally distributed with expected value $y(\cdot)$ and standard deviation σ for borrowers. Loan returns across borrowers are independent and identically distributed.

4.2.1 Borrowers

Information Borrowers differ in their type of information. Some borrowers can provide soft information whereas others are able to present hard information to lenders. Hard information is quantitative and easy to communicate to other parties; soft information on the other hand is difficult to code and catalog (Petersen (2004)). An example of hard information borrowers are businesses: they usually can provide balance sheet information which is easy to assess and store. Loans to soft information borrowers are also called "character loans": lending to these borrowers depends upon the character of the borrower as well as the judgment of the lender. The type of information is captured by the parameter z ($z > 0$), where larger values of z thereby indicate harder information.

Expected Loan Returns Expected loan returns are concave with respect to information. Hence, lending to soft information borrowers provides higher returns than lending to hard information borrowers, i.e. $y(z_1) > y(z_2) \Leftrightarrow z_1 < z_2$. Because hard information is easier to communicate and verify, borrowers with a higher z are able to obtain funding more easily. Hence, their cost of borrowing is lower and lending is less profitable for banks. Furthermore, there are decreasing marginal returns to lending: doubling the amount of borrowing does not double the expected profit for a given borrower.

Borrower's Risk Apart from the expected loan return, the risk of lending to borrowers is characterized by its standard deviation, σ. For simplicity, the standard deviation is constant across borrowers, i.e. borrowers that differ with respect to the information they provide do not exhibit a different standard deviation.[9]

4.2.2 Lenders: Bank Branches

Loans are provided by bank branches. Bank branches are operated by loan officers which are similar to investors in standard corporate finance models. In my model I do not investigate the depository base of bank branches, but simply assume that each bank branch has one unit of funding available that the loan officers lends to a specific borrower. Furthermore, loan officers decide on how much monitoring effort to exert when they lend to a borrower. Suppose there are two different loan officers labeled i and j in this market. Each loan officer lends all of his available funds to <u>one</u> borrower with a specific level of z. He maximizes expected profits by picking a borrower with a certain level of information and level of effort. Banks differ with respect to their organizational structure:

1. Single-Market Banks
   In the benchmark case, every bank operates one branch in one market. These single-market banks (or unit banks) compete for borrowers in the market. Each loan officer has one unit available to lend.

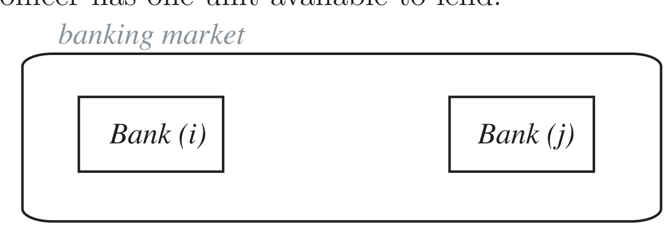


Figure 2: Two single-market banks

[9]This is a simplifying assumption. The results from my analysis also hold - under weaker assumptions - if I allow borrower risk to vary across borrowers with different information.

2. Multi-Market Banks

Multi-market banks operate branches in N distinct banking markets. For simplicity, a multi-market bank only operates one branch in each market. Loan officers of multi-market banks are therefore part of a bigger branch network, which is run by a CEO. The CEO has the power to allocate funds across branches. Since each branch has one unit of funding, the CEO decides how to allocate N units of funding among loan officers. Depending upon the CEO's allocation, a loan officer within a multi-market bank can lend more or less than one unit to a borrower.

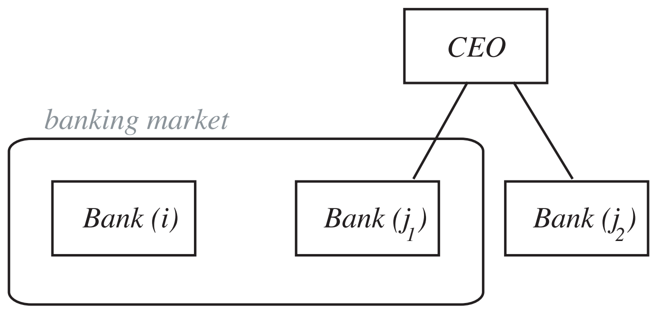


Figure 3: One single-market and one multi-market bank with two branches

Loan officers of competing banks/ branches within the market and within the multi-market bank choose their level of z and e simultaneously.

Single-Market Bank Branches Each loan officer of a single-market bank has one unit to lend. He chooses effort e and information z to maximize expected utility:

$$E(U_i) = p(e_i)y_i(z_i, z_j, 1) - (\gamma e_i - \delta z_i) \tag{1}$$

where $p(e_i)$ is the probability of obtaining expected loan return y. p is concave and twice differentiable. Expected loan return for loan officer i of lending one unit to type z_i-borrower is given as $y_i(z_i, z_j, 1)$. e_i is loan officer i's level of monitoring effort and expected loan returns from lending to type z_i increase in e.

By construction, i's expected loan return also depends upon loan officer $j's$ chosen borrower type (z_j). Bank i's expected loan return increases as bank j chooses a loan portfolio with larger z, i.e. harder information because there are benefits as bank branches differentiate themselves in their lending activity. However, this differentiation is only beneficial for a loan officer if his competitor moves into lending to hard information borrowers.

Multi-Market Bank Branches Banks can also operate a branch network across N several markets. Each branch of this multi-market bank shares similar features to single-market bank branches: it has one unit of funding available and is run by a loan officer that maximizes expected profits by choosing parameters z and e. However, a multi-market bank is run by a CEO which is has an additional layer of hierarchy.

CEO A bank's CEO distributes the banks total funds across branches. Because each of the N branches has one unit of funds available, the CEO will decide on how to distribute N units across N branches. She thereby decides the share of total funds that she will allocate to each branch for lending. Let the share of total funds awarded to branch b be denoted as q_b, then the CEO will allocate $q_b \times N$ units to branch b. A CEO decides q_b by observing the chosen level of z by the loan officer in each branch. Following Stein (2002), a CEO chooses to allocate a larger share q_b to the loan officer that picks borrowers that are characterized by harder information since soft information is harder to communicate and verify.

Loan Officers in Multi-market Bank Branches Suppose loan officer j is part of a multi-market bank. Similar to before, he will choose e and information z to maximize:

$$E(U_j) = p(e_j)y_j(z_j, z_i, q \times N) - (\gamma e_j - \delta z_j) \tag{2}$$

Note that the total amount of funding available to j are given by $q \times N$. In comparison to the single-market bank case (equation 1), the amount of funds can be larger or less than one. This is the only change compared to loan officers in single-market banks.

4.2.3 Loan Risk

As noted earlier, loan returns are described by their expected return y and standard deviation σ whereas the standard deviation of loan returns depends upon the borrower's information. Besides, a loan officer's choice of monitoring effort has an effect on the standard deviation of loan returns since an increase in monitoring effort decreases the standard deviation of loan returns, that is:

$$\frac{\partial \sigma}{\partial e} < 0$$

Note that this does not affect expected loan returns but only the spread of loan returns because the spread of loan returns decreases as effort increases. Hence, a larger choice of monitoring leads to less volatile loan returns (ex ante).

4.3 Equilibrium, Comparative Statics and Predictions

4.3.1 Equilibrium

For the equilibrium to exist, I assume that the second derivatives of expected loan returns y and probability $p(e)$ exist. Additionally, I assume that expected loan returns are concave with respect to information.[10]

Loan Officer in Single-Market Bank Branch

Choice of e and z The inclusion of δ and γ ensures that there is an interior solution and the equilibrium values of e and z are not zero. Maximizing (1) yields the symmetric equilibrium:

Lemma 1 (Single-Market Bank) *Given δ and γ, there exists a symmetric equilibrium characterized by e_S^*, z_S^*.*

Loan Officer in Multi-Market Bank Branch The organization of branches in a multi-market bank leads to changes in the optimal choice of e and z. Similar to the aforementioned case for single-market banks, loan officers maximize expected utility but take into account the fact that they can obtain a larger share of funds if they choose borrowers with harder information. In comparison to single-market bank branches, the following can be shown:

Lemma 2 (Multi-Market Bank) *Let the optimal choices of loan officers in a multi-market bank be given as e_M^*, z_M^*:*

1. *A loan officer in a multi-market bank chooses borrowers with harder information than a loan officer in a single-market bank, i.e. $z_M^* > z_S^*$.*

2. *The optimal level of monitoring effort of multi-market loan officers is lower than the optimal monitoring effort of single-market loan officers, i.e. $e_M^* < e_S^*$.*

[10] See the mathematical appendix (B) for further information on additional assumptions.

The intuition for these results is as follows: loan officers in a multi-market bank need to convince their CEO when they apply for funds. Choosing hard information borrowers (= higher z) increases - ceteris paribus - their share of available funds, but also reduces their expected loan returns. Because the first effect dominates the second, loan officers in multi-market banks select borrowers with harder information.

4.3.2 Comparative Statics

Important for the analysis is the relationship between information (z) and effort (e) as well as the relationship between the number of branches (N) and information/ effort. Let the loan officer in a single-market bank be characterized by i and the loan officer in a multi-market bank as j.

Proposition 1 (Relationship between e and z)

1. *If the optimal level of loan portfolio information is larger than a specific level $\bar{z}$, then monitoring effort and information are substitutes, i.e.* $\dfrac{\partial e^*}{\partial z^*} < 0$.
2. *If the optimal level of loan portfolio information is lower than $\bar{z}$, then effort and information are complements, i.e.* $\dfrac{\partial e^*}{\partial z^*} > 0$.

This proposition shows that, depending upon the equilibrium level of information (z^*), information and monitoring effort can be substitutes or complements which is a result of the shape of the expected loan return function relative to the shape of the probability function (Assumption A2). Figure 4 shows the relationship between effort and information for expanding and non-expanding banks.

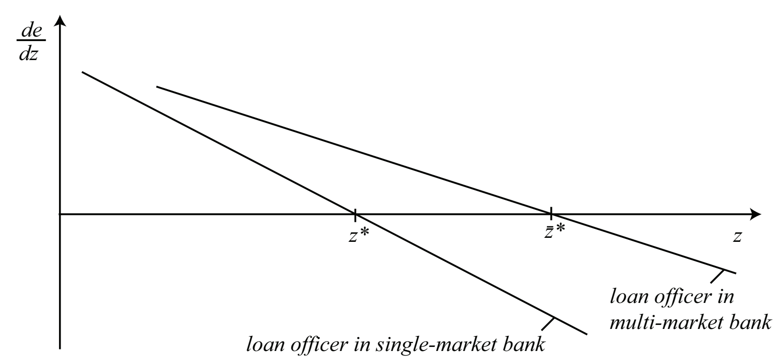


Figure 4: Relationship between $\frac{\partial e}{\partial z}$ and z

If the initial level of information is sufficiently low, expected loan returns are very high. An optimal response to a decrease in z - which increases, ceteris paribus, profits - is to decrease effort and save on costs of effort. If the initial level of information is sufficiently high, a decrease in information leads to an increase in monitoring effort. As before, choosing lower z increases expected loan returns, but the increase in expected loan returns is large enough such that the loan officer is induced to increase effort and thereby costs of effort. This additional increase in monitoring effort - despite its cost - will increase profits even more. Hence, a decrease in information leads to an increase in monitoring effort; information and effort are substitutes.

Proposition 2 (Relationship between z_i and z_j)

1. *If a loan officer's choice of effort and information are substitutes, i.e.* $\frac{\partial e_i^*}{\partial z_i^*} < 0$*, then his choice of information* z_i^* *is negatively related to his competitor's choice of information* (z_j^*)*, i.e.* $\frac{\partial z_i^*}{\partial z_j^*} < 0$.

2. *If a loan officer's choice of effort and information are complements, i.e.* $\frac{\partial e_i^*}{\partial z_i^*} > 0$*, then his choice of information* z_i^* *is positively related to his competitor's choice of information* (z_j^*)*, i.e.* $\frac{\partial z_i^*}{\partial z_j^*} > 0$.

An increase in information for bank j leads, ceteris paribus, to an increase in expected loan returns for bank i. If the initial level of information is sufficiently high, then loan officer i will react to this increase in expected loan returns by choosing a lower z. Hence, he will choose a borrower with softer information, which increases his profits further.[11] If the initial level of information is sufficiently low, a loan officer i will also increase his chosen level of information if j increases z.

Proposition 3 (Relationship between z_j, z_i and N_j)

Expanding Bank:
As a bank expands its number of branches N*, loan officers in this bank increase their optimal choice of information, i.e.* $\frac{\partial z_j^*}{\partial N} > 0$.

Non-expanding banks:
As bank j *expands its number of branches, loan officers in competing non-expanding banks decrease their optimal choice of information, i.e.* $\frac{\partial z_i^*}{\partial N_j} < 0$.

This proposition states that banks always shift lending towards borrowers with harder information as they expand. This is a result of the fact that loan officers in expanding banks always increase z to obtain a larger share of available funds.

[11] Further, he will increase monitoring effort which also increases his expected loan returns.

Because profits increase as expanding banks shift lending towards borrowers with a higher z, non-expanding banks respond by shifting lending to borrowers with relatively softer information.

Proposition 4 (Effect of an increase in concavity of y) *The earlier derived relationship between effort and information ($\frac{\partial e^*}{\partial z^*}$) becomes more pronounced as the expected loan return function becomes more concave.*

An increase in the concavity of the expected loan return function implies that the sensitivity of expected loan returns to information is smaller for low values of z. This means, expected loan returns decrease less as z increases. However, the sensitivity of expected loan returns is larger for high values of z though: a decrease in z increases expected loan returns more if the expected loan return function is more concave. This change makes the relationship between effort and information more pronounced as shown in figure 5.[12]

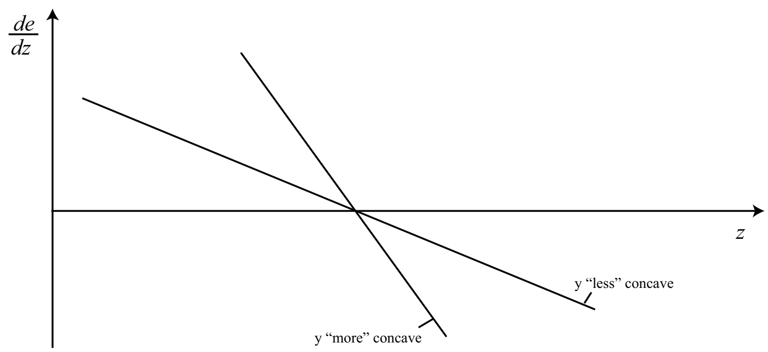


Figure 5: Relationship between $\frac{\partial e}{\partial z}$ and z if expected loan returns more concave

4.4 Empirical Predictions

For my empirical analysis I am interested in the relationship between a bank's expansion across banking markets and risk taking, whereas a bank's expansion is modeled by the number of markets it is active in. For the purpose of my model, risk is measured by the standard deviation of loan returns and hence, a larger volatility in loan returns is equivalent to higher bank risk taking. For simplicity, I argue that loan officers can decrease the standard deviation of lending when they increase

[12]For simplicity, the figure is drawn such that the critical level of information $\bar{z}$ does not change as y becomes more concave.

monitoring effort. As a result, an increase in monitoring effort decreases bank risk taking.[13]

4.4.1 Borrower Information

Proposition 3 shows that expanding banks shift lending towards borrowers with relatively harder information. Non-expanding banks respond to this by shifting lending towards borrowers with softer information. This leads to the following hypothesis:

Hypothesis 1 *As banks expand ...*

1. *... they shift lending towards hard information borrowers,*

2. *... competing non-expanding banks shift lending towards soft information borrowers.*

A larger branch network increases the extent of the principal-agent problem in bank organizations. This implies that the expanding banks will increase its lending to hard information borrowers. Competing non-expanding banks, on the other hand, always shift lending towards borrowers with soft information as competitors expand.

4.4.2 Risk Taking

Propositions 1 to 3 show that the effect of a bank's expansion on monitoring effort depends upon the initial level of information. Since monitoring effort is equivalent to bank risk taking, and effort and information are supposed to be substitutes, the model predicts the following relationship:

Hypothesis 2 *As banks expand ...*

1. *... they increase risk taking.*

2. *... competing non-expanding banks will decrease risk taking if the initial level of information is not too soft.*

Monitoring effort in expanding banks always decreases (Proposition 3). The principal-agent problem intensifies as banks expand and hence risk taking increases. Competing banks will exert more effort if their initial level of borrower information is not too soft because then effort and information are substitutes (Proposition 1). If the initial level of information is very soft, then risk taking of banks increases as competitors expand.

[13] Hence, the statement 'a decrease in monitoring effort' is equivalent to 'an increase in risk'.

4.4.3 Larger Share of Soft Information Borrowers

Proposition 4 shows that the relationship between effort and information becomes more pronounced as the loan return function increases its concavity. I interpret an increase in the concavity of the loan return function as an increase in the share of soft information borrowers in the market.[14] If there are more soft information borrowers, expected loan returns decrease less when increasing information if the level of information is soft. Hence, expected loan returns are less elastic when lending to the soft information borrower segment.[15]

Hypothesis 3 *If there are more soft information borrowers in a market, non-expanding banks ...*

1. *... decrease risk taking more if the initial level of information is not too soft, and*

2. *... increase risk taking more if the initial level of information is too soft ...*

as competitors expand.

5 Econometric Methodology

5.1 Reduced Form Analysis

Important for identification is the assumption that intrastate branching deregulation is exogenous to bank risk. In order to identify the effect of geographical restrictions on bank risk taking, I use the timing of deregulation across states. The econometric model can be written as:

$$R_{ist} = \beta B_{st} + \alpha_i + \delta_t + \varepsilon_{ist}, \tag{R}$$

where α_i is a vector of bank fixed effects, δ_t is a vector of year fixed effects and ε_{ist} is a bank-year specific idiosyncratic shock. B_{st} is an indicator variable that takes on the value of one the year after intrastate branching deregulation and zero before. The parameter of interest is β which shows the relationship between intrastate branching deregulation and bank risk taking. The underlying assumption for an unbiased estimation of the reduced form model is that B_{st} is uncorrelated with ε_{ist}.

[14]Note that in my analysis, I do not consider the share of borrower types.

[15]Changing the shape of the loan return function allows me to make the analysis comparable for a certain optimal level of information. By arguing that the optimal level of information is the same in both markets, I do not consider shifts in the relationship between optimal effort and optimal information.

5.2 Mechanism: Bank Organization and Market Structure

The reduced form analysis does not examine the underlying mechanism through which intrastate branching deregulation affects bank risk taking. This motivates the following two-stage-least squares estimation. My theoretical framework predicts that lending will shift towards borrowers with hard information as banks expand into more markets. This is associated with a decrease in risk taking as banks increase their monitoring effort. Furthermore, banks that do not change their organizational structure are affected by the expansion of competitors: as expanding banks increase lending towards borrowers with relatively hard information, competing banks shift their lending toward borrowers with softer information. If they also increase their monitoring effort, these banks will experience a decrease in risk taking.

The question I am interested in is: "What happens to the risk taking of a bank as its competitors branch into other markets?" To analyze this question empirically, I use two-stage-least squares (2SLS) estimation. Prior to intrastate branching deregulation banks were not allowed to branch freely within a state. I expect that intrastate branching deregulation is followed by an increase in the branch network of banks. Therefore I use the timing of deregulation as an instrument for a bank's expansion into other markets. This allows me to pin down the causal relationship between a bank's organizational structure on risk taking.

1. First Stage:
   The theoretical framework relates risk of bank a to its competitor's choice of organizational form. For each bank, I define a variable that captures its competitor's choice of organization. This first stage regression model can then be written as:
   $$D_{ist} = \gamma B_{st} + \pi_i + \pi_t, \tag{2SLS-1}$$
   where D_{ist} captures the organizational form (= focus across banking markets) of bank i's competitor at time t. D_{ist} is constructed such that it takes on low values if i's competitor focus on very few banking markets (= close to single-market bank). I describe how this variable is constructed in more detail in the following section. π_i/π_t measures bank-specific/ time-specific characteristics that affect the degree of competitor's organizational form for bank i in state s at time t.

2. Second Stage:
   In the second stage, I use the exogenous variation of a bank's competitor's

organizational form in order to identify its effect on bank risk:

$$R_{ist} = \beta \hat{D}_{ist} + \tilde{\delta}_i + \tilde{\delta}_t + \eta_{ist}, \tag{2SLS-2}$$

where $\hat{D}_{ist}$ is the predicted value of i's competitor's organizational form (from the first stage regression), $\eta_{ist} = \beta B_{st}(\gamma - \hat{\gamma}) + \varepsilon_{ist}$, and $\tilde{\delta}_i = \delta_i + \beta\pi_i$, $\tilde{\delta}_t = \delta_t + \beta\pi_t$.

The underlying assumption to identify the causal relationship between a bank's organizational form and bank risk taking, is that intrastate branching deregulation (B_{st}) has no other effect on risk beyond the hypothesized link between organizational form and bank risk taking. I discuss this assumption in greater detail in my empirical analysis.

6 Data and Implementation of Econometric Design

6.1 Data Sources

I use individual bank accounting data to measure risk and bank observable characteristics. Information on bank balance sheets is obtained from Report of Condition and Income data ('Call Reports'). The geographical location of bank branches is given in the 'Summary of Deposits' forms.[16] Aggregate county level data are obtained from the Bureau of Economic Analysis. Information regarding the timing of deregulation is obtained from Amel and Liang (1992) and Jayaratne and Strahan (1996).

6.1.1 Call Reports

All banking institutions regulated by the Federal Deposit Insurance Corporation, the Federal Reserve, or the Office of the Comptroller of the Currency need to file these reports on a regular basis. These reports include complete balance sheet and income statement data for each bank. Besides balance sheet information the 'Call Reports' also report changes in the ownership structure of banks.[17] I use semiannual data from the second and fourth quarter of each year from 1976 to 2007. Furthermore

[16] I am very thankful to the Federal Reserve Board for providing me with this data.

[17] I am very thankful to Susan Yuska from the Federal Reserve Bank of Chicago for providing me with this data.

I only consider commercial banks in the 50 states of the U.S. and the District of Columbia for my analysis.

6.1.2 Summary of Deposits

I obtain information on the number and location of bank branches using the 'Summary of Deposits' data for the years 1976 to 2006. The 'Summary of Deposits' contains deposit data for branches and offices of all FDIC-insured institutions and is collected for banks as of June 30 of each year. Besides information on deposits, it also reports the location of each branch or office.

6.1.3 State Level Information on Intrastate Branching Deregulation

Amel and Liang (1992) collect dates of intra - and interstate branching deregulation for the U.S. Most states liberalized their intrastate branching restrictions by 1994 when the passage of the Riegle-Neal Act removed all remaining barriers. The timing of deregulation for each state is reported in table C.I in the appendix.

6.2 Implementation of Econometric Design

6.2.1 Bank Risk Measures

Main Variable: Inverse Z-Score Following other research on bank risk taking (Boyd and Graham (1996), Laeven and Levine (2007), Cihak and Hesse (2007) and Jimenez et al. (2007)), I use *Inverse Z-Score* as a measure of bank risk. By assuming that profits are normally distributed, Inverse Z-score is given as

$$\text{Inverse Z-Score} = \frac{\text{Standard Deviation of ROE}}{\text{ROE} + 1}$$

Higher values of Inverse Z-Score imply greater risk taking. Inverse Z-Score is the main dependent variable of my analysis. In robustness checks, I use alternative variables to capture bank risk. These include:

Failure Failure of banks is recorded in the 'Call Reports'. Following the definition by the regulatory agency, I define a failure when a bank ceases to exist and resolution was arranged by the FDIC, state or other regulatory agency. 1,369 bank failures are registered during my sample period.

Distress Indicator Related to Boyd et al. (2009) I construct an indicator that identifies whether a bank is distressed. For each bank, I compute the annual change in its capital-asset ratio. Wheelock and Wilson (2000) find that a bank's likelihood of failing is negatively related to its capital-asset ratio, since capital provides a buffer when banks experience losses. Hence, if a bank's capital-asset ratio decreases, a bank's likelihood of failure increases. For each bank, I 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 one percentage point in each year. I use the one percentage point threshold because it is the tenth percentile of the annual change in capital-asset ratio in my sample.

CAMEL-Ratings U.S. bank regulators evaluate the stability of banks using balance sheet information and on-site inspections. They combine their assessment in 'CAMEL'-ratings (Capital adequacy, Asset quality, Management quality, Earnings and Liquidity), which range from one to five, with higher ratings indicating weaker banks. These ratings are not publicly available and therefore I rely on Laeven et al. (2002) to construct a 'CAMEL' rating for each bank and year using balance sheet information. Using information from banks around the world, 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 their procedure, 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 percent of all the sampled banks, and zero otherwise.[18] Second, I sum these four indicator variables and construct a 'CAMEL'-rating for each bank that takes values from zero to four. Higher values of this variable indicate higher risk.

6.2.2 Organizational Form

The theoretical framework models the expansion of banks into other banking markets. In my theoretical and empirical analysis, I do not consider the expansion of banks within the same banking market, i.e. the opening of new branches in the same market.[19] Counties in the United States are distinct bank markets as shown in earlier research by Hannan and Prager (2004) and Berger and Hannan (1989). For each

[18]For instance, if a bank's return on asset is lower than the 25th percentile, then this indicator is equal to one.

[19]In the model I assume that each bank only has one branch in each market. Competition within the organization is only for funds across banking markets.

individual bank in a county and year, I construct two measures of organizational form that capture its activity across markets.

Natural logarithm of number of banking markets:
For each bank, I count the number of banking markets it is active in and take the natural logarithm of this value. Taking the logarithm accounts for the fact that a few banks are active in many markets, whereas many banks are active in only one banking market. Hence, this variable is equal to zero if a bank is only active in one market.

Herfindahl Index of deposits across banking markets:
Banks with branches in several markets might have a different share of total deposits in each market.[20] Therefore, I compute the sum of the squared share of deposits a bank has in each county. This Herfindahl index of deposits across banking markets takes on values between zero and one, where larger values indicate that a bank focuses on one market.

For each bank and year, I then determine the average of these two variables of all banks that are active in the same county. Thus, I take the average of each measure in a county without including bank i and assign it to bank i. Hence for each bank, I determine a measure of its county competitor's organizational form.

6.2.3 Control Variables

In order to control for bank specific characteristics, I include the ratio of total loans to total assets, the log of total assets, a dummy indicating whether the bank is part of a bank holding company as well as the capital-asset-ratio. These variables are computed from balance sheet information for every bank in every year. County specific business cycle fluctuations are captured by the inclusion of the growth of local area personal income from year t to year $t-1$ as well as a lag thereof. Banking market specific effects are captured by the following control variables: log number of branches in market, log number of banks in market, the concentration of deposits across banks (Herfindahl index) in market and population per branch in market. Apart from intrastate branching deregulation, states also relaxed their restrictions on branching across state lines, i.e. interstate branching deregulation, over time. Since this might also have effects on the risk characteristics of banks, I include a dummy variable capturing this.

[20] I can only use deposits to construct this variable because the 'Summary of Deposits' only records deposits by each bank branch.

6.3 Sample Construction

I compute Inverse Z-Score using semiannual information of profits (Return on Equity) obtained from the 'Call Reports'. I compute a five period moving average of the standard deviation of return on equity: 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 this variable for the first and last two periods. Following this, I merge this information with 'Summary of Deposits' data. 'Summary of Deposits' are available on an annual basis from 1976 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 Delaware and South Dakota from the analysis. The structure of the banking system in these two states was heavily affected by other laws. It is therefore not possible to isolate the effect of intrastate branching deregulation. Furthermore, Inverse Z-Score exhibits very large dispersion within the sample. Because of this, I trim the sample with respect to the 1st and 99th percentile of Inverse Z-Score. This eliminates outliers from the sample.

7 Reduced Form Results

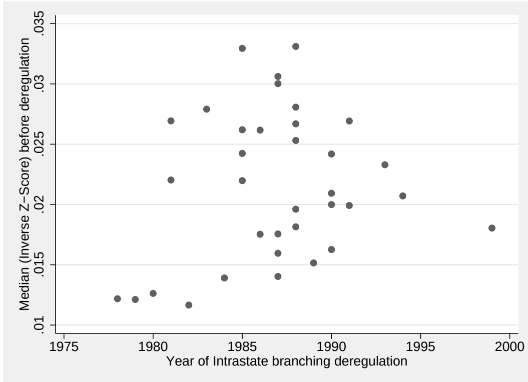
7.1 Preliminaries

The identification of the effect of deregulation on risk rests on the assumption that the timing of deregulation is not affected by bank risk. This means that states did not deregulate because of a certain level of bank risk in a state. To examine this graphically, I plot the following two graphs:

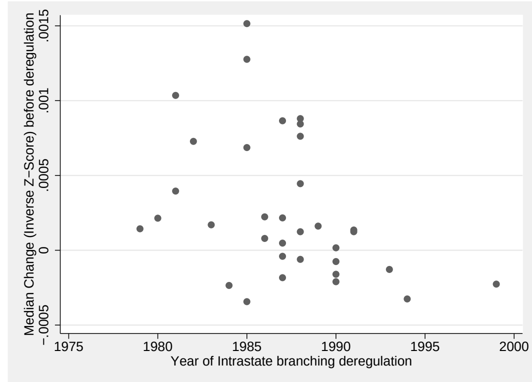
> Figure 6(a): Year of intrastate deregulation against the median Inverse Z-Score in each state before deregulation

> Figure 6(b): Year of intrastate deregulation against the average change of median Inverse Z-Score in each state before deregulation

Figure 6(a) suggests that there is no relationship between the timing of deregulation and the level of bank risk taking in a state. Similarly, figure 6(b) seems to indicate that there is no relationship between changes in bank risk before deregulation and the year of intrastate branching deregulation.



(a) Level of Bank Risk



(b) Change of Bank Risk

Figure 6: 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.

Kroszner and Strahan (1999) provide empirical evidence regarding the timing of intrastate branching deregulation: they estimate an accelerated failure time model in order to identify forces of deregulation in each state. The stability of a state's banking system is measured by the share of assets held by failing banks in their analysis and they do not find that the level of bank (in)stability in a state is correlated with the timing of deregulation. I extend their analysis using my risk variables and follow Kroszner and Strahan (1999)'s methodology by testing whether the median Inverse Z-Score in a state can predict the timing of deregulation. The estimation results are reported in C.IV in the appendix and seem to suggest that bank risk taking is not able to explain the timing of intrastate deregulation. A similar picture emerges if I use the change in the median bank's Inverse Z-Score for each state as a measure of bank risk. These findings underline the earlier conclusion that the timing of deregulation is not affected by bank risk within a state.

7.2 Intrastate Branching Deregulation and Bank Risk

7.2.1 Main Result

Regression results from the reduced form model are presented in table 1. Since Inverse Z-Score is very small, I multiply it 1,000 for my analysis. The results indicate that the liberalization of intrastate branching restrictions is associated with a decrease in bank risk. The coefficient on the intrastate deregulation dummy is negative and significant at the one percent level. In order to gauge the effect of intrastate deregulation on bank risk, I compute the decrease in bank risk as a share of its sample standard deviation: deregulation of intrastate branching restriction is followed by a decrease in the level of bank risk taking of approximately eight percent of its standard deviation.

Survivorship Bias Carlson and Mitchener (2009) argue that deregulation is associated with a weeding out of risky banks which leads to a more stable banking system. As laid out earlier, intrastate branching deregulation is supposed to be an important factor for the consolidation in the banking sector in the late 20th century (Berger et al. (1999), Boyd and Graham (1991)). During the sample period, many banks disappear because they fail, get acquired or merge with other institutions. Even though I include bank fixed effects to account for this selection, it is possible that the weeding out of risky banks affects the overall findings. In addition to this, I restrict the sample to banks that do not exit the sample because of failure, acquisition or merger. The regression results from this subsample are given in column (3) and confirm the earlier findings: the liberalization of intrastate branching restrictions is associated with a significant decrease in bank risk. However, the selection of banks out of the sample has some impact as the coefficient on intrastate branching deregulation is smaller than in the previous estimation. This is not surprising since a restriction of the sample to surviving banks intensifies a bias due to selection.

Further Control Variables In regression models (2) to (5), I include additional control variables that capture bank specific and macroeconomic characteristics. Intrastate branching deregulation is significantly associated with lower bank risk in all regression results. In model (4) I include a dummy variable indicating whether a bank expands following intrastate branching deregulation or not. The regression results indicate that risk taking only decreases for banks that do not expand into other markets after intrastate branching deregulation. Risk does not decline for banks that expand into other markets following deregulation. In model (5), I also include region specific time dummies in order to capture time-variant, region-specific effects.[21] The aforementioned findings are robust to this inclusion.

Source of Reduction: Profits and/or Earnings Volatility Given my measure of bank risk taking, the reduction in risk can either be a result of higher profits and/ or lower profit volatility. A closer inspection shows that bank profits increase following deregulation (table 2). This increase is even larger for banks that expand

[21] 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).

following deregulation. On average their return on equity rises by approximately four basis points. Higher profitability however is not accompanied by changes in earnings volatility for expanding banks: following deregulation, the standard deviation of profits does not change for banks that expand (table 2). Only banks that do not branch out into other markets following deregulation experience a decrease in their earnings volatility. This then translates into lower risk measures for non-expanding banks.

7.2.2 Economic Magnitude

The effect of intrastate branching deregulation can also be translated into a likelihood of failing. Therefore, I first determine how the probability of failing is related to Inverse Z-Score. By estimating a state and year fixed effects logit estimation, I can compute the average marginal effect of a one unit change in Inverse Z-Score.[22] Table C.V presents the average marginal effects from this estimation. It can be seen, that a one unit increase in Inverse Z-score decreases the likelihood of failing by approximately 3.3 percentage-points. Using the coefficient from model (1) in table 1, I compute that intrastate branching deregulation is associated with a decrease in the probability of failure for banks of 0.016 percentage-points ($= 3.3\% \times -\frac{4.673}{1000}$). During the sample period, on average three out of a thousand banks fail each year. Hence, intrastate branching deregulation reduces the average annual failure rate by approximately five percent.

7.3 Dynamic Analysis

In order to clarify the dynamic effects of deregulation, I include a series of dummy variables for each state that capture the effect of deregulation on bank risk for each year before and after deregulation. I use the following regression model:

$$R_{ist} = \sum_{p=-10}^{15} \alpha_p Y_{pst} + \tilde{\delta}_i + \tilde{\delta}_t + \tau_{ist}$$

where Y_{pst} is a dummy variable that takes on the value of one if in year t, state s liberalizes its intrastate branching restriction in p years.

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

[22] Because it is not possible to compute my risk measure 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.

otherwise. Similarly, D_{1MA} is equal to one in 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. The effect on bank risk in the year of deregulation D_{0s} is dropped due to collinearity from the analysis; the coefficients α_p are relative to the year of intrastate deregulation.

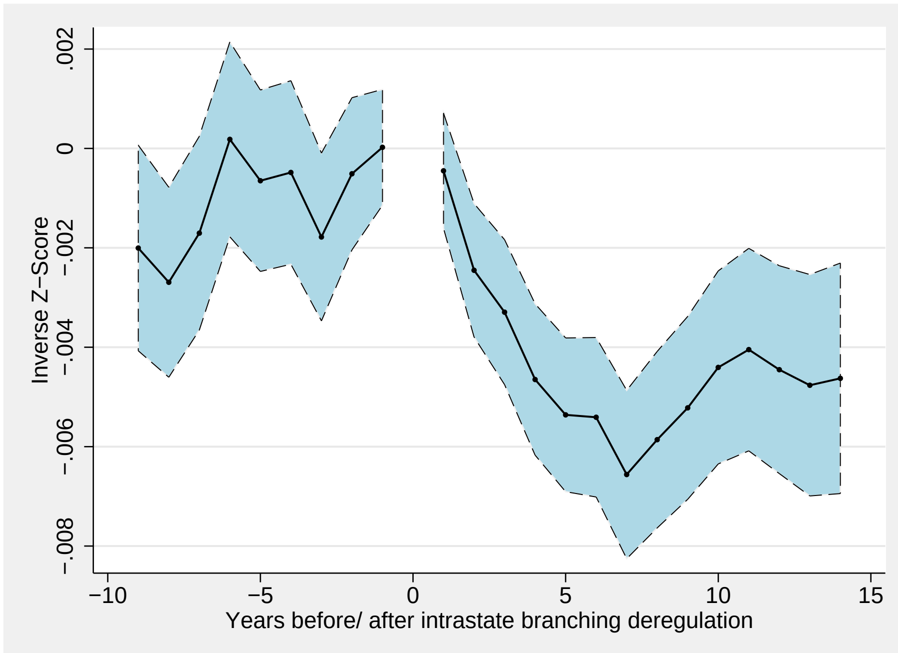


Figure 7: Dynamic Effects of Intrastate Branching Deregulation
Note: This figure illustrates the dynamic effects of intrastate branching deregulation on Inverse Z-score. The regression model is given as $R_{ist} = \sum_{p=-10}^{15} \alpha_p Y_{pst} + \tilde{\delta}_i + \tilde{\delta}_t + \tau_{ist}$ 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 7 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 taking following intrastate branching deregulation. The effect reaches its maximum approximately seven to eight years after deregulation and remains significantly different from zero after deregulation.

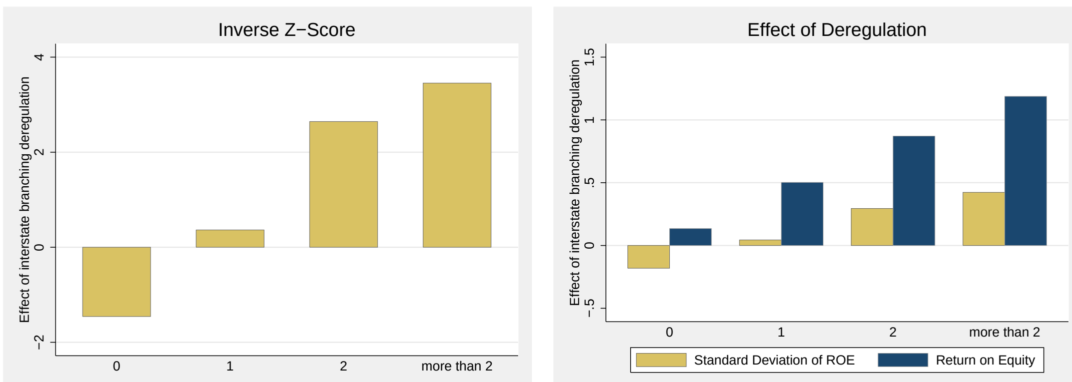
7.4 Effect by Degree of Expansion

The results indicate that the liberalization of intrastate branching deregulation is associated with a decrease in risk only for banks that do not expand geographically. In the following, I explore whether the degree of expansion is important as well.

Specifically, I analyze whether the effect is different for banks that expand in only one, two or more than three markets. I estimate the following regression model:

$$y_{ist} = \beta_0 I_{i,0} + \beta_1 I_{i,1} + \beta_2 I_{i,2} + \beta_3 I_{i,>2} + \alpha_i + \delta_t + \mathbf{X'}_{i,t}\rho + \varepsilon_{ist} \tag{3}$$

where $I_{i,k}$ is a dummy variable that takes on the value of one if a bank i expands into k markets following intrastate branching deregulation. In this regression, I do not include the interaction of these dummy variables with the intrastate branching deregulation dummy (B_{st}) because I examine whether the effect on risk depends on a bank's expansion pattern after deregulation.[23] The coefficients of interest are β_0 to β_3 and figure 8(a) plots these coefficients. The pattern of coefficients displayed in figure 8(a) shows that the effect of intrastate branching deregulation on risk taking is different depending upon the degree of expansion.



(a) Bank Risk

(b) Profits and Volatility

Figure 8: Change in risk taking by degree of expansion
Note: Figure 8(a) plots the estimated coefficients from regression of model 3 with inverse Z-Score as dependent variable. Figure 8(b) plots the estimated coefficients from regression of model 3 with components of inverse Z-Score (=ROE, standard deviation of ROE) as dependent variable. The regression model controls for bank and county specific variables.

As banks expand into more markets, intrastate branching deregulation is associated with an increase in Inverse Z-Score. In line with my earlier findings, only banks that do not branch out following deregulation decrease risk. For banks that expand in one or two markets however, the effect of intrastate branching deregulation on risk is not significant at the one percent level. For banks that expand in three or more markets following deregulation, intrastate branching deregulation is significantly associated with an increase in risk. Figure 8(b) confirms the earlier conclusion that the reduction in risk stems from a reduction in earnings volatility and an increase in profit for banks that do not expand. In addition, this figure

[23] Since this deregulation dummy is equal to one in this sample, I do not include it regression model 3.

shows that a bank's profit become more volatile as it expands into more markets following deregulation. For banks that expand into more than two markets bank risk increases because earnings volatility increases relatively more than profits. This explains the significant increase of Inverse Z-Score at the one percent level.

7.5 Robustness Checks

7.5.1 Alternative Measures of Risk

To see whether my results are driven by the use of Inverse Z-Score as my measure of risk, I use alternative variables to measure bank risk in the following robustness checks. Specifically, I repeat the earlier analysis using the computed CAMEL-ratings as a risk measure. Table 3 shows that intrastate branching deregulation is associated with a decrease in risk for banks that do not expand. Moreover, banks that expand following deregulation experience an increase in their CAMEL-ratings that is significantly different from zero at the five percent level. In the column 3 of table 3 I use a state fixed and year fixed effects logit regression to analyze whether intrastate branching deregulation decreases or increases a bank's likelihood of failing.[24] Column (3) shows estimated marginal effects from this logit estimation. Even though the results indicate that intrastate branching deregulation is associated with a decrease in the likelihood of failing, the coefficient is not significantly different from zero. That standard errors from this regression are large is not surprising given that a bank's failure is a rare event in the sample period. Identification for all parameters comes from about 0.5 percent of the whole sample since 1,369 banks out of 19,179 banks fail and failure is only determined in a bank's last year. In the last step, I use the distress indicator as dependent variable to proxy for bank risk in a state fixed and year fixed logit regression.[25] The last column of table 3 presents marginal effects and the results show that the probability of being distress for banks decreases following deregulation by approximately 0.4 percentage points. Overall, every year approximately three percent of all banks are characterized as distressed in my sample. This implies that intrastate branching deregulation decreases that rate by approximately 13 percent.

[24]As in earlier OLS regressions, standard errors are robust and clustered at the bank level.

[25]The logit estimation does not include the interaction between branching deregulation and the dummy indicating whether a bank expands following deregulation or not because the expansion dummy is only determined once a bank's state deregulates its branching restriction. If I were to include the expansion dummy, only banks that fail after intrastate branching deregulation are in the sample. Hence it is not possible to identify the effect of intrastate branching deregulation on the likelihood of failing.

7.5.2 Autocorrelation

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 at year $t-1$. In addition to this, errors ε_{ist} might be serially correlated which may also affect the estimation. As a robustness check, I use different estimators and focus on a subsample to see how sensitive my previous findings are to this issue.

Subsample I account for autocorrelation due to the construction of my main dependent variable by restricting the sample to observations where there is no overlap when constructing Inverse Z-Score. Hence, for each bank, I only include every other year in the estimation. This decreases the problem of serial correlation. By doing this there is only one period of overlap in the construction of Inverse Z-Score. Regression results from the third column in table 4 come from a sample where I only include every third year in the estimation. This eliminates all serial correlation due to construction but also decreases the sample size further. Regression results in the second and third column of table 4 show that the previous findings remain unchanged and intrastate branching deregulation is associated with a significant decrease in bank risk taking.

Different Estimators In addition to changing the sample, I also use different estimators to analyze the sensitivity of my findings to autocorrelation in table 4: the third column presents estimation results using a first difference estimator (FD) for the same subsample used in column 2. In comparison to the (previously used) within estimator, the FD-estimator is consistent under weaker assumptions: the within estimator assumes strong exogeneity ($E(\varepsilon_{i,s,t}|\mathbf{x}_{i,s,1}...\mathbf{x}_{i,s,T}) = 0$), which implies that <u>all</u> values of the regressors are assumed to be uncorrelated with the error. A FD estimator on the other hand assumes weak exogeneity ($E(\varepsilon_{i,s,t}|\mathbf{x}_{i,s,1}...\mathbf{x}_{i,s,t}) = 0$) which means that future values of the regressor can be correlated with the error.[26] However, the FD estimator is less efficient than the within estimator if errors are independent and identically distributed. The previous finding that intrastate branching deregulation is followed by a decrease in bank risk still holds when I use this estimator. In addition to the FD estimator, I estimate the regression model using a Generalized Least Squares (GLS) estimator (fifth column in table 4) that assumes that the error $\varepsilon_{i,s,t}$ is first-order autoregressive, i.e. $\varepsilon_{i,s,t} = \rho\varepsilon_{i,s,t-1} + \eta_{i,s,t}$ with $|\rho| < 1$ and $\eta_{i,s,t}$

[26] This is the case if errors follow a random walk.

i.i.d. The qualitative results do not change. Further, I use the previously applied within but compute robust standard errors following the approach of Driscoll and Kraay (1998) (last column in table 4). The estimation results using different estimators confirm the earlier findings: intrastate branching deregulation is associated with a significant decrease in bank risk.

7.5.3 Identification at Infinity

Survivorship of banks has an impact on the estimated effect of intrastate branching deregulation on bank risk. As it can be seen from table 1, the effect of deregulation is smaller once I exclude banks that are acquired, merge or fail during the sample period. Hence, the selection of banks out of the sample has an effect on my results. As a robustness check, I follow an "Identification at Infinity" approach (Chamberlain (1986)) to investigate the magnitude of this bias. First, I estimate a state-year fixed effects logit model, where the dependent variable is an indicator that takes on the value of one if a bank fails, becomes acquired or merges during the sample period. The purpose of this logit estimation is to select observations that are then included in the reduced form analysis. This logit estimation allows me to estimate for each bank-year observation a probability of exiting the sample. Then I include in the reduced form analysis only banks that do not exit the sample if their predicted probability of not exiting the sample higher than α, where α is close to one. In table 5, I present regression results where I choose $\alpha = 85$ percent, 90 percent and 95 percent respectively. The estimated coefficients on intrastate branching deregulation are negative and significant and do not differ a lot from each other. Hence, a bias due to selection of banks out of the sample does not seem to affect my previous findings.

8 2SLS Results: Organizational Form and Bank Risk

The theoretical framework argues that risk taking changes as banks alter their organizational structure. This might be a channel that explains my findings if deregulation leads to a change in the organizational form of banks. Furthermore, this change in organizational form does not only affect the risk taking of banks that change their organization: competing banks that do not expand into other markets are also affected and experience a change in their risk according to the theoretical framework.

Empirically, the identification of this causal relationship between bank organization and risk taking is not possible using Ordinary-least squares estimation. Influences, that jointly determine bank risk taking and the organizational form of banks, bias the estimation and do not allow a causal interpretation. For instance, it might be the case that causality runs the other way as a bank's risk taking determines its organizational form. To overcome this problem, I use two-stage-least squares (2SLS) estimation where I use the timing of deregulation as an excluded instrument for a bank's organizational structure. Thereby, I argue that the liberalization of branching restrictions is an exogenous shock that changes the organizational structure of banks' branch networks across markets, but does not affect banks' risk taking. Following this assumption, I argue that the liberalization of branching restrictions affects bank risk taking only by changing the organizational structure of banks. In the first part of this section, I determine the effects of intrastate branching deregulation on banks' organizational structure and lending. Then I present results from a 2SLS estimation.

8.1 Intrastate Branching Deregulation and Organization

8.1.1 Branch Network: Active Banking Markets

Average Effect As a first step, I analyze how the organizational structure of banks changes following intrastate branching deregulation. Since the model argues that banks experience an effect on their risk as competitors expand, I closely follow the theoretical framework and focus on the effects of intrastate branching deregulation on bank i's competitors' organizational form. As explained above (section 6.2.2) I construct for each bank measures that capture the organizational structure of its competitors. The underlying assumption for the 2SLS estimation is that the liberalization of intrastate branching restrictions affects the organizational structure of banks. Hence, as a first stage, I analyze what happens to the organizational form of bank i's competitors as states allow them to branch freely. In table 6, I present regression results where I use the log number of markets, bank i's competitors are active in as dependent variable. The results indicate that following intrastate branching deregulation, competitors expand into more banking markets. This effect is significant at the one percent level and robust to the inclusion of the earlier mentioned control variables.

Dynamic Effect Following the same methodology as in section 7.3, I plot the dynamic pattern of this change in competitors' organizational form.

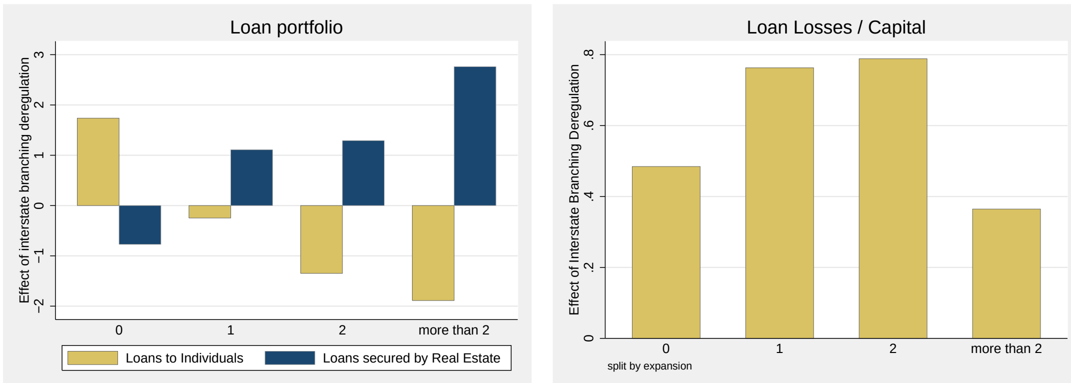
Figure 9: Effects of intrastate branching deregulation on competitor's organization
Note: This figure illustrates the dynamic effects of intrastate branching deregulation on the natural log of the competitors number of markets. The regression model is given as $ln(M_{ist}) = \sum_{p=-10}^{15} \alpha_p Y_{pst} + \tilde{\delta}_i + \tilde{\delta}_t + \tau_{ist}$ 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) 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.

Figure 9 shows that a bank's competitors branch out into other markets following deregulation: ten years after deregulation, a bank's competitors increase their average number of banking markets by approximately ten percent. Furthermore, the number of banking markets competitors are active in does not change before intrastate branching deregulation. This seems to suggest that deregulation has an effect on the organizational structure of banks.

8.1.2 Loan Portfolio and Loan Losses by Degree of Expansion

The theoretical model argues that banks increase lending to soft information borrowers as competing banks branch out. As a first test, I analyze what happens to lending of banks that do not expand following intrastate branching deregulation. Since deregulation is on average followed by an expansion of competing banks, non-expanding banks should shift their lending towards borrowers that are softer. Compared to these non-expanding banks, banks that branch into other markets should shift lending towards borrowers with relatively harder information. Furthermore, this shift in lending should be more pronounced as banks expand into more markets following deregulation.

To see whether this is the case, I analyze the share of loans to two different subgroups in a bank's total loan portfolio: loans secured by real estate and loans to individuals.[27] Figure 10(a) plots the average change of the share of loans to individuals and share of loans secured by real estate by the degree of expansion following deregulation.



(a) Effects of deregulation on loan portfolio (b) Loan losses across banking markets

Figure 10: Loan Portfolio and Deregulation/ branch network
Note: This figure plots the regression results from a bank-fixed OLS regression, where the dependent variables in the share of loans to individuals/ loans secured by real estate (figure 10(a)) and the ratio of loan losses to bank capital (figure 10(b)).

This figure suggests that lending behavior changes following deregulation: banks that do not expand, increase their share of lending to individuals and decrease their share of loans secured by real estate. Banks that expand on the other hand, increase their share of loans secured by real estate and decrease their loans to individuals. Assuming that loans secured by real estate are of relatively hard information compared to loans to individuals (Zarutskie (2007), Berger and Black (2008)), this figure seems to support the mechanisms provided by the theoretical model.

My theory argues that changes in monitoring effort lead to changes in bank's risk taking. A bank's choice of monitoring effort is not observable, but some variables are able to capture it to some extent. Specifically, the ratio of loan losses to total capital proxies for a bank's monitoring effort.[28] Figure 10(b) shows how that ratio of loan losses to capital changes following deregulation depending upon the expansion of banks. The pattern seems to suggest that the ratio of loan losses to capital increases as banks expand into more markets. Under the assumption that this variable captures monitoring effort, this might serve as evidence that supports the mechanism suggested by the theoretical model.

[27] The definition of these variables is given in table C.II the appendix.
[28] Alternatively, the ratio of non-performing loans to total loans could be used. However, non-performing loans are not available before 1984.

8.2 Competitors' Organizational Structure and Bank Risk Taking

8.2.1 Two-Stage-Least Squares Results

Hence, I now analyze whether changes in competitor's organization, i.e. log number of markets, has an effect on the risk taking of banks. Using Two-Stage-Least Squares (2SLS) estimation, I am able to identify the causal effect of changes in competitor's organization on bank risk taking by using the exogeneous variation of competitor's organization in the second stage. Table 7 reports regression results from a 2SLS estimation using intrastate branching deregulation as an exogenous instrument for competitor's organization.

In order to compare the findings to results from an OLS regression, I include the estimated coefficients from an OLS estimation in the first column. Coefficients from a 2SLS estimation are presented in columns (2) to (4). In column (2), I use the intrastate branching deregulation dummy as the excluded instrument. In models (3) to (5), I use the natural log of years since intrastate branching deregulation as an instrument for the level of competitor's organizational form. The rationale for this instrument comes from the inspection of figure 7 which shows the expansion of banks after deregulation. The instruments pass the validity test: they explain a competitor's organizational form as shown by the reported values of a F-test of the excluded instruments in table 7.

The regression results suggest that the organizational form of competitors has significant effects on risk of competing banks: banks become less risky as competitors branch out into other markets. This relationship is also robust to the inclusion of control variables as shown in columns (3) and (4). In order to gauge the economic magnitude of this effect, I use the estimated relationship between Inverse Z-Score and failure provided in table C.V: if competitors increase their number of banking markets by one standard deviation, a bank's probability of failing decreases by 0.05 percentage-points. Since the average annual failure rate of banks is 0.3 percent, this implies that a bank's annual risk of failing decreases by approximately 17 percent ($= \frac{0.05}{0.3}$).

8.2.2 Robustness Checks

Alternative Measure of Organizational Form The total number of banking markets is one way to capture the organizational structure of banks. But it is also important how banks divide their activity across markets. For instance, it might be the case that a bank is active in many markets but most of its activity is focused on only one market. Using the number of banking markets to capture organization would then define this bank as very large (in terms of geographic breadth), even though the bank is in fact focused on one market. To account for this, I also measure a bank's organizational structure as the Herfindahl index of deposits across banking markets. Larger values thereby indicate that banks are more focused on one single banking market. In table 8, I present regression results where I use this variable as the regressor of interest. The results suggest that a lower concentration of competitors on one single market is associated with lower Inverse Z-Score for banks. This finding is robust to the inclusion of further control variables as well as region specific time dummies. Hence, this suggests that a competitor's organizational form has significant impact on risk.

Endogeneous Variable: Own Organizational Form In my previous analysis I have not considered the effect of a bank's own organizational structure on risk. However, my theory argues that a bank's own organizational form is also related to risk. Since a bank's organizational form is endogenous to risk, controlling for it in the earlier regression model is not sufficient to obtain unbiased estimates. To overcome this problem and evaluate the robustness of my earlier findings, I argue that bank specific characteristics before deregulation are able to explain the expansion behavior of banks once states liberalized branching restrictions. This allows me to also instrument for the organizational form of banks. In addition to this, I also follow an "Identification at Infinity" approach (similar to section 7.5.3) where I include only single-market banks in the sample if their estimated probability of being single-market banks in a certain year is high enough.

2SLS Estimation For the 2SLS estimation, I assume that a bank's decision to expand into other markets after intrastate branching deregulation is correlated with bank characteristics before deregulation. Specifically, I assume that banks, that were before deregulation ...

... more productive in their lending (1), and

... ever part of a bank holding company (2),

expand more once states liberalized their branching restrictions. Petersen and Rajan (2002) argue that the distance between borrowers and banks increased because banks improved their lending productivity. Information regarding banks' lending productivity is not available. Therefore I follow a similar approach as Dick and Lehnert (2010) and define a bank's lending productivity as the log of total loans per bank employee. As banks become more productive because they rely, for instance, more on credit scoring models, each employee is able to handle a larger loan volume. As a result, a larger value of this variable reflects a higher lending productivity. Ashcraft (2008) finds evidence that affiliation with bank holding companies banks is a source of strength for subsidiary banks. This leads to the second assumption that banks that were ever part of bank holding companies before deregulation follow a different expansion pattern after deregulation. For my analysis I use an indicator that takes on the value of one if a bank has - at least in one year - more than the average number of branches in a banking market before deregulation.

Table 9 presents regression results from an estimation of the log of own number of banking markets on the log number of years since deregulation and the aforementioned variables. The findings seem to suggest that the two aforementioned variables are able to explain the organizational form of banks following deregulation: banks that were more productive in their lending and banks that were part of a bank holding company expand more into other markets after intrastate branching deregulation.

Following the earlier 2SLS approach, I then use these variables as additional instruments to account for endogeneity of a bank's own organizational structure. Hence, I introduce the log number of years since deregulation and the two aforementioned variables as excluded instruments in the analysis. Table 10 presents estimation results from the second stage regression. The results indicate that the expansion of competitors into more markets significantly decreases bank risk even when I control for the endogeneity of a bank's own number of banking markets. Furthermore the results seem to suggest that an expansion across several markets of banks is associated with higher bank risk. However this finding is not significant if I use the indicator of whether a bank was part of a bank holding company before deregulation to instrument for a bank's own number of banking markets.

Overall these findings suggest that my results are not affected by a bank's organizational structure, i.e. the number of banking markets in which it is active.

Identification at Infinity Similar to earlier robustness checks, I follow an Identification at Infinity approach to account for a bias due to a bank's own organizational structure. By doing this, I can account for the selection of banks to expand into more markets. First, I estimate a logit model where the dependent variable is equal to one if a bank is active in only one market in the following year and zero otherwise. Furthermore, I include the log of total loans per bank employee as an additional variable in this logit regression since lending productivity may be able to explain the expansion pattern of banks. Since there is little variation of this variable within banks, I include state-year fixed effects for this estimation. This logit model allows me to estimate the probability of being a single-market bank for each bank and year. In a second step, I estimate the earlier 2SLS analysis where I only include single-market bank observations with a predicted probability of being active in one market higher than α, where α is close to one.

In table 11 I present regression results from this approach. First, I only investigate the effect for banks that are single-market banks in that year (column 1), or during the whole sample period (column 2). Since these banks are active in only one market, any effect that comes from having a larger organization across banking markets is assumed to be zero. The results in table 11 show that the negative relationship between a competitor's expansion across banking markets and bank risk is robust. Further, this effect is still significant when I restrict attention to banks that are single-market banks during the whole sample period. The additional columns replicate the 2SLS regression where I include single-market banks and observations with an estimated probability of being single-market banks of more than 85 percent, 90 percent and 95 percent. The findings from these sub-samples show the validity of my earlier results: bank risk decreases as competitors expand into more markets, even when I account for a bank's own organizational structure.

8.3 Role of Information: Soft versus Hard Information Counties

The theoretical model argues that the effect of competitors' organizational structure on risk taking is larger if there are more soft information borrowers in a county. Following this argument, I analyze whether the effect on bank risk taking is larger in counties with more informationally difficult borrowers. Hence, I test whether non-expanding banks experience a larger decline in their risk if there are more soft information borrowers available. To analyze this, I present four measures that capture the degree of borrower's information (soft versus hard) within counties.

8.3.1 Measures of Information

Opaqueness

1. Earlier research by Morgan (2002) found that some industries are more infor-

mational opaque than others. For instance, he finds that the banking sector is characterized by a greater degree of informational asymmetries since bond rating agencies more often disagree about their assessment of banks' bond issues than about their assessment of other industries.[29] For each industry, Morgan (2002) computes a statistic (*Kappa*) which is a measure of disagreement. This statistic characterizes informational asymmetries for each industry. For my analysis I use the inverse measure (*1 - Kappa*): sectors with lower values are supposed to be less opaque since rating agencies disagree less often about their assessment of bond issues by firms from these sectors.

2. Another strand of the literature uses the share of intangible assets reported in balance sheet by firms as a proxy for opaqueness. Claessens and Laeven (2003) and Braun (2003) argue that because of technological reasons, some industries operate with a larger share of intangible assets than others. Since intangible assets are hard to assess by outsiders, a larger share of intangible assets implies also a larger opaqueness. For my analysis, I compute the share of intangible assets for each industry according to its two digit Standard Industry Classification (SIC) code using information from Compustat.[30]

The U.S. Census provides information regarding the industry structure at a county level in its 'County Business Patterns' (CBP). The CBP reports the number of employees and establishments by SIC code for each county and year in the U.S. For each county, I determine the share of establishments in each two digit SIC code, excluding the financial sector. I then multiply this share with the opaqueness variables to aggregate information at the county level.

Average Firm Size and Proprietors Income In addition to these two measures, I use the average firm size and share of proprietors income for each county to assess the level of information.

1. Larger firms tend to be organized as corporations, which means that these firms compile and report balance sheet information (= hard information). Hence, counties with larger firms can be seen as being harder with respect to the degree of their borrower's information. I compute the average firm size (= average number of employees per establishments) in a county using information

[29]He compares bond issues in the following industries: Bank, Manufacturing, Mining, Trade, Services, Transportation, Public utilities, Insurance, Other finance and Real Estate

[30]See appendix (table C.II) for further information.

from the CBP. To have a measure of opaqueness, I invert this variable: larger values then indicate smaller average firm size and a more opaque county.

2. Proprietors income is the current-production income of sole proprietorships, partnerships, and tax-exempt cooperatives. A sole proprietorship is a business entity where there is no legal distinction between the owner and the business. Compared to businesses that are structured as legal entities, proprietorships can be considered to be more opaque. Their possibility to provide information depends upon the owner of the proprietorship, which is considered to be soft. A larger share of proprietors income in a county's total earnings indicates that the county holds more soft information borrowers. For each county, I determine the share of proprietors income in 'Earnings by place of work' as reported by the Bureau of Economic Analysis in its Local Area Personal Income Statistic.[31]

The correlation of these opacity measures at a county level is given in table C.VI in the appendix. All proxies are positively correlated: the pairwise correlation coefficient between 'Asset Intangbility' and 'Inverse Kappa' is 0.608. Furthermore, counties with a larger share of proprietor's income in total personal income tend to have - on average - small firms, as the correlation between these two variables shows. The spatial distribution of counties by their opacity as measured by Inverse Kappa before deregulation is shown in figure C.2. Darker values in this map indicate a more opaque borrower county.[32] Figure C.2 shows that there is no clear spatial clustering of opaque counties in certain areas.

8.3.2 Results

For each county, I determine the level of information before states decide to liberalize their intrastate branching restrictions. I then interact this measure with the measure of organizational form. Furthermore, I restrict attention to banks that do not expand following deregulation. Regression results are given in table 12.

Consistent with the theoretical framework, I find that the effect of competitors' organizational form on risk is different according to the level of information in a county. Specifically, I find that risk is more affected by an expansion of competitors in counties with more soft information borrowers: non-expanding banks that are located in more opaque counties (as measured by Inverse Kappa or the share of intangible assets) experience a larger decrease in their risk as competitors expand

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

[32] Since larger value of Inverse Kappa are supposed to indicate more soft information counties.

into other markets. The same holds when using the inverse of average firm size (column 3) or share of proprietors income (column 4) in a county as an indicator for opaqueness.

This seems to suggest that the informational level of borrowers within a county plays an important role when analyzing the effect of bank organization on risk.

9 Conclusion

Whether changes in competition among banks increases or decreases bank risk taking is an open debate in economics. Empirical research provides evidence that supports both views. In this paper, I contribute to this debate by showing that, in addition to the underlying market structure, a bank's organizational structure can also be an important factor for its risk taking behavior.

The competitive market structure among banks and the organizational form of banks might be related to each other but do not necessarily have to. For instance, a banking sector might hold many banks and all of these banks have a relatively flat organizational form. Equally likely might be the case where a banking sector is characterized as being very competitive but all of these banks operate an extensive branch network and therefore have a more complex organizational form.

In this paper, I provide a theoretical model and show that bank risk taking does not necessarily decrease as banks expand into other markets. Loan officers in large, hierarchical banks shift lending towards borrowers with verifiable information because this information can be more easily communicated within the organization. However, loan officers in large banks do not necessarily increase their monitoring effort which then leads to an increase in risk. In addition to this, I find that competing banks that do not change their organizational scope are also affected: as competitors expand their organizational scope, these banks will differentiate themselves and shift lending to borrowers with soft information. However, the effect on risk is ambiguous for them as well as monitoring effort might increase or decrease.

In the second part of the paper, I test these empirical predictions from the model for the U.S. commercial banking sector. The U.S. provides a unique possibility to analyze this question since states liberalized their restrictions on branching within states (intrastate) at different points in time. This staggered timing of deregulation allows me to pin down the effects of deregulation on risk for individual banks. My results indicate that the liberalization of intrastate branching restrictions only leads to a significant decrease in risk taking for banks that do not expand their geographical scope following deregulation.

Building on this, I then focus on the underlying channels through which intrastate branching deregulation affects bank risk takin. Using the timing of deregulation as an instrument, I use 2SLS estimation to determine the effects of competitors' expansion into other markets on bank's risk. First I show that the liberalization of branching restrictions is followed by an expansion of banks into other markets. Furthermore, I find that expanding banks shift lending toward real estate loans, which are typically characterized by information that is easy to verify and communicate. Hence, this seems to suggest that the mechanisms as suggested by the theoretical model are at work. In a second stage analysis, I find that a bank risk declines as competitors branch into other markets. This decline in risk is robust to the measure of risk taking as well as to the identification strategy. In the last part of the analysis, I focus on the importance of borrower information within a banking market. Thereby, I find that the decrease in non-expanding bank's risk taking as competitors expand is stronger in banking markets that have a larger share of informationally difficult borrowers.

My results suggest that it is important to consider the organizational structure of banks when investigating the relationship between market structure and bank risk. Theories from Organizational Economics (Aghion and Tirole (1997), Stein (2002)) establish that incentive mechanisms within firms depend heavily upon the hierarchical structure of firms. However this theoretical insight is not considered in the literature of market structure and bank risk taking so far. From an empirical point of view my results may also be applicable to a broader setting: for instance, my findings may be helpful when analyzing implications for bank risk taking that result because of an integration of the banking sector within the European Union. However my cross-state analysis is carried out in the United States - a country that provides a homogenous legal framework at a federal level. Therefore care has to be taken when applying the results to different settings.

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A Tables

Table 1: Effect of intrastate branching deregulation on bank risk

	(1)	(2)	(3)	(4)	(5)
Intrastate Branching Deregulation	-4.673***	-4.224***	-2.909***	-2.526***	-2.498***
	(0.497)	(0.496)	(0.613)	(0.714)	(0.701)
(Intrastate Branching Deregulation) × (Expanding after Deregulation?)				3.574***	3.487***
				(0.750)	(0.745)
Ln(Total Assets)		-0.007***	-0.006***	-0.006***	-0.006***
		(0.000)	(0.001)	(0.001)	(0.001)
Capital-Asset-Ratio		-0.174***	-0.126***	-0.166***	-0.165***
		(0.011)	(0.012)	(0.020)	(0.020)
Bhc indicator		-0.003***	-0.002***	-0.003***	-0.003***
		(0.000)	(0.001)	(0.001)	(0.001)
Loans-Assets-Ratio		0.014***	0.013***	0.013***	0.013***
		(0.001)	(0.002)	(0.002)	(0.002)
Interstate Branching Deregulation		-0.007***	-0.006***	-0.005***	-0.006***
		(0.001)	(0.001)	(0.001)	(0.001)
Ln(Number of Banks)		0.004***	0.001	0.001	0.002**
		(0.001)	(0.001)	(0.001)	(0.001)
Ln(Number of Branches)		0.002**	0.002**	0.001	0.001
		(0.001)	(0.001)	(0.001)	(0.001)
HHI		-0.005***	-0.004***	-0.004***	-0.003***
		(0.001)	(0.001)	(0.001)	(0.001)
County population per branch		-0.000	-0.000	-0.000	-0.000
		(0.000)	(0.000)	(0.000)	(0.000)
Growth of personal income in county		-0.018***	-0.005***	-0.005***	-0.004**
		(0.002)	(0.002)	(0.002)	(0.002)
Growth of personal income in county (lag)		-0.018***	-0.009***	-0.007***	-0.007***
		(0.001)	(0.002)	(0.002)	(0.002)
Average Effect if bank expands after Intrastate Branching Deregulation				1.049	0.989
				(0.775)	(0.765)
Bank fixed effects	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	no
Region specific year fixed effects	no	no	no	no	yes
Observations	295738	280927	144217	125598	125598
Within R^2	0.052	0.073	0.106	0.122	0.130
Banks	18938	18664	6759	4898	4898

This table reports regression results from a bank fixed effects OLS analysis. The dependent variable is Inverse Z multiplied by 1000. Inverse Z is defined as (Standard Deviation of ROE)/(ROE + 1). Models (3) to (5) only use banks that do not fail, merge or are acquired in the period 1976 to 2006. Interstate Deregulation is a dummy variable that takes 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). Loan-Asset-Ratio is defined as (Total Loans)/(Total Assets); ln(total assets) = natural log of total assets; Capital/Assets is defined as (Bank Capital)/(Total Assets). 'Bank Holding Company dummy' is equal to one if the bank is part of a bank holding company, 'Ln(Number of Banks)' is the natural logarithm of chartered banks in the banking market, 'Ln(Number of Branches)' is the natural logarithm of all branches in the banking market, 'HHI' is the Herfindahl Index of deposits across competitors in a banking market, 'County population per branch' is the number of people per bank branch in a county. The constant is not reported.
Time dummies are used. 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 2: Effect of intrastate branching deregulation on earnings and earnings volatility

	(ROE)		Standard Deviation (ROE)	
	(1)	(2)	(1)	(2)
Intrastate Branching Deregulation	0.220*** (0.071)	0.138* (0.072)	-0.293*** (0.075)	-0.296*** (0.074)
(Intrastate Branching Deregulation) × (Expanding after Deregulation?)	0.225*** (0.084)	0.240*** (0.083)	0.417*** (0.080)	0.410*** (0.079)
Ln(Total Assets)	0.913*** (0.066)	0.899*** (0.066)	-0.595*** (0.067)	-0.614*** (0.067)
Capital-Asset-Ratio	-13.625*** (1.455)	-13.666*** (1.442)	-17.140*** (1.896)	-17.083*** (1.900)
Bhc indicator	0.181*** (0.058)	0.218*** (0.058)	-0.253*** (0.060)	-0.256*** (0.060)
Loans-Assets-Ratio	1.548*** (0.201)	1.520*** (0.200)	1.272*** (0.186)	1.297*** (0.186)
Interstate Branching Deregulation	0.271*** (0.079)	0.428*** (0.084)	-0.468*** (0.086)	-0.674*** (0.091)
Ln(Number of Banks)	-0.361*** (0.114)	-0.297*** (0.115)	0.143 (0.106)	0.219** (0.108)
Ln(Number of Branches)	-0.434*** (0.114)	-0.478*** (0.113)	0.106 (0.111)	0.102 (0.111)
HHI	-0.440*** (0.087)	-0.485*** (0.086)	-0.439*** (0.078)	-0.378*** (0.078)
County population per branch	-0.000*** (0.000)	-0.000*** (0.000)	-0.000* (0.000)	-0.000** (0.000)
Growth of personal income in county	1.605*** (0.183)	1.412*** (0.182)	-0.384** (0.192)	-0.306 (0.194)
Growth of personal income in county (lag)	2.213*** (0.196)	2.072*** (0.195)	-0.582*** (0.172)	-0.586*** (0.176)
Average Effect if bank expands after Intrastate Branching Deregulation	0.445*** (0.077)	0.388*** (0.078)	0.123 (0.081)	0.114 (0.079)
Bank fixed effects	yes	yes	yes	yes
Year fixed effects	yes	no	yes	no
Region specific year fixed effects	no	yes	no	yes
Observations	135505	135505	125423	125423
Within R^2	0.087	0.097	0.132	0.140
Banks	4900	4900	4897	4897

This table reports regression results from a bank fixed effects OLS analysis. The dependent variable is Return on Equity in percentage points and Standard Deviation of Return on Equity. The sample consists of banks that do not fail, merge or are acquired in the period 1976 to 2006. Interstate Deregulation is a dummy variable that takes 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). Loan-Asset-Ratio is defined as (Total Loans)/(Total Assets); ln(total assets) = natural log of total assets; Capital/Assets is defined as (Bank Capital)/(Total Assets). 'Bank Holding Company dummy' is equal to one if the bank is part of a bank holding company, 'Ln(Number of Banks)' is the natural logarithm of chartered banks in the banking market, 'Ln(Number of Branches)' is the natural logarithm of all branches in the banking market, 'HHI' is the Herfindahl Index of deposits across competitors in a banking market, 'County population per branch' is the number of people per bank branch in a county. The constant is not reported.
Time dummies are used. 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 3: Robustness: Other risk measures

Variable	OLS 'CAMEL'-Indicator		Logit Failure	Distress
	(1)	(2)	(3)	(4)
Intrastate Branching Deregulation	-0.010	-0.055***	-0.005	-0.407***
	(0.013)	(0.016)	(0.005)	(0.079)
(Intrastate Branching Deregulation) × (Expanding after Deregulation?)		0.096***		
		(0.102)		
Ln(Total Assets)	-0.139***	-0.047***	-0.008	-1.051***
	(0.012)	(0.014)	(0.006)	(0.025)
Capital-Asset-Ratio	-0.690***	-2.727***	-0.917	4.846***
	(0.104)	(0.341)	(0.681)	(0.599)
Bhc indicator	-0.028**	-0.005	-0.005	-0.264***
	(0.013)	(0.015)	(0.004)	(0.044)
Loans-Assets-Ratio	0.772***	0.951***	0.100	3.170***
	(0.038)	(0.042)	(0.076)	(0.151)
Interstate Branching Deregulation	-0.074***	-0.053***	-0.003	-0.687***
	(0.016)	(0.018)	(0.004)	(0.113))
Ln(Number of Banks)	-0.011	0.004	-0.004	-0.028
	(0.024)	(0.026)	(0.004)	(0.060)
Ln(Number of Branches)	0.125***	0.099***	0.005	0.450***
	(0.023)	(0.024)	(0.005)	(0.048)
HHI	0.237**	-0.000	-0.007	-0.152***
	(0.020)	(0.020)	(0.006)	(0.082)
County population per branch	0.000***	0.000***	0.000	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Growth of personal income in county	-0.020	-0.064	-0.075	1.598***
	(0.050)	(0.052)	(0.059)	(0.272)
Growth of personal income in county (lag)	-0.200***	-0.207***	-0.070	1.326***
	(0.050)	(0.054)	(0.057)	(0.247)
Average Effect if bank expands after Intrastate Branching Deregulation	0.026	0.040**		
	(0.019)	(0.019)		
Bank fixed effects	yes	yes	yes	yes
Region specific year fixed effects	yes	yes	yes	yes
Observations	122028	101423	252109	284756
Within R^2	0.038	0.066		
Banks	7091	4900	19179	18730

This table reports regression results from a bank fixed effects OLS analysis. The dependent variable is given in the row labeled 'Variable'. Loan Losses / Capital is the ratio of loan losses to bank equity. 'CAMEL'-Indicator measures the risk of banks; it is a variable that takes on the value of one to four with higher values indicating more risk. 'Distress Indicator' is a dummy variable that takes on the value of one if a bank experience a decrease of its capital-asset-ratio of more than 10% in two consecutive years. Only banks that do not fail, merge or are acquired in the period 1976 to 2006 are used for the analysis. Interstate Deregulation is a dummy variable that takes 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). Loan-Asset-Ratio is defined as (Total Loans)/(Total Assets); ln(total assets) = natural log of total assets; Capital/Assets is defined as (Bank Capital)/(Total Assets). 'Bank Holding Company dummy' is equal to one if the bank is part of a bank holding company, 'Ln(Number of Banks)' is the natural logarithm of chartered banks in the banking market, 'Ln(Number of Branches)' is the natural logarithm of all branches in the banking market, 'HHI' is the Herfindahl Index of deposits across competitors in a banking market, 'County population per branch' is the number of people per bank branch in a county. The constant is not reported.
Time dummies are used. 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 4: Robustness: Autocorrelation

Estimator	Within	Within	Within	First Difference	Within	Within
Note:	Benchmark	only every other year	only every third year	only every other year	AR(1) error term	AR(1) error term - Driscoll-Kraay-s.e.
Intrastate Branching Deregulation	-2.909***	-3.165***	-2.767***	-3.621***	-2.745***	-2.909*
	(0.613)	(0.665)	(0.772)	(1.175	(0.592)	(1.616)
Ln(Total Assets)	-6.077***	-5.356***	-5.477***	-9.503***	2.693***	-6.077***
	(0.542)	(0.618)	(0.744)	(1.775)	(0.279)	(1.051)
Capital-Asset-Ratio	-125.797***	-123.044***	-127.433***	-162.153***	-85.782***	-125.797***
	(11.762)	(14.257)	(18.667)	(17.449)	(3.857)	(20.144)
Bhc indicator	-2.399***	-1.885***	-2.329***	1.350*	-0.100	-2.399***
	(0.530)	(0.596)	(0.683)	(0.803)	(0.395)	(0.464)
Loans-Assets-Ratio	12.986***	12.260***	12.720***	1.553	11.737***	12.986***
	(1.664)	(1.965)	(2.212)	(2.817)	(1.208)	(2.931)
Interstate Branching Deregulation	-5.746***	-7.943***	-6.440***	-5.010***	-6.373***	-5.746
	(0.805)	(0.930)	(1.066)	(1.312)	(0.700)	(4.125)
Ln(Number of Banks)	0.843	0.874	1.621	0.817	2.437***	0.843
	(0.994)	(1.110)	(1.213)	(1.593)	(0.783)	(0.853)
Ln(Number of Branches)	2.289**	1.224	2.822**	0.248	4.547***	2.289*
	(1.045)	(1.083)	(1.337)	(1.639)	(0.702)	(1.334)
HHI	-4.389***	-4.598***	-5.174***	-2.217*	-0.391	-4.389***
	(0.744)	(0.837)	(0.991)	(1.305)	(0.615)	(0.993)
County population per branch	-0.000	-0.000	-0.000	-0.000	0.001***	-0.000
	(0.000)	(0.000)	(0.000)	v	(0.000)	(0.000)
Growth of personal income in county	-5.396***	-9.350***	-12.326***	-7.055***	0.269	-5.396
	(1.865)	(2.527)	(3.538)	(2.255)	(1.066)	(4.746)
Growth of personal income in county (lag)	-8.847***	-9.465***	6.851**	7.729***	-2.168**	-8.847*
	(1.590)	(2.600)	(3.325)	(2.578)	(1.063)	(4.848)
Observations	144217	69452	44434	58562	137458	144217
Within R^2	0.106	0.113	0.113	0.020		
Banks	6759	6625	6513		6623	6759
Rho					0.671	

This table reports regression results from a bank fixed effects OLS analysis. The dependent variable is Inverse Z multiplied by 1000. Inverse Z is defined as (Standard Deviation of ROE)/(ROE + 1). The underlying estimator is given in the row labeled 'estimator', further information regarding the estimator/ sample is given in the row labeled 'note'. The reference sample are all banks that do not fail, acquired or merged during the period 1976 - 2006.
The first column reports regression results from a within bank fixed effects estimation. The second column reports estimation results from a first difference bank fixed effects regression. The third and fourh colum report regression results using a sub-sample: In the third column only every other year for a bank is used; in the fourth colum, only every third year for each bank is used. The last two columns present regression results using estimators that explicitly model the error term as an AR(1) process. The last column presents Driscoll-Kraay standard errors.
Time dummies are used. Standard errors in the first four regression estimations 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 5: Robustness: Identification at Infinity

Selection		> 85%	> 90%	> 95%
	(1)	(2)	(3)	(4)
Intrastate Branching Deregulation	-2.526***	-2.693***	-2.640***	-2.012***
	(0.714)	(0.693)	(0.675)	(0.656)
(Intrastate Branching Deregulation) × (Expanding after Deregulation?)	3.574***	3.541***	3.578***	3.723***
	(0.750)	(0.737)	(0.726)	(0.729)
Ln(Total Assets)	-6.109***	-5.855***	-5.728***	-5.963***
	(0.636)	(0.615)	(0.607)	(0.613)
Capital-Asset-Ratio	-166.266***	-161.178***	-155.984***	-146.320***
	(19.589)	(18.619)	(17.776)	(16.276)
Bhc indicator	-2.577***	-2.665***	-2.773***	-2.721***
	(0.566)	(0.549)	(0.542)	(0.539)
Loans-Assets-Ratio	12.921***	12.801***	12.874***	14.104***
	(1.762)	(1.744)	(1.743)	(1.760)
Interstate Branching Deregulation	-4.632***	-5.151***	-5.933***	-6.581***
	(0.856)	(0.849)	(0.840)	(0.820)
Ln(Number of Banks)	1.467	1.401	1.170	1.326
	(1.010)	(0.998)	(0.996)	(1.055)
Ln(Number of Branches)	1.342	1.348	1.550	2.137*
	(1.068)	(1.064)	(1.069)	(1.129)
HHI	-4.049***	-4.069***	-4.142***	-4.061***
	(0.747)	(0.742)	(0.735)	(0.736)
County population per branch	-0.000	-0.000*	-0.000*	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Growth of personal income in county	-5.153***	-4.582***	-3.999**	-2.932*
	(1.769)	(1.750)	(1.746)	(1.766)
Growth of personal income in county (lag)	-6.862***	-6.438***	-5.597***	-3.966**
	(1.582)	(1.559)	(1.542)	(1.593)
Bank fixed effects	yes	yes	yes	yes
Region specific year fixed effects	yes	yes	yes	yes
Observations	125598	124627	121314	101939
Within R^2	0.122	0.123	0.125	0.130
Banks	4898	4898	4898	4898

This table reports regression results from a bank fixed effects OLS analysis using an identification at infinity. The dependent variable is Inverse Z multiplied by 1000. Inverse Z is defined as (Standard Deviation of ROE)/(ROE + 1). The sample consists of surviving banks and observations with a predicted probability of not exiting the sample higher than the percentage given in the row labeled 'selection'. The estimated probabilities are obtained from state-year fixed effects logit regression where the dependent variable is an indicator equal to one if the banks does not exit the sample due to failure, merger or acquisition. Interstate Deregulation is a dummy variable that takes 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). Loan-Asset-Ratio is defined as (Total Loans)/(Total Assets); ln(total assets) = natural log of total assets; Capital/Assets is defined as (Bank Capital)/(Total Assets). 'Bank Holding Company dummy' is equal to one if the bank is part of a bank holding company, 'Ln(Number of Banks)' is the natural logarithm of chartered banks in the banking market, 'Ln(Number of Branches)' is the natural logarithm of all branches in the banking market, 'HHI' is the Herfindahl Index of deposits across competitors in a banking market, 'County population per branch' is the number of people per bank branch in a county. The constant is not reported.
Region specific time dummies are used. 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 6: Effect of intrastate branching deregulation on banks' organizational form

Information Index:			Inverse Kappa	Asset Intangibility	Inverse Average Firm Size	Share of proprietor's income
	(1)	(2)	(3)	(4)	(5)	(6)
Intrastate Branching Deregulation	0.020***					
	(0.006)					
Ln(years since intrastate branching deregulation +1)		0.038***	0.158***	0.172***	0.107***	0.101***
		(0.004)	(0.012)	(0.017)	(0.008)	(0.007)
Ln(years since intrastate branching deregulation +1) × Information			-0.189***	-0.231***	-0.729***	-0.003***
			(0.018)	(0.017)	(0.063)	(0.000)
	(0.006)					
Interstate Branching Deregulation	0.012**	0.010*	0.013***	0.014***	0.014***	0.011**
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Ln(Number of Banks)	-0.187***	-0.191***	-0.162***	-0.158***	-0.180***	-0.185***
	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)
Ln(Number of Branches)	0.145***	0.143***	0.109***	0.100***	0.136***	0.137***
	(0.016)	(0.016)	(0.016)	(0.017)	(0.016)	(0.016)
HHI	-0.131***	-0.130***	-0.083***	-0.074***	-0.074***	-0.077***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
County population per branch	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Growth of personal income in county	0.009	0.011	-0.004	-0.005	0.001	0.004
	(0.011)	(0.011)	(0.010)	(0.010)	(0.010)	(0.010)
Growth of personal income in county (lag)	0.001	0.007	-0.006	-0.008	-0.007	-0.006
	(0.009)	(0.009)	(0.009)	(0.008)	(0.009)	(0.009)
Ln(Total Assets)	0.028***	0.028***	0.018**	0.014*	0.019**	0.015**
	(0.007)	(0.007)	(0.008)	(0.008)	(0.008)	(0.008)
Capital-Asset-Ratio	0.106**	0.108**	0.112**	0.117**	0.101*	0.093*
	(0.047)	(0.047)	(0.053)	(0.053)	(0.055)	(0.051)
Bhc indicator	-0.010*	-0.009*	-0.007	-0.004	-0.012**	-0.010*
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Loans-Assets-Ratio	0.018	0.016	0.010	0.021	0.011	0.022
	(0.017)	(0.017)	(0.018)	(0.018)	(0.018)	(0.018)
Bank fixed effects	yes	yes	yes	yes	yes	yes
Year fixed Effects	yes	yes	yes	yes	yes	yes
Observations	128215	132540	123387	123423	123673	124769
R^2	0.339	0.341	0.364	0.370	0.363	0.366
Banks	6907	6907	6049	6053	6059	6148

This table reports regression results from a bank fixed effects OLS analysis. The dependent variable is the log of competitor's banking markets. The row labeled 'Information Index' shows the interacted variable used in models (3) to (6), where larger values of 'Information index' indicate a larger share of 'soft' in a county before intrastate branching deregulation. Interstate Deregulation is a dummy variable that takes on the value of one the year after a state deregulates its interstate branching restrictions. 'Ln(years since intrastate branching deregulation)' is the log number of years since intrastate branching deregulation. 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). Loan-Asset-Ratio is defined as (Total Loans)/(Total Assets); ln(total assets) = natural log of total assets; Capital/Assets is defined as (Bank Capital)/(Total Assets). 'Bank Holding Company dummy' is equal to one if the bank is part of a bank holding company, 'Ln(Number of Banks)' is the natural logarithm of chartered banks in the banking market, 'Ln(Number of Branches)' is the natural logarithm of all branches in the banking market, 'HHI' is the Herfindahl Index of deposits across competitors in a banking market, 'County population per branch' is the number of people per branch in a county. The constant is not reported. Standard errors are robust, clustered at the bank level and reported in parentheses below. The constant is not reported. Significance stars are: * p<0.10, ** p<0.05, *** p<0.01.

Table 7: Effect of competitors' number of banking markets on bank risk

		(2SLS)		
	(OLS)	(2)	(3)	(4)
Ln(number of competitor's banking markets)	0.730	-98.529*	-41.348***	-42.965***
	(0.659)	(52.580)	(12.604)	(12.373)
Ln(Total Assets)		-5.200**	-7.273***	-7.750***
		(2.085)	(0.902)	(0.913)
Capital-Asset-Ratio		-142.741***	-156.223***	-156.358***
		(19.178)	(15.481)	(15.459)
Bhc indicator		-2.765***	-2.180***	-2.192***
		(0.925)	(0.628)	(0.625)
Loans-Assets-Ratio		17.032***	16.071***	16.211***
		(2.839)	(2.053)	(2.047)
Interstate Branching Deregulation		-3.518***	-3.735***	-4.602***
		(1.125)	(0.897)	(0.923)
Ln(Number of Banks)		-18.366*	-7.017**	-6.277**
		(10.023)	(2.791)	(2.762)
Ln(Number of Branches)		15.571**	7.688***	7.764***
		(7.107)	(2.259)	(2.198)
HHI		-17.395**	-9.986***	-9.863***
		(6.894)	(1.838)	(1.814)
County population per branch		-0.003*	-0.002***	-0.002***
		(0.002)	(0.001)	(0.001)
Growth of personal income in county		-7.343***	-8.344***	-8.024***
		(2.302)	(1.859)	(1.865)
Growth of personal income in county (lag)		-9.984***	-11.213***	-11.016***
		(1.973)	(1.829)	(1.861))
Instrument		Dummy	Ln(years...)	Ln(years...)
Bank fixed effects	yes	yes	yes	yes
Year fixed Effects	yes	yes	yes	no
Region specific year fixed effects	no	no	no	yes
Observations	124513	115393	119531	119531
Within R^2	0.089	-0.398	0.023	0.026
Banks	6522	6277	6281	6281
F-Test		7.714	66.98	66.25
Partial R^2		0.000290	0.00343	0.00346

Coefficients are multiplied by 1,000. This table reports second stage regression results from a bank fixed effects Two-Stage-Least-Squares analysis. The sample includes only banks that are not failing or merged/acquired. The excluded instrument is given in the row titled 'Instrument'. The dependent variable is Inverse Z. Inverse Z is defined as (Standard Deviation of ROE)/(ROE + 1). 'Ln(competitors banking markets)$_i$' is the natural log of the average number of banking markets all competitors of bank i are active in. Interstate Deregulation is a dummy variable that takes 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). Loan-Asset-Ratio is defined as (Total Loans)/(Total Assets); ln(total assets) = natural log of total assets; Capital/Assets is defined as (Bank Capital)/(Total Assets). 'Bank Holding Company dummy' is equal to one if the bank is part of a bank holding company, 'Ln(Number of Banks)' is the natural logarithm of chartered banks in the banking market, 'Ln(Number of Branches)' is the natural logarithm of all branches in the banking market, 'HHI' is the Herfindahl Index of deposits across competitors in a banking market, 'County population per branch' is the number of people per branch in a county. The constant is not reported.
Time dummies are used. Standard errors are robust, clustered at the bank level and are reported in parentheses below. Significance stars are: * p<0.10, ** p<0.05, *** p<0.01.

Table 8: Robustness: Effect of competitors' concentration across markets on bank risk

		(2SLS		
	(OLS)	(2)	(3)	(4)
Competitor's Concentration across banking markets (HHI)	2.708**	43.779***	25.620***	30.992***
	(1.217)	(9.991)	(6.014)	(6.370)
Ln(Total Assets)		-5.716***	-5.878***	-6.199***
		(0.549)	(0.547)	(0.559)
Capital-Asset-Ratio		-124.136***	-129.558***	-129.346***
		(11.923)	(12.186)	(12.186)
Bhc indicator		-2.289***	-2.262***	-2.223***
		(0.541)	(0.538)	(0.539)
Loans-Assets-Ratio		13.096***	13.258***	13.325***
		(1.705)	(1.694)	(1.697)
Interstate Branching Deregulation		-3.712***	-3.972***	-4.695***
		(0.912)	(0.851)	(0.858)
Ln(Number of Banks)		5.667***	4.131***	5.430***
		(1.451)	(1.188)	(1.213)
Ln(Number of Branches)		-0.059	0.695	0.387
		(1.188)	(1.108)	(1.132)
HHI		-3.149***	-3.924***	-3.249***
		(0.860)	(0.800)	(0.808)
County population per branch		-0.001*	-0.000	-0.001*
		(0.000)	(0.000)	(0.000)
Growth of personal income in county		-5.845***	-6.337***	-5.235***
		(1.964)	(1.936)	(1.950)
Growth of personal income in county (lag)		-9.551***	-11.125***	-10.511***
		(1.671)	(1.724)	(1.751)
Instrument		Dummy	Ln(years...)	Ln(years...)
Bank fixed effects	yes	yes	yes	yes
Year fixed Effects	yes	yes	yes	no
Region specific year fixed effects	no	no	no	yes
Observations	152584	141862	146430	146430
R^2	0.088	0.086	0.099	0.106
Banks	6766	6591	6592	6592
F-Test		541.7	1128	912.4
Partial R^2		0.0174	0.0497	0.0433

Coefficients are multiplied by 1,000. This table reports second stage regression results from a bank fixed effects Two-Stage-Least-Squares analysis. The sample includes only banks that are not failing or merged/acquired. The excluded instrument is given in the row titled 'Instrument'. The dependent variable is Inverse Z. Inverse Z is defined as (Standard Deviation of ROE)/(ROE + 1). 'Competitors' Concentration across banking markets (HHI)' is the Herfindahl Index based on the bank's competitors' share of deposits in each banking market. Interstate Deregulation is a dummy variable that takes 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). Loan-Asset-Ratio is defined as (Total Loans)/(Total Assets); ln(total assets) = natural log of total assets; Capital/Assets is defined as (Bank Capital)/(Total Assets). 'Bank Holding Company dummy' is equal to one if the bank is part of a bank holding company, 'Ln(Number of Banks)' is the natural logarithm of chartered banks in the banking market, 'Ln(Number of Banks)' is the natural logarithm of chartered banks in the banking market, 'Ln(Number of Branches)' is the natural logarithm of all branches in the banking market, 'HHI' is the Herfindahl Index of deposits across competitors in a banking market, 'County population per branch' is the number of people per bank branch in a county. The constant is not reported.
Time dummies are used. Standard errors are robust, clustered at the bank level and are reported in parentheses below. Significance stars are: * p<0.10, ** p<0.05, *** p<0.01.

Table 9: Robustness: Effect of own markets - 1st stage

	(1)	(2)	(3)
(Ln (years since intrastate branching deregulation +1)	-0.257***	-0.011**	-0.216***
	(0.034)	(0.004)	(0.035)
(Ln (years since intrastate branching deregulation +1)× Ln(Total Loans / Full Time Equivalent Employee) before deregulation)	0.042***		0.033***
	(0.005)		(0.006)
(Ln (years since intrastate branching deregulation +1)× (=1 if bank was ever part of bank holding company before deregulation)		0.039***	0.032***
		(0.005)	(0.005)
Ln(Total Assets)	0.368***	0.356***	0.370***
	(0.010)	(0.010)	(0.010)
Capital-Asset-Ratio	0.556***	0.659***	0.580***
	(0.085)	(0.082)	(0.085)
Loans-Assets-Ratio	0.083***	0.058***	0.078***
	(0.021)	(0.021)	(0.021)
Interstate Branching Deregulation	0.007	0.012*	0.007
	(0.006)	(0.006)	(0.006)
Ln(Number of Banks)	0.052***	0.051***	0.055***
	(0.017)	(0.016)	(0.017)
Ln(Number of Branches)	-0.007	0.000	-0.011
	(0.017)	(0.017)	(0.017)
HHI	0.000	0.002	0.003
	(0.009)	(0.009)	(0.009)
County population per branch	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)
Growth of personal income in county	0.010	0.009	0.008
	(0.009)	(0.009)	(0.009)
Growth of personal income in county (lag)	-0.011	-0.012	-0.013
	(0.009)	(0.009)	(0.009)
Bank fixed effects	yes	yes	yes
Year fixed effects	yes	yes	yes
Observations	142034	144829	141283
R^2	0.423	0.418	0.426
Banks	4970	5023	4873

This table reports regression results from a bank fixed effects OLS analysis. The dependent variable is the log number of banking markets. Interstate Deregulation is a dummy variable that takes on the value of one the year after a state deregulates its interstate branching restrictions. 'Ln(years since intrastate branching deregulation)' is the log number of years since intrastate branching deregulation. 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). Loan-Asset-Ratio is defined as (Total Loans)/(Total Assets); ln(total assets) = natural log of total assets; Capital/Assets is defined as (Bank Capital)/(Total Assets). 'Bank Holding Company dummy' is equal to one if the bank is part of a bank holding company, 'Ln(Number of Banks)' is the natural logarithm of chartered banks in the banking market, 'Ln(Number of Branches)' is the natural logarithm of all branches in the banking market, 'HHI' is the Herfindahl Index of deposits across competitors in a banking market, 'County population per branch' is the number of people per branch in a county. The constant is not reported. Time dummies are used. 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 10: Robustness: Effect of own markets - 2nd stage

		(2SLS)		
	(OLS)	(2)	(3)	(4)
Ln(number of competitor's banking markets)	-41.298***	-32.916**	-39.998***	-29.837**
	(12.653)	(13.382)	(15.010)	(13.423)
Ln(number of own banking markets)	6.439***	29.115	37.862	34.263**
	(1.228)	(18.704)	(24.676)	(15.817)
Ln(Total Assets)	-8.603***	-12.180***	-13.063***	-13.256***
	(0.874)	(3.624)	(4.292)	(3.079)
Capital-Asset-Ratio	-156.552***	-222.116***	-188.025***	-220.263***
	(15.232)	(25.124)	(20.070)	(24.160)
Loans-Assets-Ratio	15.475***	15.166***	14.877***	14.584***
	(2.041)	(2.159)	(2.181)	(2.132)
Interstate Branching Deregulation	-3.740***	-2.947***	-3.793***	-2.939***
	(0.897)	(0.929)	(0.917)	(0.928)
Ln(Number of Banks)	-7.124**	-4.099	-6.882**	-3.723
	(2.809)	(2.763)	(3.271)	(2.751)
Ln(Number of Branches)	7.564***	4.536**	5.337**	3.997*
	(2.257)	(2.278)	(2.391)	(2.251)
HHI	-9.867***	-8.213***	-9.275***	-7.943***
	(1.838)	(1.863)	(2.090)	(1.857)
County population per branch	-0.002***	-0.002***	-0.002***	-0.002***
	(0.001)	(0.001)	(0.001)	(0.001)
Growth of personal income in county	-8.475***	-8.086***	-7.392***	-7.855***
	(1.854)	(1.821)	(1.837)	(1.805)
Growth of personal income in county (lag)	-11.246***	-9.721***	-9.020***	-9.286***
	(1.825)	(1.816)	(1.837)	(1.803)
Bank fixed effects	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes
Observations	119531	106631	108447	106138
Within R^2	0.020	-0.171	-0.206	-0.201
Banks	6281	4778	4837	4702
F-Test	66.69	35.23	33.70	23.36
Partial R^2	0.00340	0.00366	0.00336	0.00379
Hansen J				0.043

Coefficients are multiplied by 1,000. This table reports second stage regression results from a bank fixed effects Two-Stage-Least-Squares analysis. The sample includes only banks that are not failing or merged/acquired. The excluded instruments are: log number of years since intrastate branching deregulation, log number of years since deregulation times times (1) the median log of total loans per Full Time Equivalent Employee before deregulation (column 2), and (2) times an indicator that takes on the value of one if the banks was part of a bank holding company before deregulation (column 2) and both (colum 3) the average number of branches in a county before deregulation ne if the bank's ever had more than the average number of branches in a county before deregulation (model 2) and log number of years since deregulation times an indicator that takes on the value of one if the banks was part of a bank holding company before deregulation(model 3).
The dependent variable is Inverse Z-Score. Inverse Z-Score is defined as (Standard Deviation of ROE)/(ROE + 1). 'Ln(number of competitor's banking markets)' is the natural log of the average number of banking markets all competitors of bank i are active in; 'Ln(number of own banking markets)' is the natural log of the number of banking markets bank i is active in.
Loan-Asset-Ratio is defined as (Total Loans)/(Total Assets); ln(total assets) = natural log of total assets; Capital/Assets is defined as (Bank Capital)/(Total Assets). 'Bank Holding Company dummy' is equal to one if the bank is part of a bank holding company, 'Ln(Number of Banks)' is the natural logarithm of chartered banks in the banking market, 'Ln(Number of Branches)' is the natural logarithm of all branches in the banking market, 'HHI' is the Herfindahl Index of deposits across competitors in a banking market, 'County population per branch' is the number of people per branch in a county. The constant is not reported.
Time dummies are used. Standard errors are robust, clustered at the bank level and are reported in parentheses below. Significance stars are: * p<0.10, ** p<0.05, *** p<0.01.

Table 11: Robustness: Identification at Infinity

Selection:	only single market banks		> 85%	> 90%	> 95%
	in year	in whole sample			
	(1)	(2)	(3)	(4)	(5)
Ln(number of competitor's banking markets)	-50.171***	-36.854**	-82.086***	-107.157***	-172.176***
	(15.235)	(16.674)	(23.194)	(29.517)	(45.432)
Ln(Total Assets)	-8.552***	-5.919***	-13.513***	-14.923***	-16.891***
	(1.107)	(1.280)	(1.449)	(1.718)	(2.311)
Capital-Asset-Ratio	-161.719***	-131.163***	-177.237***	-175.696***	-170.016***
	(17.145)	(18.645)	(21.998)	(24.891)	(30.400)
Bhc indicator	-2.054***	-1.192	-2.442***	-2.690***	-3.342***
	(0.674)	(0.812)	(0.814)	(0.927)	(1.116)
Loans-Assets-Ratio	17.445***	20.248***	16.855***	17.006***	17.645***
	(2.271)	(2.720)	(2.930)	(3.382)	(4.112)
Interstate Branching Deregulation	-3.404***	-2.983**	-2.190**	-2.167*	-2.151
	(0.943)	(1.239)	(1.056)	(1.136)	(1.368)
Ln(Number of Banks)	-8.084**	-4.409	-12.916**	-17.991***	-27.091***
	(3.409)	(3.797)	(5.237)	(6.778)	(9.498)
Ln(Number of Branches)	11.197***	6.596*	16.282***	20.733***	31.219***
	(2.986)	(3.522)	(4.649)	(5.978)	(8.922)
HHI	-10.661***	-7.904***	-10.467***	-11.408***	-13.186***
	(2.028)	(2.301)	(2.324)	(2.571)	(3.080)
County population per branch	-0.001*	-0.001	-0.001	-0.000	-0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Growth of personal income in county	-8.821***	-5.995**	-8.853***	-7.827***	-5.949**
	(1.938)	(2.343)	(2.061)	(2.157)	(2.362)
Growth of personal income in county (lag)	-10.469***	-8.192***	-10.280***	-10.059***	-9.986***
	(1.890)	(2.298)	(2.052)	(2.138)	(2.305)
Bank fixed effects	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	yes
Observations	108228	67954	80306	72136	59410
Banks	5827	3223	5424	5278	5076
F-Test	53.93	38.32	45.50	35.77	26.09
Partial R^2	0.00332	0.00329	0.00354	0.00331	0.00328

This table reports regression results from a bank fixed effects 2SLS analysis. The dependent variable is Inverse Z multiplied by 1000. Inverse Z is defined as (Standard Deviation of ROE)/(ROE + 1). This first column only uses observations from banks that are active in only one market (= single-market banks). In the second column, only banks that are single-market banks during the whole sample period are used. In models (3) to (5), single-market banks and observations with a predicted probability of being a single-market banks higher than the percentage given in the row labeled 'selection' are used. The estimated probabilities are obtained from state-year fixed effects logit regression where the dependent variable is an indicator equal to one if the bank is a single-market bank in the following year. Loan-Asset-Ratio is defined as (Total Loans)/(Total Assets); ln(total assets) = natural log of total assets; Capital/Assets is defined as (Bank Capital)/(Total Assets). 'Bank Holding Company dummy' is equal to one if the bank is part of a bank holding company, 'Ln(Number of Banks)' is the natural logarithm of chartered banks in the banking market, 'Ln(Number of Branches)' is the natural logarithm of all branches in the banking market, 'HHI' is the Herfindahl Index of deposits across competitors in a banking market, 'County population per branch' is the number of people per branch in a county. The constant is not reported.
Region specific time dummies are used. 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 12: Effect of competitors' number of banking markets on bank risk & Information

Information Index:	Inverse Kappa	Intangibility	Inverse average firm size	Share of proprietors income
	(1)	(2)	(3)	(4)
Ln(number of competitor's banking markets)	20.715***	7.442	18.724**	-2.206
	(7.799)	(7.018)	(8.336)	(10.413)
Ln(competitor's banking markets) * Information Index	-74.570***	-61.439*	-440.388***	-2.143***
	(26.402)	(34.248)	(119.612)	(0.740)
Ln(Total Assets)	-7.560***	-7.032***	-7.866***	-7.442***
	(1.297)	(1.303)	(1.339)	(1.380)
Capital-Asset-Ratio	-179.907***	-178.519***	-192.467***	-183.604***
	(25.491)	(25.792)	(26.013)	(24.103)
Bhc indicator	-1.569*	-1.436*	-1.763**	-1.703**
	(0.808)	(0.808)	(0.822)	(0.845)
Loans-Assets-Ratio	19.633***	19.989***	19.966***	20.231***
	(2.725)	(2.787)	(2.732)	(2.843)
Interstate Branching Deregulation	-3.197**	-3.374***	-2.957**	-3.437***
	(1.256)	(1.263)	(1.267)	(1.271)
Ln(Number of Banks)	2.132	1.387	1.083	-2.392
	(2.776)	(2.814)	(3.054)	(4.087)
Ln(Number of Branches)	4.625	4.657	6.093*	9.953**
	(3.404)	(3.664)	(3.674)	(5.042)
HHI	-2.997*	-3.781**	-1.323	-3.243*
	(1.583)	(1.572)	(1.435)	(1.695)
County population per branch	0.000	-0.000	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Growth of personal income in county	-5.191**	-5.234**	-5.999***	-6.347***
	(2.207)	(2.232)	(2.230)	(2.287)
Growth of personal income in county (lag)	-7.320***	-7.338***	-7.679***	-7.759***
	(2.338)	(2.338)	(2.346)	(2.394)
Bank fixed effects	yes	yes	yes	yes
Region specific year fixed effects	yes	yes	yes	yes
Observations	63521	63479	63605	63894
Within R^2	0.119	0.115	0.120	0.071
Banks	2530	2532	2533	2549
F-Test	57.96	72.97	55.06	71.72
Partial R^2	0.0240	0.0340	0.0192	0.0302

Coefficients are multiplied by 1,000. This table reports second stage regression results from a bank fixed effects Two-Stage-Least-Squares analysis. 'Information index' captures the level of information (soft vs. hard) in each county before intrastate branching deregulation. The sample only includes banks that were single-market banks before deregulation. The excluded instrument is 'Ln(Years since Intrastate Branching Deregulation +1)'. Loan-Asset-Ratio is defined as (Total Loans)/(Total Assets); ln(total assets) = natural log of total assets; Capital/Assets is defined as (Bank Capital)/(Total Assets). 'Bank Holding Company dummy' is equal to one if the bank is part of a bank holding company, 'Ln(Number of Banks)' is the natural logarithm of chartered banks in the banking market, 'Ln(Number of Branches)' is the natural logarithm of all branches in the banking market, 'HHI' is the Herfindahl Index of deposits across competitors in a banking market, 'County population per branch' is the number of people per branch in a county. The constant is not reported. Time dummies are used. Standard errors are robust and clustered at the bank level. Significance stars are: * < 0.10, ** < 0.05, *** < 0.01

B Mathematical Appendix

B.1 Additional Assumptions

Cost of Effort not too high

$$\gamma < \frac{\frac{\partial^2 y}{\partial z^2}}{\frac{\partial y}{\partial z}} \tag{A1}$$

Assumption (A1) states that the effort costs are - compared to the shape of the profit function - sufficiently low. This assumption ensures that there is an interior solution to the loan officer's problem.

Probability function concave enough

$$\frac{\partial y}{\partial z}\frac{\partial p}{\partial e} > y\frac{\partial^2 p}{\partial e^2} \tag{A2}$$

This assumption states that the shape of the probability function is sufficiently concave compared to the shape of the profit function. Re-arranging terms in (A2) yields:

$$\frac{y}{\frac{\partial y}{\partial z}} < \frac{\frac{\partial p}{\partial e}}{\frac{\partial^2 p}{\partial e^2}}$$

This function assures that effort (e) an information (z) are substitutes/ complements in equilibrium if z high/low enough.

Decreasing Returns to Lending not too stark

$$\frac{\frac{\partial y}{\partial q}}{\frac{\partial^2 y}{\partial q^2}} \leq -1 \tag{A3}$$

This assumption states that returns to lending do not decrease too much as the share of allocated funds (q) increases.

B.2 Equilibrium choice

Proof 1 (Single Market Banks) *Loan officers in single-market banks maximize $E(U_i) = p(e_i)y(z_i, z_j, 1) - (\gamma e_i - \delta z_i)$ with respect to e_i and z_i. Setting the first order* *derivative to zero yields:*

$$\begin{aligned} \frac{\partial p}{\partial e_i} y(z_i, z_j, 1) &= \gamma && (1) \\ \frac{\partial y}{\partial z_i} p(e_i) &= -\delta && (2) \end{aligned}$$

For a specific choice of δ *and* γ*, there exists exists a solution denoted as* (e_i^S, z_i^S) *with* $e_i^S > 0$ *and* $z_i^S > 0$ *since* $\frac{\partial p}{\partial e} > 0$ *and* $\frac{\partial y_i}{\partial z_i} < 0$*.*

Proof 2 (Multi Market Banks) *Loan officers in multi-market banks maximize* $E(U_i) = p(e_i)y(z_i, z_j, q(z_i) \times N) - (\gamma e_i - \delta z_i)$ *with respect to* e_i *and* z_i*. The equilibrium is characterized as:*

$$\begin{aligned} \frac{\partial p}{\partial e_i} y(z_i, z_j, q(z_i) \times N) &= \gamma && (3) \\ \left(\frac{\partial y}{\partial z_i} + \frac{y}{\partial q}\frac{\partial q}{\partial z_i} \times N\right) p(e_i) &= -\delta && (4) \end{aligned}$$

For a specific choice of δ *and* γ*, there exists exists a solution denoted as* (e_i^M, z_i^M) *with* $e_i^M > 0$ *and* $z_i^M > 0$ *since* $\frac{\partial p}{\partial e} > 0$ *and* $\frac{\partial y_i}{\partial z_i} < 0$*.*

Proof 3 (Single Market vs. Multi Market Banks) *In equilibrium loan officers in a multi-market bank choose the same level of* z_i^**. This implies that* $q(z_i^*) = \frac{1}{N}$ *and hence* $q(z_i^*) \times N = 1$*. Because of this, in equilibrium, equation (1) and (2) are equivalent. Because* $\frac{\partial^2 y}{\partial z_i^2} < 0$ *and* $\frac{\partial^2 p}{\partial e^2} < 0$*, a multi-market bank either chooses a higher/ lower e/z than a single market bank or vice versa. Since* $\frac{\partial y}{\partial q}\frac{\partial q}{\partial z} > 0$ *we have that* $z_i^M > z_i^S$ *and* $e_i^M < e_i^S$ *to satisfy the first order conditions.*

Proof 4 (Effort and information choice in equilibrium) *The first order conditions can be re-arranged to define the following implicit function*

$$F(e_i^*, z_i^*) = \frac{\partial p}{\partial e_i^*} y(z_i^*, z_j, 1) - \gamma - \frac{\partial y}{\partial z_i^*} p(e_i^*) + \delta = 0$$

Using the implicit function theorem gives the relationship between the choice of effort and the level of information:

$$\frac{\partial e_i^*}{\partial z_i^*} = -\frac{F_z}{F_e} = -\frac{\frac{\partial p}{\partial e}\frac{\partial y}{\partial z} - p(e)\frac{\partial^2 y}{\partial z^2}}{\frac{\partial p}{\partial e}\frac{\partial y}{\partial z} - \frac{\partial^2 p}{\partial e^2} y}$$

By assumption (A2), the denominator is always positive, hence

$$\frac{\partial e}{\partial z} \propto p(e)\frac{\partial^2 y}{\partial z^2} - \frac{\partial p}{\partial e}\frac{\partial y}{\partial z} = \frac{\partial^2 y}{\partial z^2}\frac{\partial p}{\partial e}\left(\frac{p(e)}{\frac{\partial p}{\partial e}} - \frac{1}{\gamma}\right) \tag{5}$$

Since this equation holds in equilibrium, we can use information from the first order condition:

$$\frac{\partial e}{\partial z} \propto \frac{\partial^2 y}{\partial z^2}\frac{\partial p}{\partial e}\frac{1}{\gamma}\left(p(e)y - 1\right)$$

Since $\frac{\partial^2 y}{\partial z^2} < 0$*, we get:* $\frac{\partial e}{\partial z} \propto (1 - p(e)y(z))$ *which can take on positive or negative values.*

Proof 5 (Information choice of competing banks) *Using the aforementioned implicit function, gives*

$$\frac{\partial z_i}{\partial z_j} = -\frac{F_j}{F_i}$$

where F_i/F_j *is the derivative of* F *with respect to* z_i *or* z_j*.* F_j *is positive:*

$$\frac{\partial p}{\partial e}\frac{\partial y}{\partial z_j} - \underbrace{\frac{\partial^2 y}{\partial z_i \partial z_j}}_{+} > 0$$

Hence,

$$\frac{\partial z_i}{\partial z_j} \propto -F_i \Rightarrow \frac{\partial z_i}{\partial z_j} \propto \frac{\partial e}{\partial z_i}$$

Proof 6 (Information choice and number of branches (Multi-Market Banks)) *The first order conditions for multi-market banks can be re-arranged to define the following implicit function*

$$F(e_i^*, z_i^*) = \frac{\partial p}{\partial e_i^*}y(z_i^*, z_j, q(z_i) \times N) - \gamma - \left(\frac{\partial y}{\partial z_i} + \frac{y}{\partial q}\frac{\partial q}{\partial z_i} \times N\right)p(e_i) + \delta = 0$$

Again, using the implicit function theorem gives:

$$\frac{\partial z_i}{\partial N} = -\frac{F_N}{F_z}$$

where F_z/F_N *is the derivative of* F *with respect to* z_i *or* N*. Because of assumption (A3),* $F_N > 0$*.*

Note that $\dfrac{\partial e}{\partial z} = -\dfrac{F_e}{F_z}$ *with* $F_z > 0$ *and* $\dfrac{\partial z}{\partial N} = -\dfrac{F_N}{F_z}$ *and* $F_N > 0$*. Hence:*

$$\frac{\partial z}{\partial N} = \frac{\partial e}{\partial z}\frac{F_e}{F_N} \Rightarrow \frac{\partial z}{\partial N} \propto \frac{\partial e}{\partial z}, \qquad \frac{\partial e}{\partial N} = -\frac{F_N}{F_e} < 0$$

Proof 7 (Information choice and number of branches (Single-Market Bank)) *Denote the single-market bank as* $\boldsymbol{i}$ *and the expanding bank as* $\boldsymbol{j}$*. We know for bank* j*, that*

$$\frac{\partial z_j}{\partial N_j} \lesseqgtr 0 \qquad if \qquad \frac{\partial e_j}{\partial z_j} \gtreqless 0$$

For single-market bank i*, we know that*

$$\frac{\partial z_i}{\partial z_j} \lesseqgtr 0 \qquad if \qquad \frac{\partial e_i}{\partial z_i} \gtreqless 0$$

Hence

$$\frac{\partial z_i}{\partial N_j} < 0$$

Proof 8 (Concavity of expected loan returns and relationship between e and z) *Note that* $\frac{\partial e}{\partial z} \propto \frac{\partial^2 y}{\partial z^2}\frac{\partial p}{\partial e}\frac{1}{\gamma}(p(e)y - 1)$*. Suppose the expected loan return function* $y'(z_i, z_j, \cdot)$ *is more concave with respect to* z_i *than* $y'(z_i, z_j, \cdot)$*. Ceteris paribus, this implies that* $\frac{\partial^2 y'}{\partial z_i^2} < \frac{\partial^2 y}{\partial z_i^2}$*. Hence, ceteris paribus:*

$$\left|\frac{\partial e}{\partial z_i}\right|_{y'} > \left|\frac{\partial e}{\partial z_i}\right|_{y}$$

C Table Appendix

C.1 Tables

Table C.I: 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

Table C.II: Variable Definitions

Variable	Description	Source
Bank		
Net Income (Loss)	RIAD4340 (Item Number)	Call Reports
Equity	1976 - 1989: RCFD3230 + RCFD3240 + RCFD3247 1990 - 1993: RCFD3230 + RCFD3839 + RCFD3632 - RCFD0297 1994 - 2006: RCFD3230 + RCFD3839 + RCFD3632 + RCFD8434	Call Reports
Return on Equity	'Net Income (Loss)' divided by 'Bank Capital'	
Inverse Z-score	Standard Deviation of Return on Equity divided by (Return on Equity +1)	
Ln(number of competitor's banking markets)	Log of average number of markets in which competitors operate branches	Summary of Deposits
Competitor's HHI across markets	Average sum of squared share of deposits for each banking company in county except bank	Call Reports and Summary of Deposits
Total Assets	RCFD2170	Call Reports
Total Loans	RCON1400 (1976 - 1984) RCON1400 - RCON2165 (1984 - 2006)	Call Reports Call Reports
Capital-Asset-Ratio	'Equity' divided by 'Total Assets'	
=1 if bank part of bank holding company	Indicator whether banking company is part of a bank holding company (RSSD9347)	Call Reports
Loans-Assets-Ratio	'Total Loans' divided by 'Total Assets'	
Loans to Individuals	Loans to Individuals for household, family, and other personal expenditures (RCON1975)	Call Reports
Commercial & Industrial Loans	(RCON1766)	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, own calculations
Inhabitants 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)
Growth of personal income in county (lag)		
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)
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		
Inverse Kappa	Disagreement of rating agencies about bond issue ratings. Ranges from complete disagreement (=1) to complete agreement (=0)	Morgan (2002)
Asset Intangibility	Average Ratio of intangible assets-to-net fixed assets of U.S. firms by SIC sector over the period 1980 to 1999	Compustat

Table C.III: Summary Statistics

Variable	N	Mean	Std.Dev.	Min	Max	Median
Full Sample						
Inverse Z-score	280874	28.61633	41.43539	2.202044	465.6421	16.11729
ln(number of competitor's banking markets)	231289	0.2335408	0.4291252	0	5.428248	0
Competitor's HHI across markets	277210	0.7977894	0.2280408	0	1	0.8806309
Loan Losses-Capital-Ratio	279215	8.368504	5.262148	0	39.97776	7.484663
Return on Equity (%)	277575	6.211163	4.152627	-23.74201	18.35391	6.382228
Standard Deviation of Return on Equity (%)	280333	0.0297076	0.0400391	0.0024556	0.4582027	0.0172014
CAMEL-Indicator	188736	0.9749067	0.9539179	0	4	1
Distress	279380	0.0266376	0.161022	0	1	0
=1 if Intrastate Branching Deregulation	280874	0.5515213	0.4973394	0	1	1
=1 if Interstate Branching Deregulation	280874	0.5419654	0.4982367	0	1	1
ln(Total Assets)	280874	10.77783	1.32796	4.718499	20.76972	10.65613
Capital-Asset-Ratio	280874	0.0947779	0.044294	0.0013627	1	0.0863128
=1 if bank part of bank holding company	280874	0.6028468	0.4893091	0	1	1
Loans-Assets-Ratio	280874	0.5617046	0.1461387	0	0.9998202	0.5766788
ln(number of banks in market)	280874	2.25677	1.048524	0	5.666427	2.079442
ln(number of branches in market)	280874	3.167038	1.387264	0	7.281386	2.890372
HHI of deposits in market	280874	0.914499	0.2796263	0	1	1
Inhabitants per branch in market	280874	3389.604	2159.247	244.5	30032.67	2833.5
Growth of personal income in market	280874	0.0729411	0.0655342	-0.682412	2.640658	0.0669515
Growth of personal income in market (lag)	280874	0.0747604	0.0661661	-0.682412	2.640658	0.0692467
Only surviving banks						
Inverse Z-score	144198	25.13224	35.19001	2.202545	465.042	14.76144
ln(number of competitor's banking markets)	115590	0.2683054	0.4509174	0	5.428248	0
Competitor's HHI across markets	141988	0.7581471	0.2383757	0	1	0.8092248
Loan Losses-Capital-Ratio	143646	8.17191	5.003727	0	39.95249	7.384332
Return on Equity (%)	142637	6.29819	3.888223	-23.74148	18.35334	6.276151
Standard Deviation of Return on Equity (%)	143857	0.0263497	0.0345088	0.0024556	0.4582027	0.0157583
CAMEL-Indicator	111017	0.8715332	0.9153466	0	4	1
Distress	142863	0.0200752	0.140258	0	1	0
=1 if Intrastate Branching Deregulation	144198	0.6556332	0.475163	0	1	1
=1 if Interstate Branching Deregulation	144198	0.6637818	0.4724162	0	1	1
ln(Total Assets)	144198	10.76948	1.277877	4.718499	20.76972	10.66596
Capital-Asset-Ratio	144198	0.1006436	0.0466979	0.0013627	1	0.0913216
=1 if bank part of bank holding company	144198	0.6060348	0.488629	0	1	1
Loans-Assets-Ratio	144198	0.5582691	0.1526151	0	0.9998202	0.5722773
ln(number of banks in market)	144198	2.105009	0.9492693	0	5.666427	1.94591
ln(number of branches in market)	144198	2.960493	1.314552	0	7.281386	2.70805
HHI of deposits in market	144198	0.9119336	0.2833924	0	1	1
Inhabitants per branch in market	144198	2938.566	1813.917	244.5	22883.75	2515.791
Growth of personal income in market	144198	0.0653823	0.0660435	-0.682412	2.640658	0.0597715
Growth of personal income in market (lag)	144198	0.0661044	0.0662155	-0.682412	2.640658	0.0604788

Table C.IV: Hazard model: Timing of Deregulation

	(1)	(2)	(3)	(4)	(5)	(6)
Median Inverse Z				9.976*		
				(5.828)		
Change in median Inverse Z					2.801	
					(17.897)	
Relative change in Median Inverse Z						-0.202
						(0.364)
Small bank asset share of all banking assets in the state	6.476***	4.878***	4.449***	7.648***	6.972***	7.115***
	(1.329)	(1.277)	(0.803)	(1.432)	(1.748)	(1.645)
Capital ratio of small banks relative to large in the state	13.254***	11.454**	9.081**	15.417***	13.541***	14.270***
	(4.095)	(4.957)	(3.651)	(4.229)	(4.937)	(4.696)
Relative size of insurance in states where banks may sell insurance, 0 otherwise	3.245**	2.720*	0.547	3.829	4.355*	4.407*
	(1.496)	(1.432)	(1.236)	(2.846)	(2.439)	(2.418)
Indicator is 1 if banks may sell insurance in the state	-1.514**	-1.371**	-0.273	-1.999*	-2.103**	-2.110**
	(0.667)	(0.631)	(0.568)	(1.203)	(1.062)	(1.053)
Relative size of insurance in states where banks may not sell insurance, 0 other	-0.931***	-0.959**	-0.041	-1.878***	-1.571**	-1.532**
	(0.351)	(0.416)	(0.433)	(0.489)	(0.760)	(0.749)
Small firm share of the number of firms in the state	-9.725***	-9.524**	-15.101***	-10.948***	-7.914**	-7.823**
	(3.190)	(3.724)	(3.274)	(2.875)	(3.627)	(3.440)
Share of state government controlled by Democrats	0.306**	0.261**	0.110	0.272*	0.295*	0.297**
	(0.131)	(0.122)	(0.131)	(0.157)	(0.153)	(0.147)
Indicator is 1 if state controlled by one party	-0.045	-0.017	0.171**	-0.156	-0.107	-0.106
	(0.071)	(0.075)	(0.080)	(0.102)	(0.093)	(0.090)
Indicator is 1 if state has unit banking law		0.194*	0.305***			
		(0.104)	(0.090)			
Indicator is 1 if state changes bank insurance powers		-0.075	-0.265*			
		(0.137)	(0.145)			
Region specific Controls			yes			
Observations	637	637	637	345	313	313

The model is a Weibull hazard model where the dependent variable is the log expected time to bank branch deregulation. Sample period is 1976 to 1994 and the sample comprises 37 states that deregulated after 1977. States drop from the sample once they deregulate. Standard errors are robust and adjusted for state-level clustering. Significance stars are: * p<0.10, ** p<0.05, *** p<0.01.

Table C.V: Relation of Inverse Z-Score and Bank Failure/ Bank Distress

	Failure	Distress Indicator
Inverse Z-Score	0.585***	2.983***
	(0.055)	(0.246)
Interstate Branching Deregulation	0.001	-0.518***
	(0.010)	(0.083)
Ln(Number of Banks)	-0.003	-0.066
	(0.008)	(0.055)
Ln(Number of branches)	0.008	0.483***
	(0.006)	(0.043)
HHI	-0.011	-0.125*
	(0.008)	(0.073)
County population per branch	-0.000	0.000***
	(0.000)	(0.000)
Growth of personal income	-0.133***	1.886***
	(0.047)	(0.255)
Growth of personal income (lag)	-0.022	1.727***
	(0.034)	(0.218)
Ln(Total Assets)	-0.005**	-1.137***
	(0.002)	(0.026)
Bhc indicator	-0.016***	-0.137***
	(0.005)	(0.038)
Loans-Assets-Ratio	0.407***	1.813***
	(0.035)	(0.125)
Year fixed effects	yes	yes
State fixed effects	yes	yes
Observations	256002	279364

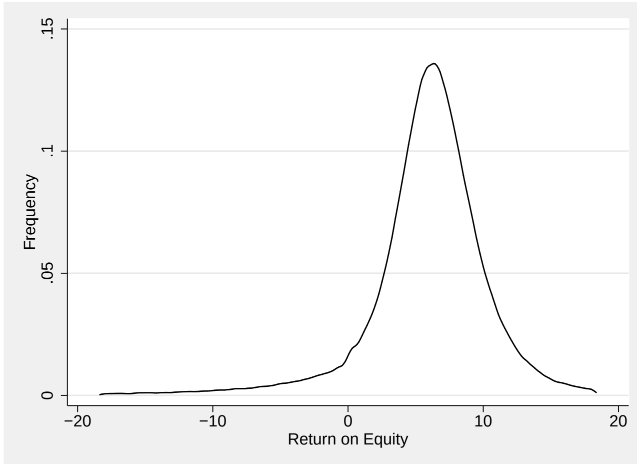
mfx at mean in % Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table C.VI: Correlation of Information Measures

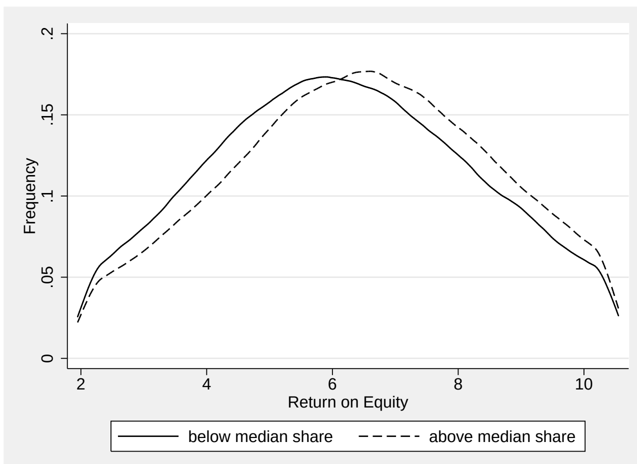
	Inverse Kappa	Asset Intangibility	Inverse Average Firm Size	Share of Proprietors Income
Inverse Kappa	1.000			
Asset Intangibility	0.608	1.000		
Inverse Average Firm Size	0.246	0.375	1.000	
Share of Proprietors Income	0.270	0.338	0.624	1.000

This table shows the pairwise correlation coefficient among the information variables at the county level.

C.2 Figures



(a) Return on Equity in full sample



(b) Return on Equity in sample for subgroups

Figure C.I: Distribution of Return on Equity in sample
This figure plots kernel density estimates of Return on Equity in the sample. In figure 1(a), the distribution of ROE in the whole sample is plotted; figure 1(b) shows the distribution of ROE for banks with below and above the sample median share of loans to individuals.

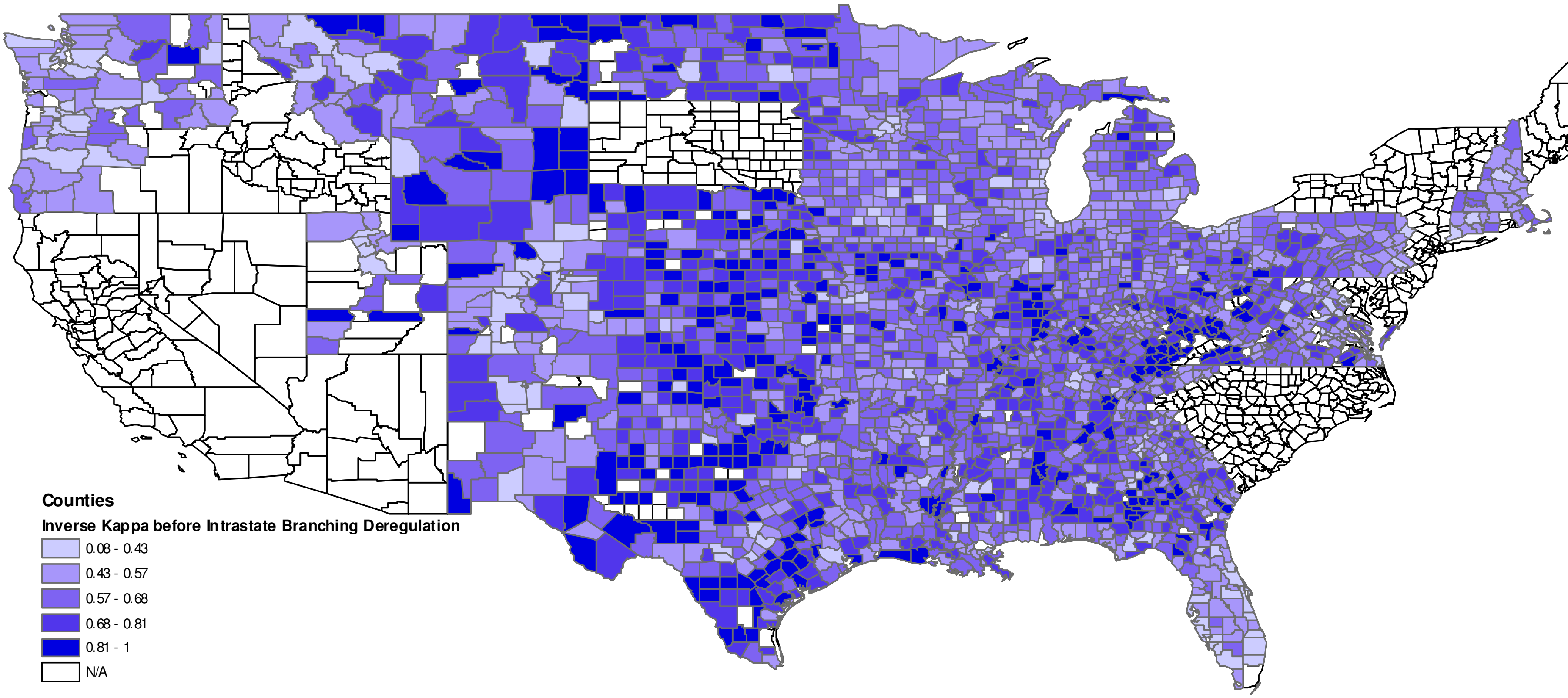


Figure C.II: Distribution of Counties with soft information before intrastate branching deregulation